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COSTA RICA
COUNTRY ECONOMIC MEMORANDUM:
THE CHALLENGES FOR SUSTAINED GROWTH

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ABBREVIATIONS AND ACRONYMS

ACCCR	Costa Rican Association of Roads and Rural Roads
ADSL	Asymmetric Digital Subscriber Line
ARESEP	Regulatory Authority for Public Services
B2B	E-Commerce Between Enterprises
B2C	E-Commerce with Individual Clients
B2G	Business to Government Services
BOT	Build-Operate-Transfer
CACM	Central America Common Market
CBI	Caribbean Basin Initiative
CEM	Country Economic Memorandum
CINDE	Costa Rica Investment Board
CNC	National Concessions Council
CNFL	National Power and Lights Company
CODESA	Development Corporation of Costa Rica
CONAVI	National Road Advisory
CONICIT	National Council for Scientific and Technological Research
Coopelesca	Rural Electrification Cooperative of San Carlos
CPI	Consumer Price Index
DR-CAFTA	Dominican Republic-Central America Free Trade Agreement
DRIP	Average Duration of Interruptions
EAP	East Asian and Pacific
EMBI	Emerging Markets Bond Index
EPZ	Export Processing Zones
FB	Fiscal Balance
FDI	Foreign Direct Investment
FOB	Free on Board
FPI	Frequency of Interruptions
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
GoCR	Government of Costa Rica
ICA	Investment Climate Assessment
ICE	Costa Rican Institute of Electricity
ICS	Investment Climate Survey
ICT	Information and Communication Technology
IMAE	Index of Monthly Economic Activity
IPP	Independent Power Producers
IPR	Intellectual Property Rights
ISO	Quality Standards
ITU	International Telecommunications Union
JASEC	Municipally-Owned Utility of Cartago
LAC	Latin America and Caribbean
LANAMME-UCR	National Laboratory of Materials and Structural Models-University of Costa Rica
MAG	Ministry of Agriculture and Livestock
MF	Monetary Financing
MINAE	Ministry of Environment and Energy
MNC	Multi-National Corporation
MOPT	Ministry of Public Works and Transport

MVP	Minimum Variance Portfolio
MW	Mega Watts
NGO	Non-Governmental Organization
NIR	Net International Reserves
OECD	Organization for Economic Cooperation and Development
OLS	Prdinary Least Square
PA	Poverty Assessment
PPA	Power Purchase Agreements
PPP	Purchasing Povwer Parity
PROCOMER	Costa Rica Foreign Trade Promoting Agency
PROPYME	Program for Innovation & Technological Development of SME
PSC	Primary Surplus of the Central Bank
QF	Quasi-Fiscal Balance
R&D	Research and Development
RER	Real Exchange Rate
RU	Research Unit
SEN	Interconnected Transmission System
SIEPAC	Regional Interconnection Network
SME	Small and Medium Enterprises
SUGEF	Superintendence General of Financial Entities
TEU	Twenty-foot Equivalent Units
TFP	Total Factor Productivity
TMMEAC	Central America Electricity Market Treaty
UNCTAD	United nations Conference on Trade and Development
USPTO	United States Patent and Trademark Office
VAR	Vector Auto-Regression
WEF	World Economic Forum

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Costa Rica Country Economic Memorandum

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EXECUTIVE SUMMARY

COSTA RICA AT A CROSSROAD

Meeting the Challenges Ahead

Over the last twenty-five years, Costa Rica has been one of the more stable and faster growing economies in Latin America primarily due to past economic reforms. Since 1980, growth in per capita income has averaged 1.2 percent, compared to 0.8 percent for Latin America as a whole, and economic volatility in the country has been about 20 percent lower than the rest of the region. Only about 10 percent of the country's population lives on less than US$2 a day, compared to a poverty rate of about 25 percent region-wide and the literacy rate is at nearly 96 percent for people ages 15 and above, compared to 86 percent in the rest of the region. These tangible socio-economic achievements have been accompanied by—and to a large extent can be attributed to—a stable macroeconomic and political environment, strong institutions, relatively open markets, and a well-educated work force. Indeed, strong growth during the 1990s can be largely attributed to reform efforts made since the mid-1980s on trade, public sector consolidation, infrastructure and moves toward liberalization of the banking system. **Costa Rica today continues to benefit from prior reforms, but the economy is at a crossroad and challenges lie ahead if the country is to provide a strong basis for sustainable growth, higher living standards, and poverty reduction in the years to come**

Costa Rica faces several economic policy choices that could have profound implications for the future. In recent years, economic growth has been modest, business innovation and product upgrading has not kept pace with the more dynamic exporting economies of East Asia, and the country's infrastructure—once the envy of the region—is in need of significant investment and upgrading in order to meet the challenges of a more dynamic and open global economy. While Costa Rica's growth is consistent with the deterioration in the terms of trade and slower growth seen across the region over the same period, a more efficient and competitive business environment would likely have led to a stronger rebound in recent years. Since 2001, real GDP growth (including the contribution of high tech industry) has averaged 4.0 percent, compared to 5.3 percent during the 1990s. At the same time, overall financing for infrastructure investment—traditionally one of the highest in the region—peaked at over 4 percent of GDP in 2000, but has steadily declined to under 3 percent. In order to unlock the benefits of trade, infrastructure needs to be available, reliable and cost effective and the environment for innovation should be strong. **Costa Rica's competitiveness will largely rest on improvements to the quality of investment and ability to spur innovation, which can largely be achieved through efficiency gains and enhancements to the institutional framework to stimulate private investment without necessitating additional spending beyond the current fiscal envelope.**

Building a solid foundation for higher growth through better public investment implies careful attention to fiscal constraints and macroeconomic stability. Indeed, in the most recent World Bank Investment Climate Survey for Costa Rica, businesses ranked concerns about macroeconomic instability as the biggest constraint to investment (55 percent of 343 firms) over a number of other factors such as cost of financing and taxes. While Costa Rica's overall consolidated fiscal deficit has fallen from 5.4 percent in 2002 to an estimated 3 percent of GDP in 2005, the narrowing has largely been due to cuts in investment and discretionary spending that may not be sustainable in coming years. Total public debt as a share of GDP has remained within 50-60 percent of GDP since 1993, which is high relative to fiscal resources and will require maintaining a primary fiscal surplus of at least 2.5 percent of GDP in order to keep the current debt ratio from rising.

Managing macroeconomic risks will entail a coordinated package of policies to limit the growth of debt, reduce inflation, and reverse the rising trend of financial dollarization. Costa Rica has historically been one of the most stable countries in the region, despite being subject to high volatility in the relative price of its traded goods. As recognized within Costa Rica, past stability should not be a reason for complacency. In addition to the potential risks associated with high public debt and enduring fiscal imbalances, a key vulnerability that has emerged since the end of the 1990's is the risk of increasing financial dollarization. Dollarization poses a risk to the financial system primarily due to the currency mismatches in debtor balance sheets. An adverse shift of the exchange rate would make it more difficult for firms to payback foreign currency denominated loans and this, in turn, would put pressure on the financial system. Reducing financial dollarization, however, will require a coordinated and complementary effort to lower inflation and improve fiscal balances. These efforts are important because a key driver of dollarization is the private sector's concern that the government might have to resort to money creation (the inflation tax) to finance the budget. As indicated by the Central Bank, reducing inflation would be helped by a move toward inflation targeting, instead of the current strategy of targeting the real exchange rate, as well as transferring the Central Bank's debt to the government, which would help clarify the Central Bank's role in maintaining price stability.

Recent Costa Rican elections suggest that there is a consensus on the need for a greater focus on policies to stimulate sustainable economic growth, but what exactly those policies should be was not made clear by voters. The recent presidential election on February 5, 2006 was decided by the narrowest margin in the country since 1966 with the candidates expressing very different visions of economic policies. Given the fragmented political environment, the new administration will face political as well as economic challenges in creating a consensus on future economic polices. The quality of information that supports that agenda will be essential as some of the most important actions that have been proposed—such as expanding free trade and opening state-owned service providers—were central elements of the national debate during the campaign for presidency.

Policy Options for Costa Rica

This Country Economic Memorandum (CEM) presents a set of key policy options to address the challenges Costa Rica faces as it seeks to reduce economic vulnerabilities, increase growth, and ultimately reduce poverty. The new government has a unique opportunity as it begins its administration to generate debate and a consensus around the policies that will likely position the country to take advantage to be competitive in a global world economy. In this context, while opening markets to freer trade is an important tool for spurring growth (and DR-CAFTA is potentially a key step in that process) it will require complementary policies to help promote internal development and ensure that the benefits are spread across different sectors and income groups. These complementary policies would have benefits independent of the external openness of the economy, but the gains to sustainable growth and poverty reduction would be amplified in the environment of freer trade and the increasingly globalized world economy.

Consultations between the World Bank, government representatives, and private sector organizations in November-December 2005 concerning the content of this report focused on the complementary agenda for Costa Rica, including infrastructure and innovation while maintaining macroeconomic and financial sector stability. These objectives are not necessarily inconsistent, but will require working within a modest fiscal envelope in the near term to provide for greater opportunities in the long term. The primary objective of this report is to explore the link between economic growth and infrastructure services and innovation in the context of macroeconomic stability.

Findings and policy options in the Country Economic Memorandum include the following key areas and issues:

Reducing Macroeconomic Vulnerabilities

- **Reversing the rising dollarization trend would be helped by a coordinated set of policies, particularly strengthening of public finances as soon as possible.**

- **Moving toward inflation targeting and greater exchange rate flexibility over the medium term would help provide the appropriate framework for reducing inflation while encouraging de-dollarization**

- **Maintaining a primary fiscal surplus of at least 2.5 percent of GDP would help to ensure debt sustainability under a wide range of potential macroeconomic outcomes, while facilitating de-dollarization and inflation reduction under a more independent monetary policy.**

- **Recapitalizing the central bank would enhance the central bank's credibility in its fight against inflation. It should also be a separate policy priority because raising the primary surplus to 2.5 percent of GDP would not, in and of itself, eliminate central bank losses.**

Reducing Infrastructure Bottlenecks

- **In transport, rehabilitation and maintenance of the key trade corridors, beginning with the road from San Jose to Puerto Limon and the operations of the Atlantic ports would help facilitate trade and business expansion.**

- **In the electricity sector, incentives for expanding generation assets and improving regulatory oversight would enhance the sector's governance and contractual framework and contribute to greater supply and reduced energy prices.**

- **In telecommunications, sector reforms now under discussion are likely to bring productivity gains and technology transfer.**

- **In transport, electricity, and telecommunications, the execution of pending concessions, public-private partnerships and private investments will help to expand infrastructure and growth.**

- **A greater reliance on user fees—through tolling, partial tolling and/or new fuel taxes—may be necessary to finance road rehabilitation, expansion and maintenance. Outside financing may be triggered through a wider use of credit enhancements, such as minimum traffic guarantees for shadow tolls on medium-density roads.**

Enhancing the Environment for Innovation

- **International evidence suggests that the public sector needs to play a critical role to spur private-sector investment in innovation, including investments in R&D and in licensing foreign technologies, which are at the heart of long-run economic growth, even in the context of governance weaknesses.**

- **The evidence also suggests that the potential social gains of such investments can be huge in countries of similar levels of development as Costa Rica.**

- **In the process of fiscal consolidation, the public budgets for programs such as the matching grants scheme under PROPYME, which is consistent with global best practices, should be protected as much as possible.**

- **The scope and efficiency of the program could be enhanced through modest reforms, including the reconsideration of the limits on the participation of large firms, a broadening of the scope of the grants, and the opening of permanent grant application windows.**

- **These efforts could be accompanied by renewed monitoring and evaluation of the matching grants scheme, based on state-of-the-art evaluation systems. Other agencies at the center of the country's national innovation system that might benefit from forward-looking evaluations include PROCOMER and the Ministry of Science and Technology.**

- **Since the tax incentives that are currently provided through the Free Zones will need to be reformed in order to make them compatible with international trade norms, it is worth considering and evaluating the option of transforming the existing tax incentives into incentives for private-sector innovation. But tax incentives are generally not the best policy instrument to promote R&D.**

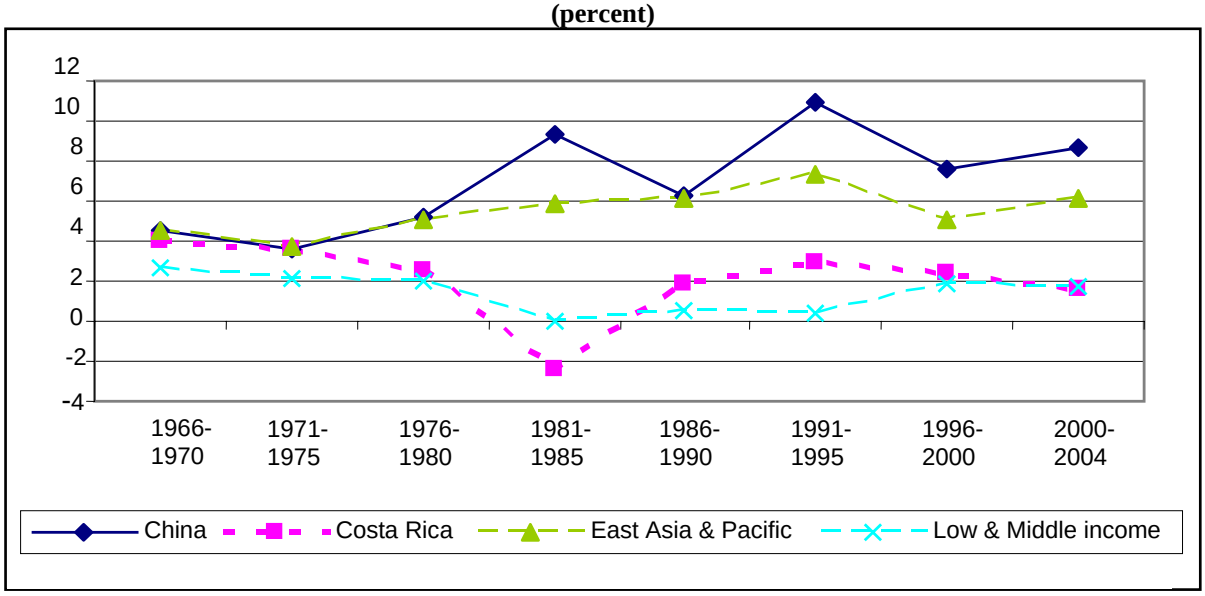
- **Closing the secondary enrollment gap is likely to yield long-run benefits for the efficiency of the country's innovation system. Likewise, firm-level evidence suggests that dealing with the aforementioned infrastructure bottlenecks should also spur private-sector innovation efforts in the long run.**

COSTA RICA COUNTRY ECONOMIC MEMRANDUM

POLICY REPORT

1. To achieve a higher standard of living for its population and reduce the share of its population in poverty, Costa Rica will have to grow faster. The emerging-market countries that have successfully reduced poverty (mainly in East and South Asia) have only done so with high rates of growth. While Costa Rica's per capita growth rate—around 2 percent—has been similar to the average growth rate of low and middle income developing countries and better than most Latin American Countries, its performance has deteriorated relative to high-savings and export-oriented countries in East Asia and China (Figure 1). In fact, Costa Rica's growth rate and adverse changes in income distribution has meant that progress on poverty reduction has been stagnant since the mid-1990s[1]. Nonetheless, Costa Rica's own historical experience and that of the high growth countries in Asia and elsewhere provide optimism that its performance can improve.

Figure 1: Real GDP Per Capita Annual Growth (percent)



Source: World Bank (WDI/GDF 2006)

2. Analysis of Costa Rica's historical sources of growth suggests that increases in total factor productivity—which is due to aspects such as enhanced efficiency, innovation, and a better organization of production processes and resources across the economy—was a major contributor to growth during the last decade. Indeed, the contribution of factor productivity to overall growth increased from -1.5 percent in the 1980s to 1.3 percent in the 1990s (Table 1). Behind these increases in total factor productivity were the structural reforms experienced by Costa Rica during the late eighties and early nineties on trade, public sector consolidation and infrastructure. Education improvements also contributed, though less so, reflecting the already high secondary enrollment levels achieved in Costa Rica since the early 1980s. With regard to macroeconomic stabilization policies, the absence of systemic banking crisis during the nineties stands as a key contributor to Costa Rica's per capita growth, followed by the moderate reduction in average inflation observed between the two decades. These findings suggest that further reforms to supporting quality infrastructure and policies that encourage innovation, in the context of macroeconomic stability, would provide a solid basis for growth in coming years.

[1] See Chapter 1.

Table 1: Costa Rica – Sources of Output Growth
(percent change)

Period	Output Growth	Sources of Growth		
		Labor	Capital	Total Factor Productivity
1961-70	6.05	3.25	1.86	0.95
1971-80	5.64	4.53	2.37	-1.26
1981-90	2.41	2.91	1.02	-1.52
1991-00	5.25	2.41	1.48	1.37
Ave. 1961-00	4.84	3.28	1.68	-0.12

Source: Loayza, Fajnzylber & Calderón (2002)

3. This policy report summarizes key policy options for enhancing growth in connection to three critical areas: macroeconomic and financial vulnerabilities, infrastructure bottlenecks, and innovation. The new government has a unique opportunity as it begins its administration to generate debate and a consensus around the myriad of policies that will likely increase growth and to position the country to take advantage of a more open economy. In this context, while opening markets to freer trade is an important tool for spurring growth, and DR-CAFTA is potentially a key step in that process, it will require a set of complementary actions to help promote internal development and ensure that the benefits are spread across different sectors and income groups. (See Box 1)

Box 1.1 DR-CAFTA Expected Impact on Central America

The recent Bank report "DR-CAFTA: Challenges and Opportunities for Central America" (December 2005) provides a preliminary assessment of DR-CAFTA, with particular attention to three key themes: (i) expected trade and non-trade benefits, (ii) actions that Central American countries need to pursue to capitalize on the new opportunities, and (iii) identification of the population groups that will require assistance to adapt to a more competitive environment.

The report concludes that DR-CAFTA is likely to improve growth levels, due to the expected positive effects on trade and investment levels. Greater trade levels will arise due to the removal of virtually all tariff and quota barriers to trade among all parties, consolidating—and expanding in some areas—the preferential market access that Central American countries have enjoyed in U.S. markets through the Caribbean Basin Initiative (CBI) program. DR-CAFTA should also promote greater levels of foreign and domestic investment, by improving the certainty of market access in the U.S., solidifying broad economic reforms of recent years and by spurring further reform efforts. Investors should respond positively to the modernization of key regulations in the areas of trade in services, Government procurement and intellectual property rights—including provisions for greater transparency in Government regulations—which will be made more credible under DR-CAFTA commitments.

However, analyses of the gains from trade suggest that these gains depend on the ability of economies to successfully adjust to changes in relative prices and ensuring restructuring of the economy. Hence, the magnitude of the benefits from DR-CAFTA will depend critically on the ability of the Central American economies to pursue a complementary policy agenda, with special emphasis on trade facilitation (e.g., ports, roads, customs), institutional and regulatory reforms (e.g. transparency, rule of law, red tape), and innovation and education that should foster greater investment flows. Costa Rica will be required to make significant legislative changes to adapt policies and regulations to its commitments under DR-CAFTA, to allow greater access to significant portions of its telecom and insurance markets. These reforms had been long postponed and should further foster the modernization, efficiency and competitiveness of these areas of the economy.

Source: World Bank, 2005

4. The policies discussed in this report are elements of that set of complementary actions. As Costa Rica continues to confront more integrated and competitive world markets, it faces the need to maintain its long history of macroeconomic stability and prudent fiscal policy while improving infrastructure and enhancing innovation and technology adoption. The remaining sections of this policy report summarize these policy options in more detail.

I. Assessing Macroeconomic and Financial Vulnerabilities

5. Costa Rica has registered notable macroeconomic and financial stability in the past two decades compared to other countries in the region and has avoided the type of currency, banking, and/or debt crises that have devastated emerging economies elsewhere. However, government authorities recognize that a history of stability should not be a reason for complacency: key macroeconomic vulnerabilities have emerged since the end of the 1990's that will need to be addressed in the near term in order to continue to provide macro-financial stability as one of the foundations of future growth.

6. The historical primary surplus, that averaged 1 percent of GDP over the last five years, has been sufficient to stabilize the public sector (central government plus central bank) debt ratio at around 50 percent of GDP. This debt level and the historical average of the primary surplus, however, are not a source of comfort going forward. In effect, the already high debt level has a potential of increasing in a low growth scenario, especially if contingent pension liabilities were to materialize. In addition, the level of public debt would have been even higher had it not been for the continued use of monetary financing to cover part of the central bank losses, but such financing has in effect set a floor to the reduction of inflation. Likewise, the primary surplus has been achieved to date mainly through unsustainable expenditure compression, not just of investment expenditures but also of recurrent expenditures, including tight control of the wage bill. This expenditure squeeze has bottled up social and political pressures that will have to be acknowledged sooner or later, especially through increased investment in physical infrastructure, education, and health. Furthermore, the buildup of pressures to increase public investment has coincided with the absence of political consensus for tax reform, without which the ability of the government to maintain the current primary surplus, let alone to increase it, is in doubt. Moreover, in the absence of a significant and permanent increase in fiscal revenues, the primary fiscal surplus achieved historically appears difficult to sustain in the future, with the risk that a vicious circle of low growth and deteriorating debt viability could emerge.

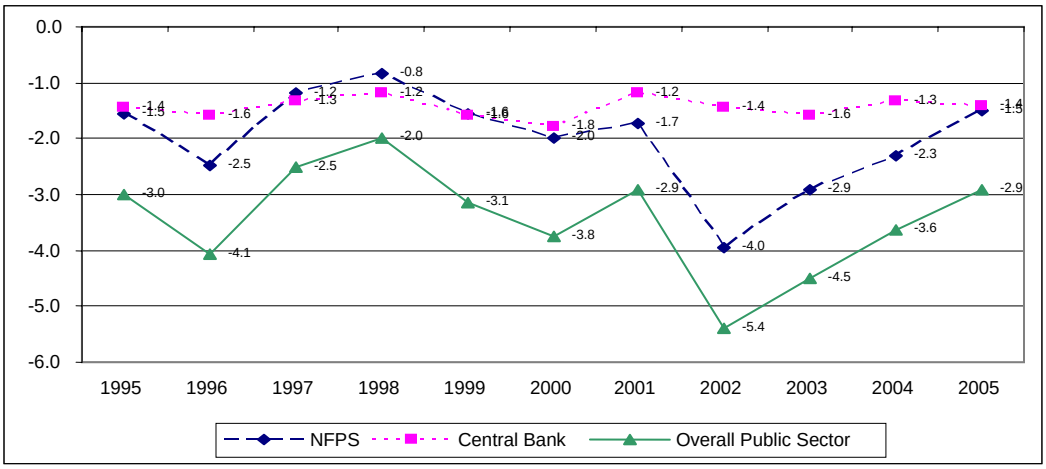
7. In addition to the potential risks associated with high public debt and fiscal imbalances, a key vulnerability that has emerged since the end of the 1990's is the risk of increasing financial dollarization. Dollarization poses a risk to the financial system primarily due to the currency mismatches in debtor balance sheets. An adverse shift to the exchange rate would make it more difficult for firms to pay back foreign currency denominated loans and this, in turn, would put pressure on the financial system. Reducing financial dollarization, however, will require a coordinated and complementary effort to lower inflation and improve fiscal balances. These efforts are important because a key driver of dollarization is the private sector's concern that the government might have to resort to money creation (the inflation tax) to finance the budget. As indicated by the Central Bank, reducing inflation would be helped by a move toward inflation targeting, instead of the current strategy of targeting the real exchange rate, as well as transferring the Central Bank's debt to the government, which would help clarify the Central Bank's role in maintaining price stability.

Macroeconomic Facts and Trends

8. The strong growth performance of Costa Rica over the past two decades has been achieved at a relatively low inflation rate by Latin American standards. Moreover, despite having been subject to relatively high volatility in its terms of trade, output growth has been stable and the real exchange rate has been low. This good growth performance with low macro-financial volatility has been anchored on a stable policy environment and a high and growing integration into the world economy**.**

9. ***Fiscal Balance***. Costa Rica's fiscal deficit has oscillated around 3.5 percent of GDP since the mid-1990s, reflecting depressed tax revenues and a significant increase in pension expenditures. The overall fiscal deficits have prevented total public debt from declining and it has hovered within 50-60 percent of GDP since 1993. Although the fiscal deficit narrowed to around 3 percent of GDP in 2005 from a peak of 5.4 percent of GDP in 2002, the recent decline was largely due to cuts in investment, restrained wage bill and temporary profits in state-owned enterprises (Figure 2). This overall fiscal balance has been accompanied by a relatively large central bank deficit that reached 1.4 percent of GDP at end-2005.

Figure 2: Overall Public Sector Balance, 1995-2005



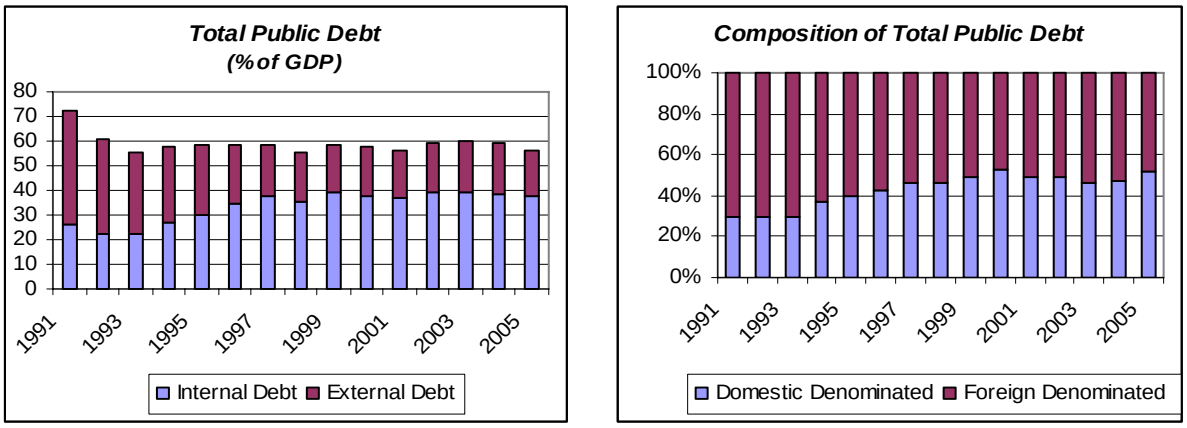
Source: Central Bank of Costa Rica. Data for 2005 reflects preliminary estimates.

10. ***Inflation***. The inflation trend (5-year moving average) in Costa Rica has declined over the last fifteen years from about 20 to around 12 percent, more or less in line with declines in global inflation and in parallel with that of other middle income countries. However, Costa Rica's inflation has remained consistently above the group's trend by about 5 percentage points throughout the period. Moreover, in 2004 inflation picked up at a faster pace than in other countries in the region, reaching 14 percent in 2005. As a result, the inflation path is beginning to further diverge from the average inflation rate in the rest of LAC.

11. ***Financial dollarization***. At present, dollarization is widespread in Costa Rica. Deposit dollarization in the offshore and onshore banking system stands at over 62 percent, while the share of dollar loans is even higher, around 70 percent. According to the available estimates the resulting currency mismatches of the banking system amounted to the equivalent of about 10 percent of GDP in 2005, having increased from 2 percent of GDP registered in the late 1990s. Moreover, Costa Rica's financial dollarization is high by international standards and has been rising steeply over the past decade. The proportion of dollar deposits in total onshore deposits in Costa Rica rose from the equivalent of 10 percent of GDP in 1995 to 20 percent in 2005 and, on a trend basis, Costa Rica's deposit dollarization has not only exceeded significantly that of the other LAC countries but the difference has been widening over time.

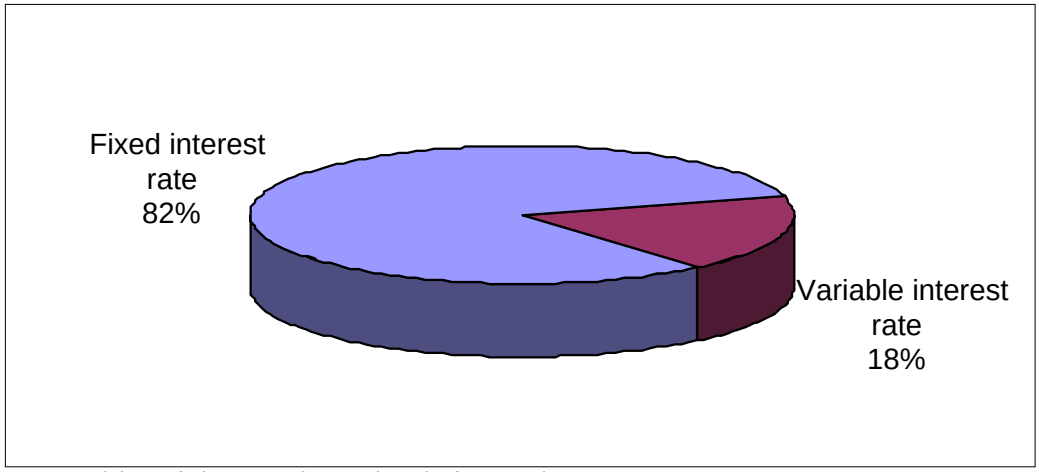
12. ***Total Public Debt.*** During the last fifteen years, total public debt has remained in the range of 50-60 percent of GDP and at end 2005 it stood at around 52 percent of GDP, of which about two-thirds was domestic debt[2]**.** While a decline in Central Bank debt has been offset by increases in Central Government debt, the share of local currency denominated debt in total debt (external and internal) has risen from about 30 percent in the early 1990s, to nearly 50 percent at present (Figure 3). Regarding the composition of public debt, there has been a reduction in exposure to rollover, interest rate, and exchange rate risks, although exchange rate risk remains relatively high. Central government debt in the last 5 years has been issued in fixed rather than variable rates, resulting in an increase in the share of fixed interest rate debt to more than 80 percent (Figure 4). Finally, the average maturity of central government debt has also increased—as of December 2005, it was 2.3 years for internal debt and 5.2 years for external debt—thereby mitigating rollover risk. During the last decade debt service has remained at a relatively high level in relation to fiscal revenues (18.7% in average), compared to an average of 12.3 % of a group of middle income countries.

Figure 3: Total Public Debt as % of GDP and Composition of Total Public Debt.



Source: Ministry of Finance and Central Bank of Costa Rica.

Figure 4 : Interest Rate Profile of Central Government Debt
(Percent Shares of Total Debt)



Source: Ministry of Finance and Central Bank of Costa Rica.

[2] Total public debt referred to in this paragraph is defined broadly to comprise the debts of the central government, central bank, public entities and public enterprises. It differs from the debt definition used in the Debt Sustainability Analysis in Chapter 2, which represents a subset of total public sector debt (comprising the combined debt of the central government and central bank) and on which the findings and policy recommendations of this report are based.

Challenges Going Forward

13. The situation described above raises a number of important analytical issues and questions including the following: What explains the high and rising financial dollarization in Costa Rica and does it matter for future growth? If it does matter, what could be done to mitigate its risk consequences? Similarly, should Costa Rica's fiscal and debt trends be a source of concern? If so, should Costa Rica aim to maintain a higher primary surplus to ensure debt viability? Finally, are financial dollarization and debt sustainability linked and, if so, how? These questions are addressed below with the conclusion that there is a need for policies and actions to mitigate the risks to growth stemming from rising financial dollarization and unfavorable public debt dynamics.

14. These macro-economic concerns relate closely to micro-economic policy-making. In particular, a greater commitment to supporting major investments in productive infrastructure and programs to support innovation and technology will be required in order to maintain the competitiveness of Costa Rica's business and trade environment. On one hand, the fiscal constraints described in this report will impact the ability of the State to finance micro-economic priorities such as the rehabilitation and expansion of the secondary road network. On the other hand, the continued neglect of infrastructure and the lack of support to innovation and technology will result in downward pressure on growth. These issues are addressed in more detail in Chapters 3 and 4.

Determinants of Financial Dollarization

15. The crawling peg regime is a proximate determinant of financial dollarization in Costa Rica. The regime has tended to strengthen inflationary inertia and the pass-through from changes in the exchange rate to changes in domestic prices. It has, at the same time, resulted in relative stability of the real exchange rate while leaving the price level without a firm anchor. In such an environment, investors would naturally expect inflation to be more volatile than the real exchange rate.

16. The empirical work of this report confirms that the expected volatility of inflation is a key macroeconomic determinant of dollarization and that dollarization would be hard to reverse without a structural break The degree of dollarization is found to respond positively and significantly to the volatility of inflation, while the colon interest rate appears to be somewhat of a deterrent against the advance of dollarization. Furthermore, dollarization is found to be highly affected by its previous maximum value, which suggest that it would be very difficult to reverse without a qualitative improvement in fiscal and monetary credibility. The relevance of inflation volatility also suggests that dollarization is associated with a perceived risk that the government may eventually resort to money creation (the inflation tax) to raise resources. This risk may have acted as an incentive for depositors to take financial positions in dollars so as to hedge against inflation risk.

Consequences and Risks of Financial Dollarization

17. There are at least three reasons to be concerned about rising dollarization in Costa Rica: exchange rate-induced credit risk, liquidity risk, and a fall in holdings of local money**.** Credit risk arises from the combination of currency mismatches in debtor balance sheets and increases with the probability and magnitude of adverse shocks to the real exchange rate. Although the observed volatility of the real exchange rate has been low, thereby mitigating credit risk, the risk would remain a matter of concern for several reasons. First, even if a financial crisis driven by credit risk is believed to be a low probability event, it would likely be a high cost event (both economically and socially). Second, the volatility of the equilibrium exchange rate is not independent of the degree of currency mismatches—the higher the mismatches, the higher the volatility. Third, the volatility of the real exchange rate would rise if the fiscal process weakens.

18. Regarding liquidity risk, financial dollarization reduces the ability of the central bank to act as lender of last resort to the banking system, because the central bank can only supply unlimited liquidity in terms of domestic currency. Regarding the effect on the holdings of local currency, dollarization can reduce the base on which the Central Bank raises resources at zero interest rate cost, complicating debt viability. The higher the dollarization ratio, the lower the demand for real money balances and the consequent decrease in the ability to raise monetary financing requires a higher primary surplus for debt sustainability.

Debt Sustainability in an Environment of Uncertainty

19. Rising fiscal and debt pressures pose potential downside risks to growth. While the current primary surplus has helped to stabilize the existing debt ratio, albeit at a relatively high level, it has been achieved through compression of government expenditure since the political consensus to secure a fiscal reform has been elusive. In addition to the challenge of maintaining the current primary surplus, the debt sustainability analysis in this report suggests that higher primary surplus is needed.

20. The debt viability analysis in Chapter 2 is circumscribed to the combined accounts of the central government and central bank leaving out the accounts of public enterprises and public entities. This helps highlight the institutional barriers to the transfer of resources from public enterprises (and other public entities) to the central government. In fact, under the current legal framework, the central government cannot tax the income of the public enterprises or require them to pay dividends. This segmentation implies that a saving effort in public enterprises cannot be easily used to finance an increase in, for example, government investment in transport infrastructure or education. Hence, barring a shift towards concessions or private sector investments in sectors controlled by public enterprises, entails that the central government has to raise its own income in order to increase investment in sectors under its responsibility, such as transport, education, and health.

21. The debt sustainability analysis addresses the question of what level the fiscal primary surplus should be in order to help ensure that the government can maintain public sector debt viability under a reasonable range of scenarios. This is examined using three different approaches. The first is the classic deterministic approach, which calculates the likely level of future debt by assuming alternative but predetermined paths for macroeconomic variables (such as interest rates, growth, and exchange rates), without capturing explicitly the relationship among them. The second is a probabilistic approach, which derives probability distributions of the future paths of macroeconomic variables using historical averages and standard deviations. The final approach is also probabilistic, but captures the dynamic interactions between the macroeconomic variables and runs simulations to forecast stochastic trajectories for the relevant variables. The last approach is the most innovative.

22. The first approach, the deterministic method, was applied to four scenarios. The first two scenarios are based on historical values: one takes values at their historical averages while the other use the variables deviated from their historical average. Under the first historical scenario, the required primary surplus would be 1.3 percent of GDP, only 0.3 percent of GDP above its historical average. Under the second historical scenario the required primary surplus would be 4 percent of GDP per year, which is much larger than its historical average of 1 percent. The two additional scenarios take into account a passive versus a more active policy attitude, meaning the approval of a fiscal reform package. . These yielded results contained within the bounds of the two previous historical scenarios: a required primary surplus of 1.9 and 2.7 percent of GDP for the active and passive scenario, respectively.

23. The two probabilistic approaches suggest that a primary balance of at least 2.5 percent of GDP is prudent under a reasonable degree of confidence. Under the simple probabilistic approach, holding a primary balance of 2.5 percent of GDP would maintain debt sustainability 75 percent of the time. A

primary balance of at least 4 percent would be required for sustainability almost 100 percent of the time, but this would clearly be overly cautious. Under the more sophisticated approach, the required primary surplus is not a single value; it is a probability distribution that reflects the uncertainty in the trajectories of the macro economy. If the objective is to ensure at least an 80 percent probability that debt would be sustainable, a primary surplus of the order of 2.5 percent of GDP would be necessary. Clearly, the results from both the deterministic and probabilistic models suggest that Costa Rica should consider increasing the primary fiscal balance to reduce its risk of fiscal financing difficulties.

Key Policy Options for Reducing Macroeconomic Vulnerabilities

24. Dollarization and public debt are two important sources of macroeconomic vulnerability**.** Addressing these vulnerabilities in a coordinated and sequenced manner, would help ensure that Costa Rica continues on a sustained growth path. The key policy options that would help to reduce vulnerabilities include the following:

- **Reversing the rising dollarization trend would be helped by a coordinated set of policies, particularly strengthening of public finances as soon as possible.** At the root of the dollarization phenomenon are systemic risks (particularly potential inflation risks) that create incentives for investors to prefer the dollar over the local currency. The policy effort therefore would benefit most from eliminating the inflationary risk, which would necessarily entail the durable achievement of a stronger primary surplus. Moreover, if fiscal adjustment is postponed and dollarization continues to increase, a threshold of high dollarization might be reached that could render exchange rate flexibility and prudential actions to weak to halt further dollarization

- **A convergence over the medium term towards a new monetary regime, characterized by inflation targeting and greater exchange rate flexibility, would help reduce inflation.** In this regard, two preconditions are crucial: the first is a credible strengthening of the fiscal position to lower perceptions of inflation risk, and the second is maintaining and strengthening the independence of the Central Bank. The current crawling peg regime, which served Costa Rica well in the past, is promoting inflationary inertia and dollarization, which increases the scope for output volatility and renders the financial system more vulnerable to shocks. The crawling peg exchange rate regime—which has been in effect for over 20 years—commands considerable credibility in the country and may be credited for having avoided large real exchange rate overvaluations and currency crises. However, through the systematic targeting of the real exchange rate, rather than inflation, the crawl has further tightened the link between inflationary expectations and the exchange rate and has promoted dollarization.

- **The gradual move towards a new monetary regime would require a carefully designed and managed transition, as well as complementary policies in the prudential and debt fronts.** The transition should proceed very much along the lines already set out in the recently published inflation report of the central bank. This gradual move towards greater exchange rate flexibility and a firmer inflation anchoring should be complemented by prudential policies aimed at ensuring that banks internalize better the dollarization risks. Several options could be considered in this regard, including the introduction of explicit provisioning or capital requirements to confront loan losses associated to currency mismatches, and/or the explicit incorporation of dollarization risks in the banks' own risk management activities. Another possible mechanism to reduce incentives to dollarize would be the creation of inflation indexed debt instruments as a way to facilitate the transition into a non-dollar unit of account.

- **The achievement of a stronger primary fiscal surplus—of the order of 2.5 percent of GDP for the combined balance of the central government and central bank—should be at the top of the policy priorities.** This policy objective is justified in many fronts— it would ensure debt sustainability under a wide range of macroeconomic outcomes, while facilitating de-dollarization and inflation reduction. Moreover, by increasing the resiliency of fiscal sustainability, a higher primary surplus may give rise to a virtuous circle—leading to greater investment confidence that would lift growth, which would in turn help the government grow out of debt and further fortify the primary surplus by enhancing tax revenues. The fact that the historical primary surplus of 1 percent of GDP was enough to stabilize the joint debt of the central bank and central government at around 50 percent of GDP should not be a source of comfort. This was due in part to chance—with better than expected macroeconomic outcomes—and in part to higher inflation—with the central bank monetizing debt losses.

- **To achieve this primary surplus objective, a significant and permanent increase in the ratio of fiscal revenue to GDP appears necessary**. Otherwise, the government may feel compelled to obtain resources from public enterprises (e.g., by requiring them to pay dividends or by taxing their income). But this could undermine the already low level of infrastructure investment, which might create a vicious circle where low investment and growth lead to low fiscal revenue and rising concerns about debt viability which would, in turn, further erode investment and growth.

- **The recapitalization of the central bank should constitute a separate policy priority, complementary to the objective of increasing the primary surplus, as it would significantly enhance the central bank's credibility in the fight against inflation.** The achievement of a stronger primary surplus is not likely to be sufficient to eliminate the quasi-fiscal losses of the central bank. This problem should be addressed head on, through a capital injection from the government, which need not be in cash—it can be done via the issuance of central government bonds. This decision, while admittedly difficult politically, would enhance the fight against inflation as it would remove the pressure on the central bank to avoid adding to the debt problem, by printing money to finance part of its losses. While the law prohibits the central bank from monetizing the deficits of the central government, it does not prevent the central bank from monetizing its own deficits. Hence, as long as the central bank has losses, investors would remain concerned that the central bank would engineer an inflation surprise to finance such losses. The recapitalization of the central bank would also make the fiscal constraints more transparent not only to lawmakers but also to citizens at large, increasing the likelihood that an appropriate portion of new revenues from a tax reform would be actually saved and directed towards the needed increase in the primary surplus.

II. Costa Rica's Infrastructure: Reducing Bottlenecks to Growth

Infrastructure and Growth

25. A wide range of empirical studies supports the conclusion that infrastructure is a major contributor to economic growth, particularly for developing countries. The approach to understanding the linkage has varied, with different analyses considering:

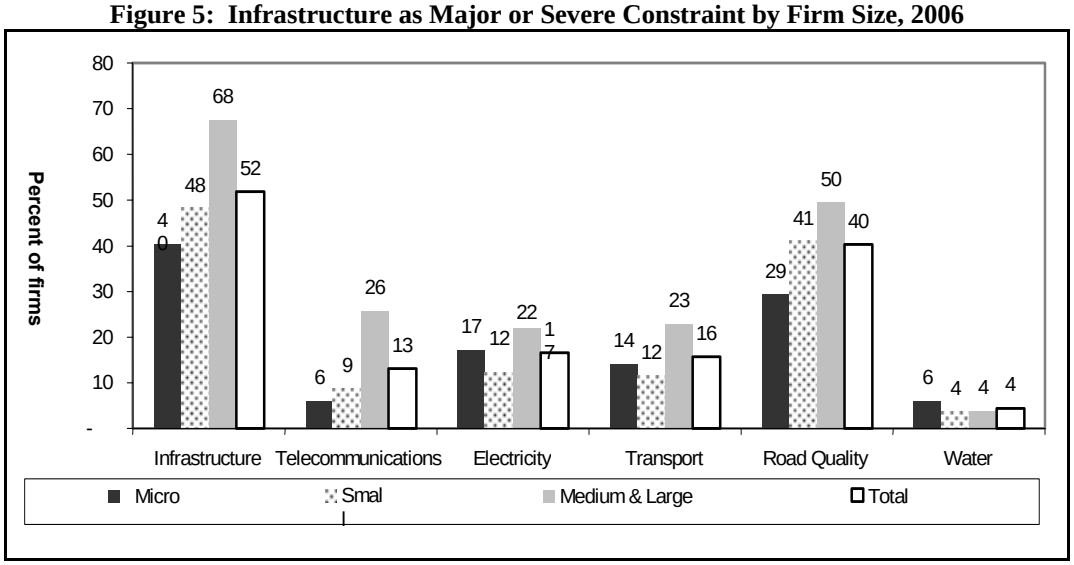
- the impact of infrastructure on aggregate total factor productivity;
- the impact of individual sectors on growth;
- the region-specific impact of infrastructure stocks across sectors; and
- the separate impact of infrastructure service quality on growth.

26. The cumulative result of this literature is a robust demonstration of infrastructure's role as a driver of growth.[3] Underlying the "direct linkage literature" (infrastructure and growth), is the recognition that infrastructure is an important determinant of firm productivity. That is, the supply, quality and price of infrastructure are defining elements of firm cost structure and competitiveness. With trade liberalization spreading, logistics and transport costs alone tend to be higher than duties imposed on imports as well as the cost of quotas and other non-tariff barriers.

27. This micro or firm-level perspective on the importance of infrastructure for competitiveness can be captured two ways: through perception-based surveys of firms and investors; or through firm-level analyses that evaluate the costs of doing business. Many surveys—such as the World Economic Forum's Business Competitiveness Index—query firm managers and investors about their perceptions of infrastructure services. Other surveys, such as the World Bank's Investment Climate Surveys, compile financial and trade data from individual firms to illustrate the relative importance of each element of production, including transport services, customs, electricity and telecommunications. When aggregated, the surveys help to quantify and prioritize infrastructure-related challenges such as bottlenecks to the shipment of goods; the impact of delays and lost, damaged or stolen cargo on shipment values; and the cost impact of energy and telecommunications service problems.

28. Just as strong trade policies and efficient infrastructure can contribute to growth, trade barriers and poor infrastructure can stymie growth. In Costa Rica, direct barriers to trade such as duties and quotas appear to be less constraining than physical bottlenecks in the production and movement of goods. Indeed, 52 percent of firms surveyed for the ICS found infrastructure to be a major or severe constraint to their investment climate while only 7 percent of firms found trade regulations to be a major or very severe constraint. When asked in more detail about the infrastructure constraints, 42 percent found road quality and/or transportation to be a major constraint, disaggregated to 40 percent for road quality and 16 percent for transport. Likewise, 28 percent identified electricity and/or telecommunications services as major constraints—disaggregated as 13 percent (telecomm) and 16 percent (electricity) (Figure 5).

Figure 5: Infrastructure as Major or Severe Constraint by Firm Size, 2006



Source: World Bank Investment Climate Survey (2005).

[3] From Fay and Morrison (2005), and Calderón and Servén (2004b) with input from Briceño-Garmendia, Estache, Shafik (2004)

29. Perhaps more importantly, the analysis also found that the poor conditions of infrastructure in Costa Rica affect firms' integration into global markets. Poor infrastructure affects the capacity of firms to export, as well as the ability of countries to attract foreign investments. It thus reduces opportunities for greater international integration, higher competitiveness and enhanced technology and innovation. Because of the importance of infrastructure in the physical movement of goods, bottlenecks contribute to high logistics costs which, in turn, lead to high inventory levels. Unreliable infrastructure will result in higher losses in transit, the need to hold higher inventory rather than order just-in-time, and generally higher cost of transport.

30. The Logistics Survey conducted for this study focused on three high value-added goods and found the range of logistics costs as a percent of value to be 13 to 24 percent.[4] Because the goods analyzed--processed foods, cut flowers and medical equipment--are of extremely high value in relation to their weight, the logistics costs for those products are low in comparison to the nation's total mix of products. (Transport costs alone often represent over 50 percent of the delivered cost of low-value-to-weight goods such as cement, coal, grains and other products shipped in bulk.) This suggests that Costa Rica's national average logistics cost for goods may be even higher. How does that compare with industrialized countries which should serve as the benchmark for Costa Rican competitiveness?

31. The average share of all logistics costs to product value in OECD countries is around 10 percent.[5] This average includes the full range of products--from high value air shipments down to low value bulk cargoes--suggesting that Costa Rican firms are faced with a significant cost disadvantage when competing against firms in industrialized countries. Much of this extra logistics cost burden that has been placed on Costa Rican products can be attributed to differences in infrastructure quality and reliability—particularly in transport. Poor quality and reliability result in damaged goods, demurrage charges, lost sales and higher inventory levels.

32. For Costa Rica, this lesson is of critical importance: In order to unlock the benefits of trade, infrastructure must be available, reliable and cost effective and a wide range of firms must have access to that infrastructure. By focusing on the bottlenecks to trade that are revealed through this process, policy makers can address the country's competitiveness and potential to achieve higher growth rates.

Infrastructure-Related Constraints and the Competitiveness of Costa Rica's Firms

33. The results of the sectoral diagnoses and the surveys conducted for the CEM tell a remarkably consistent story across infrastructure sectors about the unique paradox that Costa Rica now faces:

- The country possesses a tremendous endowment of infrastructure forged from a legacy of public commitment. That is, access to infrastructure in a broad sense is excellent in comparison with neighboring countries.

- Service and infrastructure quality are suffering from underinvestment, lack of innovation and weak regulation and that is impacting firm competitiveness.

34. Over decades of steady investment, Costa Rica built an extensive network of infrastructure in nearly all productive service areas. The financing of this infrastructure has mostly relied on public funds and the management and operations of the services has relied on public institutions. These transport, electricity and telecommunications networks were allowed to develop in the context of a profound sense

[4] Calculation excludes raw material inputs to avoid redundant calculation as raw materials generally contain even higher transport costs as percentage of total value.

[5] See L. Guasch, The World Bank (2002)

of "social compact" felt by taxpayers toward public service providers. The resulting infrastructure endowment has contributed to Costa Rica's high and stable growth levels in decades past.

35. A high-level review of Costa Rica's transport, electricity and telecommunications endowment reveals a country that is a regional leader in productive infrastructure in terms of connectivity. Across all of Costa Rica's primary, productive infrastructure backbone—roads, electricity and telecommunications—the country has made remarkable achievements in providing access to a large portion of its citizens and businesses. In transportation, Costa Rica leads its peer group in road density, measured as the length of total or paved roads per worker. Indeed, it has 30 percent more paved roads per worker than the next most densely paved country in Latin America. In electricity, the reach of the network and connection rates are among the highest in the region while the country ranks third in electricity capacity per capita. Costa Rica has made impressive progress in the availability of information and communication technology (ICT), ranking first among its peers in mainline teledensity as well as personal computer density and second in Internet usage.

36. Despite past successes in building out infrastructure networks, public expenditure levels have declined and some of the public service providers have been unable to keep up with sectoral innovation. The private sector has not been allowed to play a compensatory role because of the long-established position of public authorities and agencies as integrated owners, operators, investors and managers of infrastructure services. Regulators who might have attacked the issue of declining service quality have not been granted sufficient tools, resources or independence to raise the specter of institutional shortcomings on the part of public service providers. The result has been a decline in the quality of services across sectors—even as connectivity remains high. That quality slippage is beginning to affect firm competitiveness, particularly for small and medium-sized manufacturers.

37. As a result of this faltering commitment to infrastructure in recent years, growth in the endowment of most of Costa Rica's productive infrastructure has begun to wane. In transport, Costa Rica's paved road density has declined each year since a high in 1998 as growth in paved roads was offset by more rapid growth in the labor force. The maintenance of such an extensive network has proven to be a core challenge for the Government —a point which is discussed in more detail in the section of Chapter 3 which is dedicated to Costa Rica's infrastructure quality. Similarly, efforts to increase the capacity of the ports through a concessioning program in Caldera and a rationalization of operations at Limon and Moin have not progressed, leaving Costa Rica with notably uncompetitive ports, and forcing about 60,000 containers per year to move through Panama's ports. Likewise, an upgrading of the international airport has been on hold while the awarded concession has battled through the court systems.

38. In electricity, generation expansion has stopped over the last few years and shortages loom in the future without a rejuvenation of the investment program. Mobile telephony has also has not kept up with neighbors, competitors or the potential of Costa Ricans to utilize the new technology. As for the quality of services, the ICS reveals that Costa Rican businesses suffer from surprisingly frequent outages and long waiting periods for connections in both electricity and fixed line telephony.

39. In addition to the immediate impact on access to markets and firm competitiveness, Costa Rica's reputation as an attractive investment location may also be impacted by the faltering quality of infrastructure services. A recent survey of major industrialists gave Costa Rica low marks in the quality of its transport infrastructure (Table 2). Costa Rica ranked poorly in most categories of transport infrastructure in the survey of business executives contained in the World Economic Forum's Global Competitiveness Report 2004-2005. In regards to ports, Costa Rica was tied with Guatemala for the lowest ranking in its peer group. Air transport was the only category in which Costa Rica's score exceeded the peer group average.

Table 2: Comparative Survey on the Quality of Infrastructure

	Overall infrastructure quality	Port infrastructure quality	Air transport infrastructure quality
Argentina	3.6	3.6	4.1
Brazil	3.5	3.1	5.1
Chile	4.9	4.8	5.7
Colombia	2.9	3.0	4.4
Costa Rica	**3.0**	**2.5**	**4.8**
El Salvador	4.4	3.3	5.6
Guatemala	2.7	2.5	3.5
Honduras	3.0	3.8	3.3
México	3.4	3.3	5.0
Panamá	4.0	5.7	5.2
Indonesia	4.2	4.4	4.4
Philippines	2.5	2.6	3.9
Thailand	4.6	4.2	5.3
Average	**3.6**	**3.6**	**4.6**

Note: Survey based subjective evaluation on scale from 1-"poorly developed and inefficient" to 7-"among the best in the world."
Source: World Economic Forum, Global Competitiveness Report 2004-05

40. What are the specific impacts of the decline in expenditure and the inability to leverage private sector involvement in infrastructure?

- The quality of the primary road network is poor and worsening, resulting in losses from delays of shipments as well as breakage and theft of between 8 and 12 percent of sale value for exported goods;

- The primary ports remain unreformed and inefficient resulting in over 15 percent of container cargo now moving through Panama and absorbing estimated US$70 to US$100 million in additional road haulage costs per year;

- Electricity quality measurements from time for connection to severity and duration of outages is surprisingly poor and worse than competitor countries;

- Electricity generation capacity is low given Costa Rica's level of income and has not kept up with the rise in demand in recent years;

- Mobile penetration levels are low by regional or competitor standards.

41. This quality slippage is beginning to affect Costa' Rica's competitiveness, particularly for its small and medium-sized firms. To reverse the decay, public sector resources will have to be re-dedicated to the task of selective rehabilitation and expansion while some sectoral reforms that challenge the traditional "in-house" public solutions may be necessary.

Key Policy Options for Enhancing Infrastructure for Growth and Competitiveness

42. Policy options for improving the performance of Costa Rica's infrastructure include two key elements: (1) a recognition of the real source of the fiscal constraint related to infrastructure; and (2) a series of sector-specific initiatives that require the involvement of senior fiscal authorities as well as the technical agencies that implement each service.

1) Investment Decisions

43. How should the infrastructure investment needs be financed given current fiscal constraints and how will this differ from the country's traditional investment patterns?

44. **Historically, Costa Rica's investment levels in infrastructure have mapped closely to its growth levels—to the benefit of the country's economy.** That is, at between 3 and 4 percent of GDP, investments in infrastructure have traditionally been the second highest in Latin America—after Chile (4 to 6 percent)—as have Costa Rica's growth levels. Perhaps because the rate of infrastructure investment as percent of GDP continues to remain higher than most Latin American countries or perhaps because Costa Rica's levels of access to basic services (electricity, roads, fixed line telephones and water and sanitation) are among the highest in the region, infrastructure investment trends have not attracted much attention. It has only been recent reports of quality problems arising from Costa Rican investors, shippers and businesses that have focused a clearer light on the state of infrastructure investment in the country. Indeed, signs of quality problems in Costa Rica's infrastructure service provision are at odds with the traditional view of Costa Rica as a regional leader in the provision of infrastructure services.[6]

45. **To understand the cause of the quality problems that have arisen across the productive infrastructure services requires a deeper analysis than the overall investment trends.** The next level of detail—investments levels by sector (telecom, electricity, transport, water)—reveals a pattern of expenditure which is different from other middle and upper income countries throughout the world. Nearly all comparator and competitor countries use public funds for those infrastructure investments that contain an important social or merit good characteristic—such as roads, water and sanitation. Those same countries rely on the private sector to finance infrastructure services which are more readily paid for by user charges—such as telecommunications, electricity and other types of energy supply. By contrast, the lion's share of Costa Rica's public expenditures in infrastructure is increasingly going toward telephony and electricity generation while public investments in other areas of infrastructure are falling.

46. **In terms of Government accounts, ICE's growing investments in telecommunications and energy hides the massive decline in Costa Rica's public investment**. In fact, public investment in transport dropped from about 2.0 percent of GDP between 1976 and 1984 to about 0.3 percent of GDP between 1996 and 2004. As a result of the public nature of all the financing sources for infrastructure, a chain reaction of fiscal constraints has emerged:

- The government's budget has reached its current state based upon a tradition of investment in infrastructure that appeared high (because of the independent revenue sources of ICE from telecommunications and electricity tariffs), but which is, in fact, woefully low;

- The underinvestment in transport stock has resulted in a poor quality road network, dilapidated bridges and poor port access. This deferment of investment and routine maintenance has driven up the per unit cost of maintenance and rehabilitation exponentially;

[6] See the World Economic Forum's Global Competitiveness Report and in the Investment Climate and Logistics Surveys conducted for this Report

- ICE's autonomy and the logic of auto-sufficiency in ICE's two sectors does not allow for transfer of investment funds between sub-sectors (e.g., from telecommunications to roads);

- Even if the transferring of funds were possible through a system of cross-subsidies or bond financing on the back of ICE, it would not be desirable. ICE will have enough difficulty in the years ahead to finance the backlog of investment needs in energy supply; and address the growing quality concerns in electricity distribution and fixed line telephony. This will have to be done in the face of greater competition (and, possibly, lower revenues) in mobile telephony.

47. **In short, additional sources of funds will be required to rehabilitate the transport network of Costa Rica.** Having recognized this, the Government is moving forward with concession contracts for the few highways with sufficient traffic to self-finance through tolls; and the concessioning of the ports. The Government is also looking at ways to increase the fuel tax to cover road maintenance and rehabilitation for lower density roads.

48. **These initiatives are vitally important and are encouraged in the infrastructure chapter of this report.** However, unless the Government is able to construct a large, separate account for road financing out of fuel taxes, these measures are unlikely to finance the investment, rehabilitation and deferred maintenance gap that the sector currently faces. As discussed below, the Government may have to consider even more creative approaches to accessing capital and leveraging the private sector in the provision of low and medium-density roads.

2) Sector-Specific Initiatives

While the commitment of high level fiscal authorities is a necessary prerequisite for deriving new sources of financing for infrastructure investment and maintenance, a series of sector-specific policies are required to shore up the performance of the sectors and protect the value of existing and future assets:

- **In transport, rehabilitation and maintenance of the key trade corridors, beginning with the road from San Jose to Puerto Limon and the operations of the Atlantic ports would help facilitate trade and business expansion**. The new Government's announced intentions to rededicate itself to infrastructure investment is welcome news to Costa Rica's manufacturers, service firms and potential investors alike. In leveraging private financing and enhancing Costa Rica's reputation for contracting integrity, the financial closure of at least one major road concession over the next six months or so will send positive signals to the infrastructure investment market. Given the singular importance of Puerto Limón-Moín for the competitiveness of the country's trade, and the current levels of inefficiency suffered by Costa Rica's shippers, a new governance structure and investment strategy for the Atlantic ports becomes a priority. Port reform at Limón-Moín should no longer await the results of the concessioning of Caldera.

- **Where highway rehabilitation and expansion are necessary but tolling is unlikely to cover the entire cost, the lumpy fiscal burdens might be "levelized" or spread out over many years through the use of enhancements**. Credit enhancements such as minimum traffic or revenue guarantees backstopping partial tolling commitments would shift the initial financing costs to a consortium of construction, maintenance and operating firms. While the contingent liabilities associated with such guarantees would need to be valued openly and fairly in the public accounts, they would, at least, help to spread out lumpy investments and to shift maintenance and operating responsibility to the private sector. For roads and bridges where traffic volumes are too low to cover large rehabilitation or expansion projects, toll-financed contracting might still be considered to cover the costs of routine maintenance. A detailed analysis of per unit costs associated with current maintenance contracting should be undertaken to determine whether

longer term and performance-based rehabilitation and conservation contracts would yield greater returns for the scarce resources being spent on the road network. Finally, the bundling of road and port investment obligations with land development opportunities (e.g., property leasing, tourism site or industrial park development) could be considered to entice consortia into providing infrastructure as part of more complex investments.

- **In the electricity sector, incentives for expanding generation assets and improving regulatory oversight would enhance the sector's governance and contractual framework and contribute to greater supply and reduced energy prices.** In the short-term, the Instituto Costarricense de Electricidad (ICE), Autoridad Reguladora de Servicios Públicos (ARESEP), and Ministerio del Ambiente y Energía (MINAE) should focus on relieving the impending generation shortages by empowering the agency to concession hydro-power; defining tariff adjustments that provide ICE with the resources to fund immediate generation investments; and defining contractual arrangements for renewing private generation agreements as well as the trading of existing contracts. In the medium-term, a sector strategy that reevaluates market structure including the role of greater regulatory independence will become necessary. Without a sector plan that considers the Central America trading mechanism, it will be difficult for Costa Rica to take full advantage of the integrated market.

- **In telecommunications, sector reforms now under discussion are likely to bring productivity gains and technology transfer**. The Government of Costa Rica has begun the process of designing a more modern legal and regulatory framework that recognizes the competitive potential of the industry. While this is being done in anticipation of DR-CAFTA's requirements, the Government should press ahead with the sector reforms now under discussion. This will require the restructuring of the sector to create a separate telecommunications regulator; liberalization of service provision; the creation of a telecommunications policy function; increased and rationalized access to radio spectrum; and the improvement of information generation. In order to carry out these reforms in a coherent manner, the Government should consider drafting of a comprehensive "e-Costa Rica" strategy or digital agenda that would define telecommunications sector reform and connectivity agenda; an integrated e-Government strategy, and a strategy to promote the development of the IT industry and attract investment through IT-enabled services.

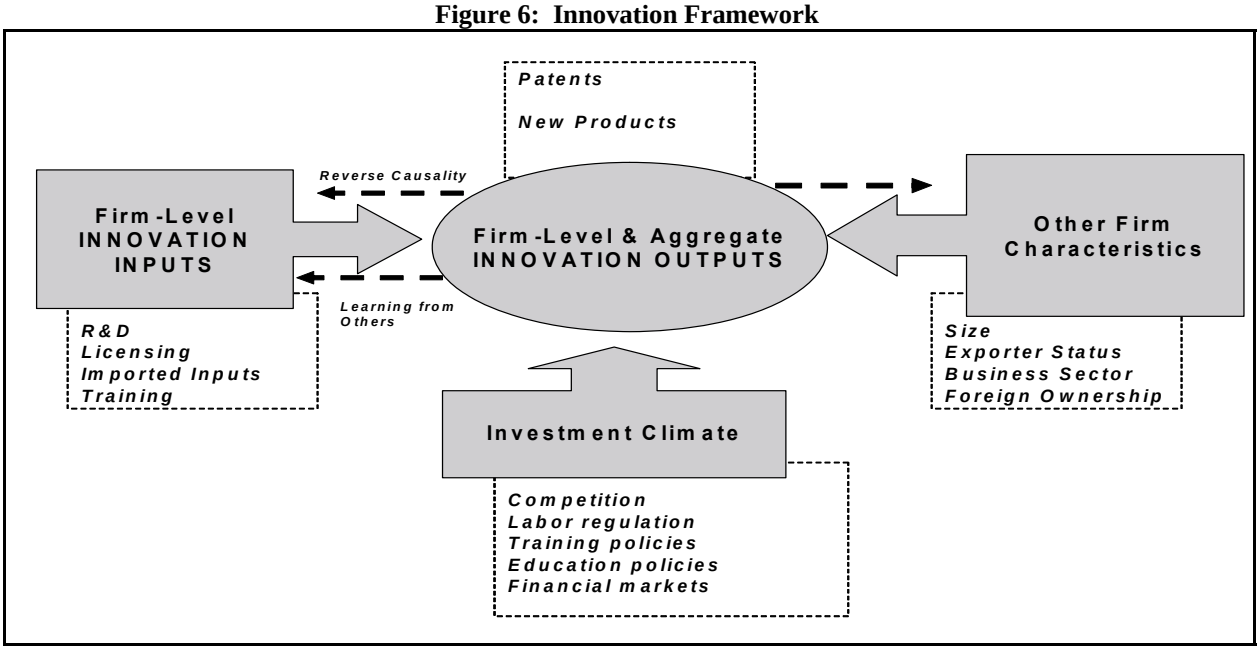
III. The Role of Innovation in Costa Rican Development

49. Numerous studies recognize the link between productivity growth and investments in innovation, and some point out that much of the widening gap between rich and poor countries is due, not to differences in capital investment, but in technological progress. The main focus of the analysis summarized in this section is on the role played by the private and public sectors and how these efforts interact in the context of public policies that help or hinder private innovation. It provides a description of the status of innovation in Costa Rica by analyzing aggregate and firm-level data and comparing this country's performance in recent years with those of countries at similar levels of development. The work also discusses new macroeconomic evidence linking innovation and economic growth on the one hand, and the role of market failures in hampering overall innovation performance on the other hand. Finally, it describes innovation policies and programs currently in place in Costa Rica, assesses their recent performance through a qualitative analysis and presents conclusions and main policy recommendations.

Why Government Policy Matters

50. Policy makers are interested in understanding the factors that promote or impede innovation and in undertaking initiatives and policy actions that benefit the general society by targeting innovation-related market failures. The analysis of the causes and consequences of innovation and its relationship to economic growth and firm performance can be captured succinctly in a simple framework where firm-level innovation is a result of firm level investments in innovation inputs (Figure 6). But the firm-level decisions regarding expenditures or other business decisions that determine a firm's ability to learn, adapt, and change, are themselves shaped by the business environment. Without a proper participation of the public sector in promoting investments in innovation, it is likely that the private sector alone will make sub-optimal levels of investments in innovative activities and this is where market failures have an impact.

Figure 6: Innovation Framework

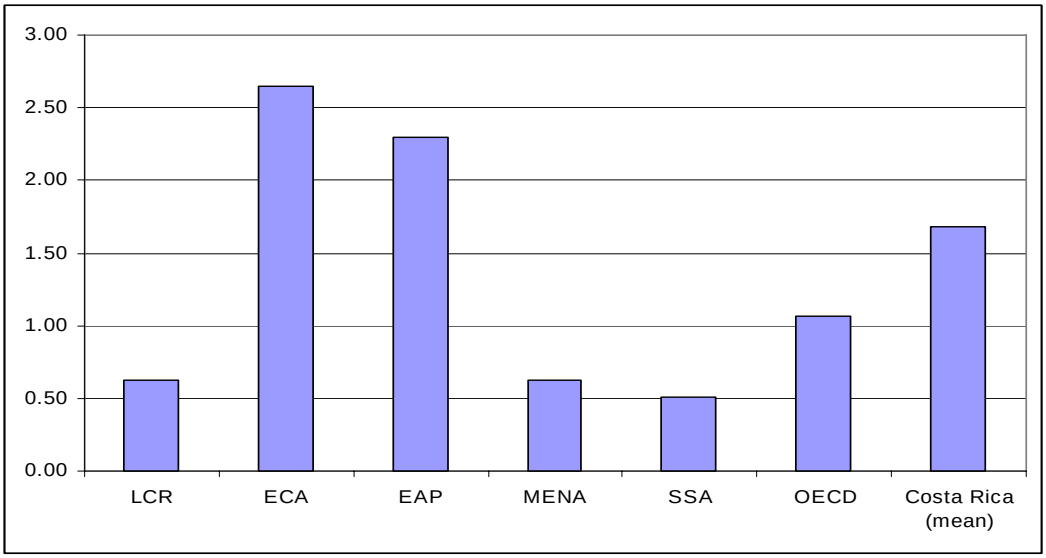


Source: World Bank (2002)

How Much Does Costa Rica Innovate?

51. A standard growth accounting exercise for Costa Rica sheds light on the contribution to growth that can be attributed to the accumulation of physical capital, the increase in the labor force and the increase in total factor productivity. As shown in Table 1, the Costa Rican economy has showed average rates of productivity growth equivalent to 1.98 over the 1991-2000 compared to the LAC average of 0.7 for the same period. The figure bellow shows additional estimates of TFP growth for the typical developing country belonging to the various geographic areas, including LAC. Although Costa Rica fared well with respect to the typical LAC country, it did not fare well with respect to the typical East Asian and Pacific (EAP) country. (Figure 7)

Figure 7: Median TFP Growth Rates by Regions Compared to Costa Rica's Average 1991-2000



Source: World Bank Staff calculations, assuming a capital share of GDP of 40% for all countries and years, and based on data provided by Loayza, Fajnzylber and Calderón (2005).

52. Based on these results, it is clear that Costa Rica canto increase its total factor productivity to pursue the higher and sustained rates of growth that are necessary to catch up to more stellar performers. In this context, innovation and technology adoption take center stage.

53. A strong education base is a prerequisite for innovation and technological change and Costa Rica's educational attainment is among the highest in Latin America, but there is still room for improvement, especially when one compares this performance to other countries with similar income level. The country has made remarkable efforts in reaching the goal of universal primary education of its population. Today, more than 60 percent of the adult population has some primary schooling, and net enrollment rates for those in the appropriate age cohort are almost 100 percent. Despite this, Costa Rica's overall educational performance is still not fit to propel the country into a virtuous growth cycle. Average years of educational attainment are still somewhat lower than other Latin American countries with similar income per capita, and far from innovating countries such as Israel and Ireland.

54. In sum, from an international comparative perspective, Costa Rica shows some strengths and weaknesses in terms of its innovation outputs and inputs. Regarding outputs, it is difficult to conclude that Costa Rica is falling behind in international patenting, given that it is a relatively small economy, but it does seem to be lagging behind in terms of scientific output and with respect to the frequency of emergence of new export products. On the side of the inputs, Costa Rica's clearly underperforms in terms of research and development effort, but seems to be outperforming similar countries in terms of licensing payments. But, falling behind in one indicator might be less harmful than falling behind in another since the social rates of return might be different across the different types of innovation inputs, which in turn can vary depending on the institutional context and investment climate in which firms operate.

Key Policy Options for Enhancing the Environment for Innovation

55. Macroeconomic evidence suggests that Costa Rica should put innovation at the top of its development agenda. First, innovation seems to be perhaps even more important for long-term economic development than governance or the quality of public institutions; Second, the social rates of return to R&D seem to be quite high suggesting that if Costa Rica can provide the correct incentives and institutional framework, the payoffs from innovation policies can be substantial; and third, market failures seem to hamper the most common type of innovation in developing countries, namely the introduction of export products that already exist around the globe. Key conclusions are:

- **Policies to promote innovation would help to improve Costa Rica's development prospects.** Innovation outcomes, measured by the accumulated number of patents over a long time period, appear to raise the level of development across countries. In this context, innovation is just as, or perhaps even more important for long-term economic development as governance or the quality of public institutions. But, national innovation systems—public sector policies, research centers and universities, and the private sector—should be well integrated in order for innovation policies to have a high rate of social return. Hence to aid the targeting of innovation policies in Costa Rica, this report provides a comprehensive empirical assessment of firm characteristics and innovation inputs that are associated with various indicators of innovation outputs, namely the introduction of new products, product upgrading, changes in production processes, and meeting international product-quality standards.

- **Costa Rica can provide incentives and the appropriate institutional framework so that it receives the potentially high payoffs from the social returns to R&D and innovation policies.** The social rates of return to R&D, one of the key innovation inputs, seem to be quite high for countries with similar levels of development as Costa Rica.

- **Given its level of development, Costa Rica seems to be an under-performer in R&D, scientific publication, and export discoveries and would benefit from greater investments in innovation or improving the quality of public policies and institutions that affect private-sector investments in innovation.** Market failures seem to hamper the most common type of innovation in developing countries, namely the introduction of export products that already exist around the globe. Consequently, the benchmarking exercises that portrayed Costa Rica as an under-performer in R&D, scientific publication, and export discoveries become worrisome when the empirical evidence suggests that the potential gains from improving either the level of investments in innovation inputs or improving the quality of public policies and institutions affect the efficiency with which the country uses its scarce innovation inputs.

- **Although Costa Rica's matching grants program that subsidizes private-sector innovation projects is consistent with global best practices, various aspects can be reformed in order to enhance its performance.** Some of the features that could be reviewed are: (i) the limits on the participation of large firms; (ii) the narrow scope of the grants, which are currently targeted on joint ventures between firms and research centers that are not chosen by the firms themselves; and (iii) the fixed-time grant competitions, which limit the grant applications to those submitted by certain dates, could be changed to an open window allowing firms to submit proposals at any time. However, it is difficult to derive strong recommendations from the available data, and thus it is arguable that the main reform in the near future should focus on the future monitoring and evaluation of the program.

- **The matching grants program could be monitored to improve performance, in accordance with state-of-the-art evaluation techniques, but this might require collecting additional information from private-sector participants in the program.** Furthermore, the activities of PROCOMER and of the Ministry of Science and Technology, which are key pieces of Costa Rica's national innovation system, could also be evaluated in the future, but these remain topics for future discussions and analysis.

- **Education, innovation, and infrastructure, seem to be worth prioritizing in the country's public policy agenda.** The evidence put forth in this report suggests that Costa Rica's public expenditures related to secondary schooling, its matching grants program, and perhaps the budget of the Ministry of Science and Technology, as well as those related to improving the quality of its infrastructure, should be protected as much as possible in the context of fiscal consolidation. If budget cuts in these areas are required to maintain the country's cherished macroeconomic stability, then the recommendations regarding the efficiency of public expenditures outlined above and in the previous chapter become even more important.

IV. Outline of the Country Economic Memorandum

56. This Country Economic Memorandum provides an in-depth look at the three key areas prioritized to maintain and improve growth prospects and reduce poverty over the coming years in Costa Rica. Chapter I starts with a benchmarking exercise to compare Costa Rica's growth performance with respect to other countries, followed by an analysis of the sources and the main determinants of growth during the 90s and concludes by identifying the main areas where further reforms or policy interventions promise to yield the greatest growth impact. Chapter II focuses on the macroeconomic and financial vulnerabilities that have emerged in recent years that could hinder growth, with special attention to dollarization and public debt sustainability and lays out policy options to address them. Chapter III investigates the role that infrastructure plays in economic growth. It provides an overview of Costa Rica's infrastructure endowment and service quality and identifies the areas of intervention that will be needed in order for infrastructure to remain a key contributor, rather than a bottleneck to growth. Finally, Chapter IV analyzes the role that innovation can play in accelerating Costa Rica's growth and development, including a qualitative assessment of relevant government policies.

Chapter 1 Costa Rica's Growth Performance, Determinants and Productivity[1]

1.1 Introduction

1. Over the past twenty five years Costa Rica's GDP growth (4.0 percent) exceeded Latin America's average growth (2.2 percent) and the growth rates of all other Central American countries (2.9 percent) In light of the above-average performance, this chapter addresses three questions: First, how has Costa Rica performed in comparison to other countries? Second, which are the main factors behind past economic growth in Costa Rica? Third, are these factors going to continue to sustain growth in the future and further improve Costa Rica's long-term growth performance? The chapter starts by benchmarking Costa Rica's growth with respect to other countries, as a first assessment of the country's growth performance. It then follows with a historical review that describes the link of policies and other developments to growth; an analysis of the main determinants of growth during the 1990s and concludes with a consideration of Costa Rica's prospects for sustaining and increasing growth. Chapters 2 to 4 will then address in detail performance and policy issues in connection with three key areas that support long term growth: macro-finance, infrastructure, and innovation.

2. **Since the 1960s, there have been two periods of strong growth in Costa Rica: 1965-1979 and 1992-1999.** The overall conclusion of this chapter is that the strong per capita GDP growth from 1965-79 resulted almost exclusively from labor growth and investment, while per capita growth since 1992 was partly driven by efficiency-enhancing reforms implemented since the mid-1980s that raised factor productivity. These reforms covered trade, public sector consolidation, infrastructure, and partial opening of the banking system. However, Costa Rica's relatively good growth performance has been accompanied by disappointing results on poverty reduction since 1994. In fact gains in poverty reduction stalled between 1994 and 2002 and slightly increased since 2003 (See Box 1.1)

3. **Empirical findings analysis suggests that Nicaraguan immigration has not been a significant cause of stagnating poverty rates in Costa Rica**. Since 1994 and particularly since 2000, in-flows of immigrants have been too small to have had much impact on aggregate levels of poverty, however, the evidence does suggest that Nicaraguan immigrants may have had several effects on both growth and poverty, although their net impacts are not completely clear. On one hand, by providing low-wage labor to agriculture, Nicaraguan immigrants have almost certainly helped competitiveness in Costa Rica's agricultural sector. The size of this effect is difficult to estimate, however. On the other hand, Nicaraguan immigration during the late 1990s contributed to an increase in the relative supply of low-skilled labor at a time that the relative demand for more-skilled labor was rising. Immigration thus contributed, along with other factors, to higher wage inequality in Costa Rica between 1992 and 2002. Nonetheless, the precise impact of immigration on wage inequality does not appear to have been large, as Nicaraguans are generally concentrated in sectors where relative wages have been rising. Indirect evidence suggests that immigrant labor may also have contributed to higher unemployment rates among low-skilled workers, rates which have risen since the mid-1990s. A much more important cause of Costa Rica's stagnating poverty rates, however, is the growing mismatch between the low skills of poor workers and the increasing demand for higher-skilled labor. This suggests that ensuring that the poor acquire greater job skills – particularly through improved access and achievement at the secondary school level – is a key component of a poverty reduction strategy for Costa Rica.

[1] Primary contributors to this chapter include Ricardo Tejada (LCSPE) and Mauricio Carrizosa (LCSPE), with valuable input from Ana Lucia Armijos (LCSPE) and David Gould (LCSPR).

Box 1.1 Growth, Inequality, and Poverty Reduction in Costa Rica

Costa Rica has made considerable progress in reducing poverty and improving social indicators since the beginning of the 1990s; poverty levels are low, health outcomes and access to basic services are high, both by regional standards and compared to other middle income countries. Notwithstanding these achievements, Costa Rica faces a number of important challenges going forward.

- **While the percentage of the population that is poor declined from 32 percent in 1989 to 23 in 1994, the poverty rate has essentially stagnated since then.** Indeed, in 2004, 24 percent of the Costa Rican population was still considered poor. Similar patterns are seen with respect to extreme poverty, which fell from 9.9 percent in 1989 to 6.8 percent in 1994, but remained at 6.6 percent in 2004. This is surprising, given that Costa Rica has experienced relatively consistent growth over the last decade.
- **Income inequality has risen also**; while still relatively low by regional standards, Costa Rica's gini coefficient rose from 0.44 in 1989 to 0.48 in 2004.
- Although Costa Rica continues to make important progress in education – a critical input to increase the productivity and incomes of the poor – **the country still lags behind the Latin America and Upper-Middle Income country averages at the secondary school level**. Moreover, the poor continue to lag behind the non-poor in educational attainment, affecting their ability to participate and benefit from economic growth.

A forthcoming Poverty Assessment examines recent developments in Costa Rica and identifies several reasons why progress in poverty reduction has stalled over the last 10 years. Specifically:

- **Levels of GDP growth, along with household income growth has slowed during recent years.** Household survey data for Costa Rica (EHPM) show that household per capita income grew at early 5 percent per annum from 1989 to 1994, but at only 1.5 percent from 1994-2000. Since 2000, the data suggest that average per capita household incomes have barely changed.
- **Since 1994, patterns of growth have tended to favor the non-poor.** Income growth has tended to be higher in non-poor regions than in poor regions and in sectors that employ relatively skilled labor compared to sectors that employ low-skilled labor. The benefits of growth have benefited relatively better-off households. Since 2000, poor and near-poor households have actually experienced negative income growth, while the wealthiest 25 percent of households experienced positive income growth.

Changes in the ways that the benefits of growth have been distributed in Costa Rica reflect broader changes in economic circumstance within the country and in the world economy, including shifts in the relative supply and demand for skilled and unskilled labor. Specifically, demand for relatively skilled labor has increased faster than the supply. As a result: (i) Real earnings of more skilled workers have increased faster than those of less-skilled workers; (ii) despite small increases in the national unemployment rate, unemployment among the poor and among less-skilled workers has increased significantly; (iii) unemployment rates for poor workers increased from 8 to 17 percent (1994-2003), while rates for non-poor workers stayed steady at below 5 percent; and (iv) the proportion of poor people working part-time instead of full-time has also increased – this trend is most notable among single, working mothers

Altogether, the evidence suggests the need for a multi-dimensional strategy to re-invigorate the fight against poverty. The PA outlines potential areas for action, including: (i) Promoting higher sustained levels of growth; (ii) strengthening the human capital of Costa Ricans, with special emphasis on improving secondary school along with stronger skills formation among low-skilled workers; (iii) expanding social protection programs – insurance as well as assistance – to ensure that the poorest and most vulnerable have adequate access to support; (iv) providing greater social supports, such as affordable child care options, to ensure that poor, working mothers can find (and keep) full-time and remunerative employment; (v) defining regionally differentiated investment strategies, and (vi) strengthening information systems for improved poverty monitoring and more effective targeting and impact of poverty-reduction efforts.

1.2 Growth Performance Relative to Other Countries

4. **How does Costa Rica's long-term growth compare with other countries?** The panels in Figure 1.1 plot per-capita long-term (1975-2004) GDP growth against per-capita GDP in 1975 for all countries for which purchasing power parity GDP data are available. This Figure shows the degree of per-capita GDP convergence across countries and where a particular country's per-capita is compared to others. Panel A shows that Costa Rica's growth rate (indicated by the symbol "□" and by the arrow in the two panels) was similar to those exhibited by high income countries and therefore its per-capita GDP did not converge to those of high-income countries**.** In order to converge, Costa Rica would have had to grow faster than the higher income countries. In general, when considering all countries there has not been a systematic absolute convergence–i.e., some countries converge, others recede–although econometric research has generally verified the existence of conditional convergence, i.e., that a lower initial GDP has a positive "catching up" effect on growth although other variables might prevent a country from converging in an absolute sense. This is indeed the case of Costa Rica when placed in the context of all countries. It is also the case of most Latin American countries.

Figure 1.1 – Panel A:
Per-Capita GDP in 1975 with respect to Average P.C. GDP Growth 1975-2004: 109 Countries

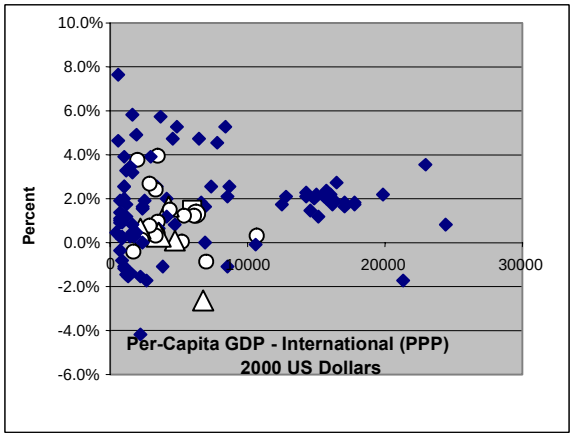
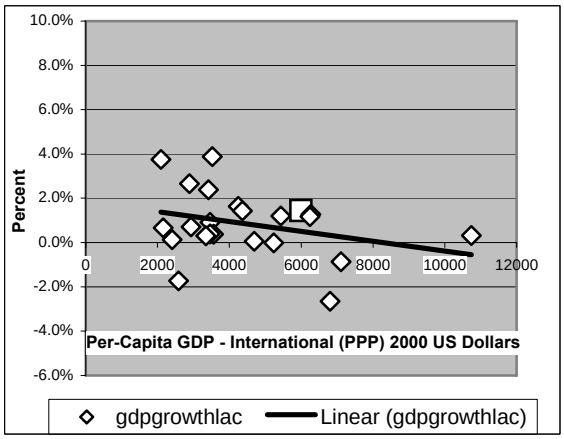


Figure 1.1 – Panel B:
Per-Capita GDP in 1975 with respect to Average P.C. GDP Growth 1975-2004: 23 LAC Countries



Source: World Bank Staff Calculations

5. **When cast in the context of Latin American countries alone (indicated by white symbols ○ or Δ in Panel A of Figure 1.1), Costs Rica's growth performance looks much better**. Cost Rica is above the absolute convergence regression line in Panel B, indicating higher than average growth for a Latin American country (see also Table 1.1). However, Costa Rica has lost some ground in the last five years in some of the areas of reforms (public sector consolidation, infrastructure, and innovation) and growth has slowed to 4.0 percent on average. While Costa Rica's growth performance is consistent with the deterioration in the terms of trade and slower growth seen across the region since 2000, a more efficient and competitive business environment would likely have led to a stronger rebound in recent years.

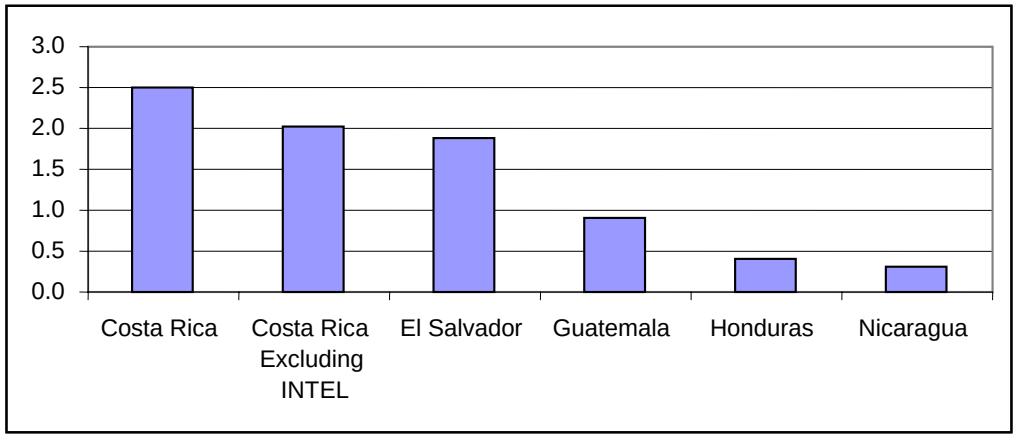
Table 1.1: GDP Growth and Volatility in Costa Rica* and LAC

	Growth rates of GDP			Growth rates of GDP per capita			Volatility of output per capita**		
	LAC	**CRI**	**Diff.**	**LAC**	**CRI**	**Diff.**	**LAC**	**CRI**	**Diff.**
1961-1970	5.3	6.1	0.8	2.7	1.9	-0.8	1.62	1.14	-0.48
1971-1980	5.9	5.6	-0.3	3.4	2.8	-0.6	2.71	2.09	-0.62
1981-1990	1.2	2.4	1.2	-0.7	-0.4	0.3	2.85	2.44	-0.41
1991-2000	2.9	4.6*	1.7	2.1	2.2*	0.1	1.65	1.64*	-0.01
2001-2005	2.6	3.7*	0.9	1.1	1.9*	0.7	…	1.22*	…
1981-2005	2.2	3.6*	1.3	0.8	1.3*	0.3	…	1.90*	…

Note: *After 1998, growth figures exclude high tech companies.
**Output volatility was calculated using the band-pass filter developed by Baxter and King (1999)
Source: Loayza (2002), CEPAL (2006) and BCCR (2006). LAC figures represent the Region's median

6. **This track record of relatively high output growth persists even after discounting the effect of large foreign high technology investments of recent years**. Figure 1.2 depicts the 1990-2005 *per-capita* GDP growth rates for Central American countries. The chart verifies Costa Rica's growth prominence in the Central American context. Costa Rica has been able to attract foreign direct investment at an average rate of 3 percent of GDP since 1990, including high tech investors such as Abbot Laboratories, Baxter, Procter and Gamble. In 1998, the American computer chip manufacturer INTEL started operations becoming the biggest company in the country in terms of sales. Value added by high tech firms accounted for about 6 percent of GDP in 2004. One could argue that such companies may substantially inflate growth figures while not really providing much value added to the rest of the economy (see Box 1.2). To account for this possibility, the growth indicators presented in Table 1.1 and Figure 1.2 exclude the high tech industry since 1998. These indicators also confirm the conclusion that Costa Rica has experienced higher than average growth rates.

Figure 1.2: Growth Rates of GDP per Capita in Central America 1990-2005 average



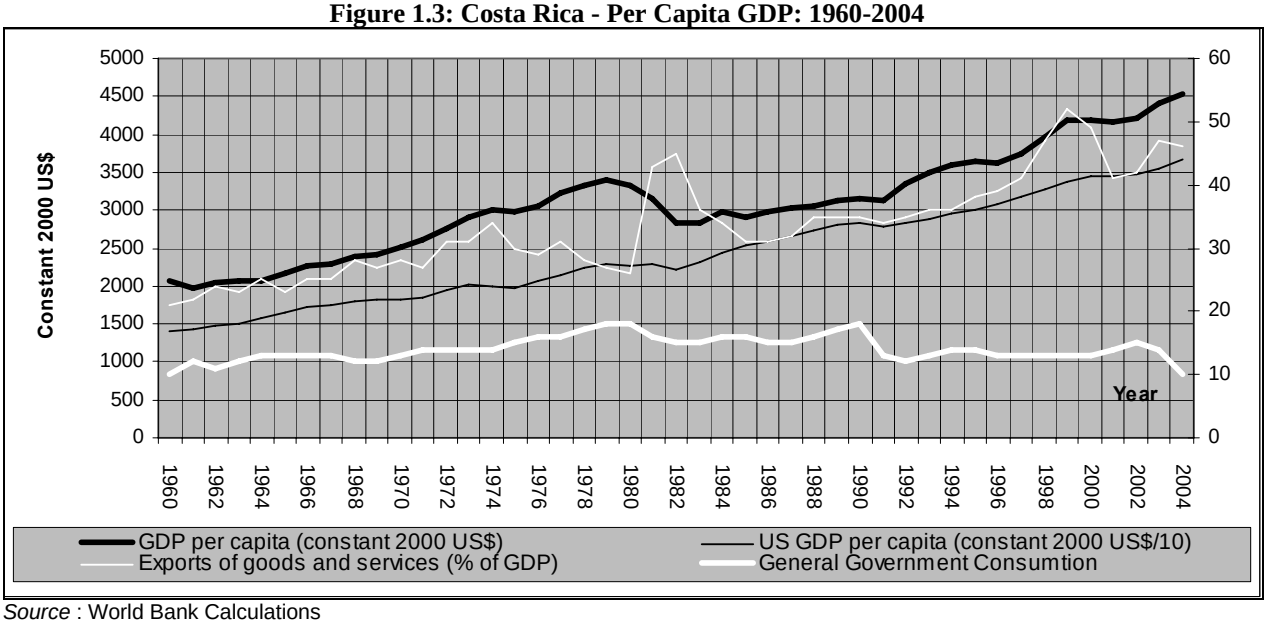
Source: WDI and Central Bank of Costa Rica.

7. **Two additional aspects of Costa Rica's growth determinants that have been present throughout the period are the country's low volatility and its dependence on US growth, the main market for its exports**. Table 1.1 shows the standard deviation of cyclical fluctuations of output per capita, a standard measure of volatility of GDP. Since the 1960s growth has been less volatile relative to the average volatility of LAC countries. Volatility has also been in a declining path since the mid 1980s, reflecting a more open and diversified economy with stable macroeconomic policies. Low volatility may well have contributed to Costa Rica's relative high growth in the Latin American context. In spite of the above, since 1991 Costa Rica's output volatility has tended to be closer to the regional average, suggesting that the related benefits of having lower volatility may not be as strong as in prior years.

1.3 Historical Economic Performance

8. **This section examines Costa Rica's historical performance as a first approximation to understand the factors that have driven growth in this country**. These casual observations are complemented in the next section with a discussion of available econometric results. Figure 1.3 depicts the path of *per-capita* GDP together with other variables of interest. The first point to note is that the path of Costa Rica's growth since 1960 shows strong performance from 1965 to 1979; a recession from 1980 to 1983; a gradual recovery from 1984 to 1991; and strong, although cyclical growth from 1992 to 2004.

Figure 1.3: Costa Rica - Per Capita GDP: 1960-2004



Source : World Bank Calculations

9. **How can one understand these changes in performance? A good place to start is a review of five distinct periods that reflect the various economic models and policies followed since 1950**. According to Rodríguez-Clare et al. (2003), these periods are: (1) The agro-export period of much of the 1950s and early 1960s, (2) The import substitution model and subsequent integration into the Central American Common Market during the 1960s, (3) The creation of state owned enterprises and increase in public sector debt of the 1970s, (4) the economic crisis of the 1980-1984 period and (5) the structural reform period that followed together with a strategy of outward oriented export-led growth strategy that continues to date.

10. ***The Agro-export period of the 1950s.*** Prior to 1959, GDP growth largely reflected the performance of the country's two traditional export crops of the country, coffee and bananas (Costa Rica was the first Central American country to start successful exports of coffee and bananas). As a result,

international price fluctuations of these two commodities resulted in sometimes high, but very volatile growth rates, and this period ended in 1964 after at least four years of little or no growth. Nevertheless, macroeconomic stability was maintained, with moderate current account deficits and low inflation. The fiscal deficit increased to moderate levels due to higher public investment in education, health services, and infrastructure (especially in electricity, water and telecommunications).

11. ***The import substitution and integration into the Central America Common Market (CACM) in the 60s.*** Two important policy developments then occurred. First, in 1959, the Government introduced new import substitution policies, with the enactment of an industrial protection law. This Law established a broad system of trade related protection measures for the local industry as well as tax and credit incentives. The main goal of these policies was to foster industrialization and reduce the country's exposure to its major traditional crops, following the same trend of the rest of the LAC region. Second, to deepen the import substitution scheme through a greater export market for its manufacturing sector, Costa Rica joined the Central American Common Market (CACM) in 1963. Joining the CACM required the elimination of most trade barriers among member countries, but at a cost of imposing very high tariffs to the rest of the world imports.

12. During the second half of 1960s Costa Rica achieved average growth rates of 7 percent (Table 1.2) mostly a result of the high growth achieved by the industrial sector (8.6 percent on average) fueled by an increase of 31 percent in manufacturing exports to the CACM. Other sectors also contributed to Costa Rica's growth performance during this period. The agricultural sector grew 8 percent on average as a result of the significant increase in productivity resulting from the introduction of high-yield varieties of crops, the use of pesticides, improved management techniques and an increase in the use of land for agricultural purposes. Public services in telecommunications, electricity and water also grew rapidly, but slower than other sectors, financed by higher public external borrowing and fiscal deficits. These sectors were also labor intensive, absorbing a greater share of employment during the period. During the 60s the manufacturing sector increased its participation in total GDP from 14 percent to 18 percent, while agriculture started to decrease its participation in GDP (see Table 1.3).

Table 1.2: Costa Rica–GDP Growth Rates by Sector 1961-2005

	61-65	66-70	71-75	76-80	81-85	86-90	91-95	96-00	01-05
GDP	5.2	7.0	6.1	5.3	0.1	5.1	5.6	5.0	3.7
Agriculture	3.2	8.1	3.4	1.9	1.8	5.5	4.9	3.3	1.9
Industry	8.6	8.6	9.2	6.8	-0.4	5.4	5.7	7.0	2.8
Construction	6.2	4.4	11.2	9.7	-3.9	5.5	6.3	1.7	4.9
Electricity, water	8.7	12.7	8.0	7.6	5.6	5.6	5.1	5.9	4.8
Manufacturing	9.5	9.3	8.9	6.0	0.1	5.4	5.8	8.2	2.4
Services	4.9	5.8	5.7	5.8	-0.1	4.9	5.2	4.5	5.1
Transport and Comm.	3.3	8.2	11.8	9.4	1.2	8.2	8.0	8.0	11.1
Commerce and Tourism	5.2	6.8	3.1	6.4	-2.1	5.4	6.9	3.6	2.9
Housing	3.4	3.7	4.8	3.3	1.4	2.5	2.8	2.7	2.4
Banking	8.0	7.0	10.7	6.9	2.8	8.4	3.8	7.9	8.1
Public Administration	4.4	5.1	7.0	4.7	-0.1	2.1	1.8	1.2	2.1
Other Services	6.6	4.9	3.7	3.8	0.2	4.6	5.8	5.2	2.3

Source: Central Bank of Costa Rica

Table 1.3: Costa Rica – Structure of GDP by Sector 1961 – 2005

	61-65	66-70	71-75	76-80	81-85	86-90	91-95	96-00	01-05
GDP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture	24.8	23.1	20.1	19.8	17.3	12.9	13.4	11.7	8.7
Industry	21.4	23.6	26.6	26.6	30.4	31.3	30.1	31.0	29.4
Construction	4.9	4.4	5.1	5.8	4.5	4.7	4.5	3.9	4.7
Electricity, water	1.3	1.6	1.7	1.9	2.9	2.6	3.1	2.6	2.9
Manufacturing	15.2	17.7	19.9	18.9	23.0	23.9	22.5	24.5	21.8
Services	53.8	53.3	53.3	53.6	52.3	55.9	56.5	57.3	61.9
Transport and Comm.	4.2	4.3	4.5	4.3	6.7	7.8	8.4	8.4	9.2
Commerce and Tourism	20.3	20.2	20.6	19.6	20.1	19.6	19.9	19.7	19.4
Housing	10.2	8.6	6.6	6.2	5.7	7.9	5.7	4.7	4.2
Banking	3.8	4.1	4.8	5.1	4.0	4.3	4.4	4.3	5.7
Public Administration	9.5	10.7	11.9	14.0	11.7	11.3	11.4	11.6	13.3
Other Services	5.7	5.4	4.9	4.4	4.1	5.0	6.8	8.6	10.0

Note: From 1983 onwards, GDP sums at Factor Cost.
Source: Central Bank of Costa Rica.

13. ***The creation of state owned enterprises and increase in public sector debt of the 1970s.*** Two important developments need to be highlighted during this period. First, civil conflict during the 1970s in other Central American countries, together with the end of the initial "boom" phase of the import substitution model, substantially reduced CACM trade and thus its role as a growth engine like in the previous period. The share of exports in GDP declined from 33 percent in 1974 to 26 percent in 1980. Second, public policy took a turn towards a larger state. From 1970 onwards, the share of general government consumption in GDP, a measure often used as an indication of the burden of the public sector, began to increase. This measure rose from 12 percent in 1969 to 18 percent in 1980. Furthermore, in 1972, the Development Corporation of Costa Rica (CODESA) was created. This was a State holding company that created and operated several state enterprises with the ideal of developing an "Entrepreneurial State". CODESA financed most of its investment from domestic banks (that were also state owned) and through external loans from commercial banks.

14. Fiscal relaxation supported these policies, with deficits that increased public sector debt from 17 percent of GDP in 1974 to 30 percent in 1980. Inflation remained at moderate levels throughout this period helped by the fixed nominal exchange rate regime against the U.S. dollar. But because inflation was nonetheless higher than in the United States, a substantial real exchange rate appreciation occurred. The current account deficit consistently grew during this period reaching 14 percent of GDP in 1979. Exports continued to grow following increases in international coffee prices between 1974 and 1977, but the volume of exports only increased 4 percent between 1973 and 1980 compared to the 11 percent average growth rates observed during previous years. The terms of trade deterioration caused by the first oil shock of 1973 was offset by the increase in coffee prices. GDP growth remained high at 2.9 percent per capita during the 1970s, a situation that soon proved to be unsustainable and was dramatically changed by the economic crisis that followed.

15. ***The economic crisis of the 1980-1984 period.*** The growth boom of the seventies became unsustainable when coffee prices fall and international interest rates began to increase at the beginning of the 1980s, initiating a deep economic crisis that lasted throughout the first four years of the decade. The financial crisis, fueled by high fiscal deficits and public external debt levels, together with a fixed exchange regime, interrupted external financing from commercial banks and made Costa Rica the first country in Latin America to default on its external debt obligations in July 1981. During this period, GDP

growth fell to its lowest in Costa Rican history, 0.1 percent on average and 1.8 percent drop in per capita terms (see Table 1.2)

16. In 1981 the nominal exchange rate lost 150 percent of its value vis-à-vis the U.S. dollar and an additional 70 percent in 1982. By the end of the most severe part of the crisis in 1983, the Costa Rican colon had lost 380 percent of its value with respect to 1980 levels. These adjustments generated a sharp contraction in aggregate demand and employment levels and, for the first time since 1950, Costa Rica poverty rates increased, reaching to 54 percent of the population in 1982 from 30 percent at the end of the seventies[2]. Other human development indicators also worsened, most notably the secondary enrollment rate that decreased from 48 to 42 percent during this period.

17. ***The period of Economic Reforms and Export-led growth.*** Starting in 1984, Costa Rica undertook several structural reforms to address the crisis, that can be summarized in three groups: (i) Macroeconomic stabilization measures; (ii) Development of a non-traditional export sector and foreign direct investment (FDI); and (iii) Improvements in the financial sector. The overall aim of the reform effort was to reduce the economic role of the state while empowering the private sector to lead the growth process in the country. Several measures were undertaken to ensure macroeconomic stability that helped redress growth to previous levels and to trigger sustained growth thereafter. First, the multiple-tier exchange rate regime was replaced with a single rate crawling peg system that is still in place. Second, in order to reduce the fiscal deficit and Central Bank losses, Costa Rica eliminated most of its agricultural subsidies, froze public sector salaries, and reformed the public pension system. It also renegotiated public debt, established limits for new borrowing, increased electricity, and telephone rates to better reflect production costs, and closed or privatized CODESA companies. On the revenue front, the value-added tax rate was increased and the tax base broadened, while cutting income tax rates and import tariffs. In spite of these fiscal measures, the combined public sector deficit (including Central Bank losses) oscillated between 2 and 4.5 until the beginning of the 1990s.

18. **Macroeconomic stabilization was complemented by trade reforms beginning in 1986, which reversed earlier import substitution and domestic support policies**. In the period 1986-90, emphasis, once more[3] was placed on nontraditional export promotion through the Law for Export Processing Zones (EPZ) and major tariff reforms that cut average tariff levels from 53 percent in 1985 to 16 percent in 1987. Costa Rica also established several institutions to promote the country and successfully attract foreign direct investment. Some of which were private non-profit partnerships like the Costa Rican Investment Board (CINDE), which was entrusted with promoting foreign investment, training farmers and marketing non-traditional products. Since 1990, the focus has shifted toward reducing the anti-export bias through greater import liberalization (by first joining GATT in 1989 and then eliminating most import licenses and quotas), and gradually phasing out export subsidies.

19. **Finally, during the mid 1980s some additional measures were taken to address the structural problems of Costa Rica's financial sector**. Controls on interest rates were lifted and the Central Bank of Costa Rica stopped influencing credit allocation among sectors. Private banking institutions were allowed to emerge and by the mid-1990s they were receiving all types of deposits from the general public. However, as Chapter 2 of this report will better illustrate, several reforms are still pending in order to address the current vulnerabilities derived from growing financial dollarization, far above the Central American region inflation and high levels of debt.

[2] UNDP (2001).

[3] Costa Rica started to promote nontraditional exports in 1981 through the Law for Industrial Parks and Export Processing Zones

1.4 The Theoretical Framework to Analyze Costa Rica Growth

20. **Several studies have argued the importance of productivity growth to economic growth.** Fajnzylber and Lederman provide evidence of a correlation between a country's rate of GDP growth and the total factor productivity contribution to that rate, by decomposing growth. They also argue that during periods of reform productivity, gains are higher. In their study they find that over the 1950-1995 period, Latin American countries grew 3.5 percent on average, but productivity contributed only 0.2 percentage points to that growth during the 1980's, productivity growth in LAC on average fell 1.7 percent, which helped to constrain the growth rate to only 0.8 percent, resulting in the so-called "lost decade." Costa Rica was not an exception, during the 1980's GDP grew at its lowest rate of the last forty years (2.4 percent), mostly due to an important decrease in total factor productivity (TFP) of minus one percent caused by the economic crisis of that time.

21. **In order to better understand the reasons behind Costa Rica's medium term growth performance, it is useful to begin with the application of the growth accounting framework.** Decomposing GDP growth (Y) into the growth of factor input quantities of capital (K), labor (L) and of total factor productivity (TFP)–a residual that captures changes in the "quality" of factors used and the efficiency of factor allocation–commonly known as the Solow residual method for growth accounting and is formally expressed with a Coob-Douglas production function as:

$$(1) \qquad Y = K^{\alpha} * L^{1-\alpha} * TFP$$

22. **TFP can be derived from Equation (1) as a residual.** The conclusions of this exercise are discussed in Section 1.5 based on the results of a comprehensive cross-country regional study carried out by Loayza, Fajnzylber and Calderón (2002) from the World Bank[4].

23. **Then, and in order to analyze the influence of economic policies on Costa Rica's growth**, the **study** takes a cross-country panel perspective by regressing per capita growth against a variety of economic, political, and social variables. Broadly speaking, such a relationship can be expressed as:

$$(2) \qquad Y_{it} = \alpha + \beta X_{it} + e_{it}$$

where Y_{it} denotes the rate of per-capita GDP growth in country i during period t, X_{it} denotes the vector of explanatory variables, e is a vector of random errors, and β and α are the equation parameters to be estimated. Assuming there exists a stable relation between the explanatory variables and per capita GDP growth, it is then possible to trace Costa Rica's performance in per capita growth (Y) to shortcomings in one of the explanatory variables (X) or to country specific shocks. Changes in per capita growth over different periods can now be explained with the estimated parameters of equation (1). Section 1.5.2 discusses the main implications for Costa Rica from this second exercise.

24. **The study by Loayza, Fajnzylber and Calderón (2002) carries out this regression analysis using panel data from 78 countries for the period from 1960 to 1999.** Different panel data sets are used in the regressions, depending on whether the data is averaged over the entire sample, over 5-year or 10-year intervals. The twelve explanatory variables were chosen on the basis of attention received in the academic literature and policy circles, as well as the robustness exhibited in previous empirical studies when tested in combination with other variables. These explanatory variables fall into five categories:

[4] Loayza, Fajnzylber, and Calderon (2002)

- ***a transitional convergence factor***, represented by the initial level of GDP per capita, which captures the notion that poorer countries grow faster than richer countries, other things equal, because of decreasing returns to scale in production functions;

- ***a cyclical recovery*** term, given as the gap between actual and potential output, which captures the tendency of growth to revert to a trend level, after periods of above or below-trend growth, typical of business cycles;

- ***structural policies and institutions,*** comprising indexes that measure educational attainment levels, financial depth, trade openness, government consumption, and public infrastructure[5];

- ***stabilization policies,*** comprising indexes to measure lack of price stability, output volatility, the risk of balance of payment crisis and the occurrence of systemic banking crises,[6] and

- ***external conditions,*** captured by the changes in the terms of trade and period-specific shifts that proxy for general world growth.

25. **It is important to note that the structural and stabilization policy variables used in the regressions described above refer to policy outcomes, rather than to policy settings or reforms.** For instance, the trade openness variable is the volume of trade (exports + imports) over GDP, rather than some index of tariff rates or quantitative restrictions. Similarly, the index used to measure the coverage of infrastructure is the number of fixed telephone lines per capita, rather than some index of success in privatization or strengthened regulatory capacity. In general, one expects GDP growth to be more closely related to policy outcomes than to policy reforms. On the other hand, the use of policy outcomes in the analysis requires that a link be established between specific policy measures or instruments and particular outcomes, before these analytic results can be translated into concrete policy advice.

1.5 Analysis of the Determinants of Past Growth and Productivity Gains

26. The key finding of the empirical analysis is that growth during the 1965-79 period was primarily driven by factor accumulation, with productivity growth playing, on average, a nil or maybe negative role; and that during the 1992-2004 period, factor accumulation played a smaller role, while total factor productivity (TFP) growth provided a significant positive contribution. The contrast between low or negative TFP growth during the first of these high-growth periods and positive TFP growth during the second of these high-growth periods is linked to the existence of efficiency enhancing reforms.

1.5.1 Growth Accounting

27. **Methods.** Table 1.4 reports the results obtained from the application of three growth accounting methods. The first, the traditional Solow decomposition, does not adjust for the "quality" of labor, (as measured by the stocks of human capital) and for the actual employment of capital and labor. The second method adjusts for changes in the quality of labor associated with increases in education. The third method adjusts for the rate of employment of capital and labor. The authors adjust for the degree of utilization of the capital stock by using, as a proxy, the rate of labor employment. Regarding labor, they

[5] The specific indicators used as proxy for the structural policy variables are: education (secondary enrollment), financial depth (private domestic credit over GDP), trade openness (trade volume over GDP), government consumption as percentage of GDP, and public infrastructure (main telephone lines per capita).

[6] The specific indicators used as proxy for the stabilization policy variables are: price stability (inflation rate), output volatility (std. deviation of output gap), risk of BOP crisis (real exchange rate overvaluation index) and the occurrence of systemic banking crises (fraction of years that a country undergoes a systemic banking crisis).

adjust for employment by, first, deducting from the working-age population the number of inactive and unemployed people and, second, adjusting for the number of hours actually worked.

Table 1.4: Costa Rica – Contribution to Output Growth (percent change)

	Output		Components of Growth		
Period	growth		Labor	Capital	TFP
(1) Traditional Solow Residual Method					
1961-70	6.05		3.33	1.86	0.87
1971-80	5.64		2.95	2.37	0.33
1981-90	2.41		2.31	1.02	-0.92
1991-00	5.25		1.80	1.48	1.98
Ave. 1961-00	4.84		2.60	1.68	0.57
(2) Solow Residual after Adjusting for Human Capital					
1961-70	6.05		3.25	1.86	0.95
1971-80	5.64		4.53	2.37	-1.26
1981-90	2.41		2.91	1.02	-1.52
1991-00	5.25		2.41	1.48	1.37
Ave. 1961-00	4.84		3.28	1.68	-0.12
(3) Solow Residual after Adjusting for Human Capital and Input Utilization					
1961-70	6.05		…	…	…
1971-80	5.64		…	…	…
1981-90	2.41		3.19	1.06	-1.84
1991-00	5.25		2.55	1.46	1.24
Ave. 1961-00	4.84		2.87	1.26	-0.30
Memo item:	**LAC average (Traditional Solow Residual Method)**				
1961-70	5.08		1.67	1.94	1.53
1971-80	4.69		1.80	2.36	0.68
1981-90	1.21		162	0.98	-1.31
1991-00	3.54		1.54	1.32	0.70
Ave. 1961-00	3.63		1.66	1.65	0.47

Source: Loayza, Fajnzylber & Calderón (2002)

28. **Labor.** As shown in Table 1.4 above, the results of using the traditional Solow production function reveal that the growth of labor has been the main factor contributing to GDP growth for most of the last twenty-five years, except during the 1990s where TFP growth accounts for an important share. The labor component contributed an average of 2.60 percent per year to output growth during the period 1960-2000, compared to an average of 1.66 percent for LAC as a whole. Although the contribution of labor increases when adjusting for the level of educational attainment of the population (second method) as well as for the rate of labor utilization (third method), TFP accounts for an increasing share during the nineties with a contribution to growth oscillating between 24 and 38 percent depending on the method employed.

29. **Why did labor contribute so much in the 1960s and 1970s and less in the 1990s? To understand this one must look at the increase of the participation of women in the labor force that took place between 1960s and the late 1980s.** This increase was prompted by better levels of educational attainment in the female population that was entering the labor force, which not only increased the availability of labor as percentage of the population during those decades, but also improved its quality as working women in Costa Rica are on average better educated than men. Unfortunately the pace of this trend during the nineties was much slower than those of previous decades: female participation in the labor force in Costa Rica almost doubled from 1960 to late 1980s increasing from 16 to 28 percent, but only increased to 31 percent in 2000 according to ILO figures. It is therefore difficult to expect that in the medium term labor will increase its contribution to Costa Rica's output growth.

30. **Capital.** Physical capital growth contributed an average of 1.68 percent per year to growth during 1960 and 2000, compared to an average of 1.65 percent for the LAC Region. Therefore, it does not appear that Costa Rica is significantly constrained by low investment levels compared to the average Latin American country, but as we will explain in the next paragraph, it is low compared to other countries of its income level. Capital accumulation increased its contribution to growth during the 1990s with respect to the previous decade by 0.5 percent, because of greater private investment much of which was in the form of foreign direct investment. As explained at the beginning of this chapter, the high capital accumulation during the seventies was the result of the proliferation of public enterprises that were later closed or privatized due to the substantial losses they generated. This is consistent with a number of studies that suggest that there is an important link between capital accumulation and total factor productivity growth, indicating that efforts to improve capital accumulation will tend to improve the productivity of the economy[7].

31. **Notwithstanding its important role in fostering economic growth, capital accumulation in Costa Rica is still relatively slow when compared to countries within the same income level.** In 2004, investment as percentage of GDP in Costa Rica was 18 percent, less than the Latin American average of 20 percent and much less than other upper middle countries like Chile (23 percent), Mexico (22 percent) and the Czech Republic (25 percent). Due to the fragility of Costa Rica's fiscal position and already high levels of public debt, the country would benefit from fostering private sector investment in key **infrastructure** projects.

32. **Total Factor Productivity.** As we have seen, in the 1990s Costa Rica experienced much faster rates of GDP growth than in the 1980s, driven mostly by unprecedented increases in the rate of growth of total factor productivity. The contribution of TFP to overall growth increased to 1.3 percent from -1.5 percent in the 1980s. This is an important result as TFP growth is generally the result of a continuous process of input (i.e. capital and labor) reallocation to the sectors of the economy with higher productivity gains. TFP growth also reflects the adoption of new technologies and innovation that improve input utilization without requiring huge increases on input supply. As a result, it has been found that the changes in total factor productivity growth better explains the changes in output growth over long periods in comparison to the accumulation of labor or capital[8].

33. Although the 1990s was a decade of reform and recovery in LAC, according to Loayza et al. (2002) only in a few instances (Argentina, Chile, El Salvador and Costa Rica) did the recovery in the 1990s resulted in economic growth rates that surpassed those of the 1960s and 70s. These countries have in common that they conducted important market-oriented reforms and/or accomplished important processes of economic and political stabilization.

1.5.2 Growth Determinants

34. **The importance of the structural reforms are better illustrated by considering the results of an empirical model that explains the difference in per capita growth rates during the 1990s between Costa Rica and Chile** (Table 1.5). As explained in more detail in Section 1.4 above, the difference in per capita growth rates is attributed to various factors that include five indexes that measure educational attainment levels, financial depth, trade openness, government consumption, and public infrastructure. The aggregate contribution to growth of these five policies is presented as the "Structural Policies" variable in Table 1.5.

[7] Easterly and Levine (2003); Klenow and Rodríguez-Clare (1997).

[8] Fajnzylber and Lederman (1999); Barro (1999); Grossman & Helpman (1993).

35. **Chile was the best performing country in LAC during the 1990s in terms of per capita growth rates with an average of 5 percent during the decade, outperforming Costa Rica by over 2 percentage points.** Even though Costa Rica undertook several important reforms since the mid 1980s, it is clear from Table 1.5 that the deeper structural policies accomplished by Chile during the decade are the most important factor behind the differences in per capita growth rates between both countries. Transitional convergence also appears as an important factor behind differences in growth, but it plays a role in the opposite direction due the fact that Costa Rica is a poorer country in per capita terms. Transitional convergence implies that poorer countries grow faster than richer countries (all else held constant) because poorer countries are further away from the forefront of the technology frontier and can adopt new technology at a faster rate than richer countries that are already close to the frontier. Transitional convergence adds about 0.54 percentage points to Costa Rica's growth rate compared to Chile's during the 1990s.

Table 1.5: Explaining Differences in Growth Rates Between Chile and Costa Rica During the 1990s

Chile Per Capita Growth (average 1991-2000)	4.81
Costa Rica Per Capita Growth (average 1991-2000)	2.92
Observed Difference	**1.89**
Projected Difference	**1.69**
Structural Policies	2.13
Cyclical Reversion	0.12
Stabilization Policies	0.09
Country-Specific Effect	0.02
External Conditions	-0.13
Transitional Convergence	-0.54

Source: Loayza et al. (2002)

36. **The main component of the per capita output growth experienced in Costa Rica during the 1990s was substantial increases in total factor productivity growth, even after adjusting for human capital and input utilization.** As this is not the case for all countries in the LAC region, one can expect that the structural reforms experience by Costa Rica during the late eighties and early nineties are a decisive factor behind its higher than average growth and productivity rates observed during this period. But as the comparison with Chile suggest, Costa Rica could still benefit from deeper structural policies to achieve higher rates of per capita output growth.

37. **Which reforms have caused higher growth in Costa Rica during the 1990s with respect to the 1980s?** In an effort to identify a menu of policy options available for the country the next paragraphs explore in more detail the reforms. The methodology used above to explain the difference in growth rates between two different countries, can also be applied over time but within a single country in an effort to derive the contribution from structural and stabilization policy variables to past changes in growth. Table 1.6 presents the results of carrying this exercise for Costa Rica, including the predicted and actual changes in average per capita GDP growth observed in the 1990s with respect to the 1980s.

38. **According to the regression equation, the projected change in per capita growth in the 1990s should have been on average 1.13 percentage points higher that that in the 1980s.** The actual change (3.3 percent) in per capita growth over both decades turned out to be higher as Costa Rica's economy swing from an annual decline of -0.4 percent during the eighties to 2.9 percent during the nineties, after experiencing a sharp recovery from the economic crisis of the 1980-85 period. But if compared to the non-crisis period of 1986-1990, the improvement was 1.32 percent, much closer to

predicted change of the model used in Table 1.6. It is still reassuring to observe that the projected change in growth rates for those decades have the same sign as the changes in actual rates, indicating that changes in growth over time are not completely due to random shocks but rather that Costa Rica can influence long-run growth.

Table 1.6: Costa Rica Changes in Per Capita Growth 1990s vs. 1980s

Projected change in per capita growth[9]	**1.13**
Transitional Convergence	**-0.19**
Cyclical Recovery	**0.36**
External Conditions	**-0.31**
Terms of Trade	0.17
Period Shifts	-0.48
Structural Policies and Institutions	**1.12**
Trade Openness	0.41
Infrastructure	0.36
Reduction in Government Consumption	0.26
Education	0.17
Financial Depth	-0.09
Stabilization policies	**0.15**
Systemic Banking Crisis	0.29
Inflation	0.04
RER overvaluation	-0.02
GDP Volatility	-0.16
Memo Items	
Average Per capita growth during 1990s	2.92
Average Per capita growth during 1980s	-0.42
Actual change in per capita growth	3.34

Source: Loayza et al. (2002)

39. **The first important result in Table 1.6 is that the increase in per capita growth in Costa Rica is essentially due to structural policies.** These policies in the areas of Trade Openness (contribute the most to growth by 0.41 percentage points), Infrastructure (0.36 percentage points) and reduction in the Government Consumption (0.26 percentage points). Education contributes a modest 0.17 percentage points to per capita growth reflecting the already high secondary enrollment levels achieved in Costa Rica since the early 1980s[10]. With regard to macroeconomic stabilization policies, the absence of systemic banking crisis during the nineties stands as the most important contributor to Costa Rica's per capita growth, follow distantly by the moderate reduction in average inflation observed between both decades.

40. **CAFTA promises to be an important tool to ensure that trade-led growth continues to play an important role in Costa Rica's future**. CAFTA is likely to improve growth levels for the participating countries in Central America due to the expected positive effects on trade and investment

[9] The table explains the changes (increase or decrease) of average growth rates between decades.

[10] This does not imply that Costa Rica could benefit more from improving the "quality" of basic and secondary education.

levels. Greater trade levels will arise, consolidating and in some cases expanding the preferential market access that Central American countries have enjoyed in U.S. markets through the Caribbean Basin Initiative (CBI) program. CAFTA is also expected to deepen regional trade integration among the Central American nations themselves and would additionally promote greater levels of foreign and domestic investment, by improving the certainty of these countries' market access with the U.S., strengthening the broad economic reforms of the past years and prompting further reform efforts. But as suggested by recent World Bank research in this area, a complementary agenda to optimize the growth impact from CAFTA in Costa Rica must address infrastructure and macroeconomic and financial issues[11]. Furthermore, as Costa Rica continues to integrate into world markets, there is a need to intensify efforts at enhancing innovation and technology adoption, given that these are necessary to seize and maximize the gains from international integration

41. **The recent overall deterioration in the state of Costa Rica's infrastructure presents important challenges to future long-term growth.** As explained in more detail later in this CEM, the provision of infrastructure services is still dominated by public companies and agencies. The state is a major provider of telecommunications, electricity, roads, and ports services and the increased need for fiscal austerity is creating investment gaps in several areas. The deteriorating performance of Costa Rica's infrastructure is most acutely felt in the key transport inputs to competitiveness such as ports and roads. Therefore, in order to avoid worsening transport infrastructure and non-competitive utility services becoming potential constraints to Costa Rica's growth in the years ahead, Costa Rica could make greater use of the private sector in the financing and operation of its infrastructure networks.

42. **As shown in Table 1.6, a sustainable public sector and a stable macro-financial environment has an important role to play if Costa Rica is to maintain or improve the average per capita growth rates observed during the 1990s.** The government consumption proxy used in the estimation exercise reflects the lower public debt and fiscal deficit levels attained in Costa Rica during the 1990s with respect to the previous decade. On the financial front, it is not surprising that the lack of financial depth negatively contributes to per capita growth during the nineties in spite of the partial reforms that were taken, as Costa Rica's financial sector still present weaknesses by international standards with high intermediation spreads and interest rates.

1.6 Summary and Conclusions

43. **Due to its relative macroeconomic environment, openness to trade and capital flows, Costa Rica has grown at a faster pace than countries with similar income levels.** Moreover, low levels of output volatility have accompanied the above average performance in the growth front. In terms of per capita income, growth and growth volatility Costa Rica is in the upper third of the middle-income countries group, and only a few Latin American countries can show a better growth performance and higher per capita income. Costa Rica's average growth rate in the last fifteen years (1990-2005), is the highest in Central America, the 6th among Latin American countries and the 20th among middle income countries at a global level.

44. **Growth of labor and capital inputs account for most of the Costa Rican growth in the 60s, 70s and 80s, while in the 90s total factor productivity accounted for a significant share of total output growth**. The recent increase in total factor productivity growth can be attributed to several structural reform efforts made since the mid-1980s including trade, public sector consolidation, infrastructure investment and partial liberalization of the banking system.

[11] World Bank (2005).

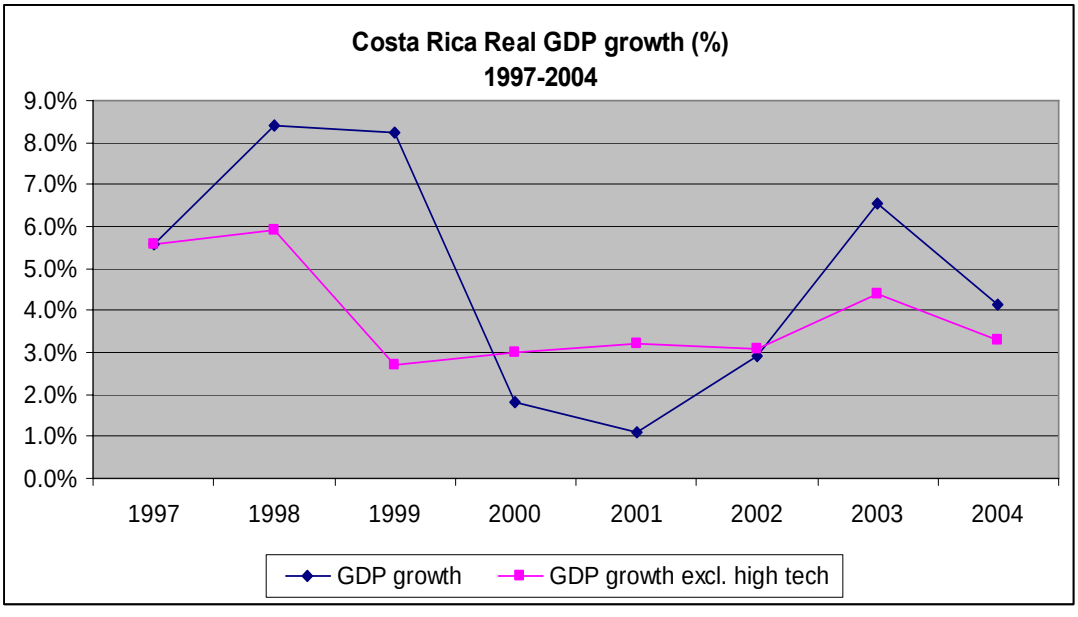
45. **Despite the achievements seen in Costa Rica over the last five years, the country has been loosing ground in several areas jeopardizing prospects to improve the type of growth performance that was able to achieve in past decades.** During the last five years (2001-2005) the annual average growth rate of 4 percent has been accompanied by a widening current account (4.5% on average), high fiscal deficits (4.4% on average), growing dollarization and double digit inflation, while high public sector debt levels (53.6% on average) raises concern about its sustainability. To reverse this trend, greater trade openness should be complemented by a myriad of policies in key areas with a bearing on growth and poverty reduction: macroeconomic and financial vulnerabilities, infrastructure bottlenecks, and innovation. The remaining chapters of this Country Economic Memorandum provide an in depth look at these three areas.

Box 1.2 Costa Rica's GDP Statistics in the Presence of Major Exporting Companies

The fact that several of the biggest companies in Costa Rica are inside Export Processing Zones (EPZs) raises a question on the level of integration they have with the local economy, specially in the presence of high tech companies like INTEL that are relatively huge with respect to the rest of the economy. To illustrate this issue, the chart below shows GDP growth rates including and excluding the high technology sector since 1997 (one year before INTEL began operations). It is clear from the chart that total GDP growth rates, including the technology sector, are more volatile than those excluding it, imposing an important upward or downward bias in the rate of GDP growth. In fact, output volatility increases in Costa Rica when using total GDP figures to calculate it.

The above bias will not have major implications if high tech companies in Costa Rica exhibit a high degree of integration with the local economy. But as reported by Jenkins (2005), high tech companies in Costa Rican EPZs bought from the local economy only 26 percent of all the intermediates used in production. In the analysis of Costa Rica's economic growth during the 1950-2000 period, Rodríguez-Clare et al. (2003) explicitly adjust GDP growth series to reasonably reflect INTEL's contribution to the Costa Rica's GDP, based on the observation that the company's profit rates are substantially higher than Costa Rican standards.

There is little doubt that the presence of such companies generates benefits and positive externalities for the rest of the Costa Rican economy (see Jenkins-2005, Larraín et al. 2000 among others). However, when using total GDP figures for analytical purposes one should make sure that the conclusions observed are also true for the rest of the local economy and not merely the reflection of the behavior of a handful of companies.



Source: :World Bank staff calculations.

Chapter 2 Assessing Macro-Financial Vulnerabilities: The Downside Risks to Growth Stemming from Financial Dollarization and Public Debt Dynamics[1]

2.1 Introduction

1. **This chapter analyzes two potential sources of macro-financial vulnerability—financial dollarization and public sector debt dynamics—that can adversely affect future growth**. In contrast with other chapters in this CEM, which generally discuss policy areas that could boost the upside potential for Costa Rica's long run growth, this chapter focuses on downside risks to growth. It analyzes the nature and relevance of vulnerabilities arising from (i) un-hedged currency mismatches in debtors' balance sheets—a phenomenon associated with the high degree of dollarization of financial contracts—and (ii) concerns regarding the sustainability of public sector debt. The chapter also examines the linkages and feedback loops between these two, seemingly different but fundamentally interrelated, sources of downside risks to growth. The chapter also discusses the associated policy challenges and options.

2. **Given these sources of vulnerability, the commendable macroeconomic and financial stability achieved in past decades should not be taken for granted going forward.** Costa Rica registered notable macroeconomic and financial stability in the past two decades, compared to other middle-income countries in the region. In particular, it avoided the type of currency, banking, and/or debt crises that have ravaged emerging economies elsewhere. This should not be a reason for complacency, however, as it masks sources of tension, not least in respect of public sector debt and financial dollarization. As Costa Rica continues to integrate into international financial markets, moreover, these sources of tension can become even more treacherous by increasing the potential for financial turbulence.

3. **In effect, the current crawling peg regime, which has served Costa Rica well in the past, is promoting inflationary inertia and dollarization, which increases the scope for output volatility and renders the financial system more vulnerable to shocks.** The crawling peg exchange rate regime—which has been in effect for over 20 years—commands considerable credibility in the country and may be credited for having avoided large real exchange rate overvaluations and currency crises. However, by *trading short-term real certainty against long-term nominal uncertainty* (through the systematic targeting of the real exchange rate, rather than inflation), the crawl has further tightened the link between inflationary expectations and the exchange rate and promoted dollarization. As a result, Costa Rica displays a relatively high pass through of exchange rate movements to prices, which limits the ability to induce a real depreciation at a moderate cost in terms of inflation. Financial dollarization, for its part, has been on an increasing trend. At present, around 70 percent of loans in the combined onshore and offshore banking system are dollar-denominated. Consequently, un-hedged currency mismatches in debtor balance sheets are widespread, with at least half of the dollar loans estimated to be loans to debtors in the non-tradable sector. This makes the solvency of the financial system vulnerable to large real exchange rate devaluations and heightens interest rate volatility and pro-cyclicality (interest rates increase during downturns), thereby compounding the adverse effects of economic slumps on borrowers' debt servicing capacity. In addition, the high deposit dollarization raises banks' exposure to liquidity risk and makes quantity adjustments (deposits and international reserves), rather than price (exchange rate) adjustments, the first line of defense against adverse systemic shocks.

[1] This chapter was prepared by Augusto de la Torre (LCRCE), on the basis of a background paper written by Mr. Guillermo LeFort (consultant) and with contributions from Ana Lucia Armijos.

4. **In addition, in the absence of a significant and permanent increase in fiscal revenues, the primary fiscal surplus achieved historically appears difficult to sustain in the future, with the risk that a vicious circle of low growth and deteriorating debt viability could emerge.** The historical primary fiscal surplus, averaging more than 1 percent of GDP in the past 5 years, has succeeded in stabilizing the combined central government and central bank debt at around 50 percent of GDP. This debt level and the historical average of the primary surplus, however, are not a source of comfort going forward. In effect, the already high debt level has a potential of increasing in a low growth scenario, especially if contingent pension liabilities were to materialize. In addition, the level of public debt would have been even higher had it not been for the continued use of monetary financing to cover part of the central bank losses, but such financing has in effect set a floor to the reduction of inflation. Moreover, the primary surplus has been achieved to date mainly through unsustainable expenditure compression, not just of investment expenditures but also of recurrent expenditures, including tight control of the wage bill. This expenditure squeeze has bottled up social and political pressures that will have to be acknowledged sooner or later, especially through increased investment in physical infrastructure, education, and health. Furthermore, the buildup of pressures to increase public investment has coincided with the absence of political consensus for tax reform, without which the ability of the government to maintain the current primary surplus (let alone to increase it) in the future is in doubt.

5. **To achieve the primary surplus objective, a permanent increase in the ratio of fiscal revenue to GDP appears necessary, otherwise the government may feel compelled to obtain resources from public enterprises (e.g., by requiring them to pay dividends or by taxing their income).** But this could undermine the already low level of infrastructure investment, which might create a vicious circle where low investment and growth lead to low fiscal revenue and rising concerns about debt viability which would, in turn, further erode investment and growth. Given the mentioned pressures to raise public investment, even if a tax reform were approved, it would be politically difficult to allocate a significant portion of the additional revenues to increasing the primary surplus. The foregoing considerations highlight the complexity of the policy challenges and are particularly worrisome in light of the analysis later in this chapter, which shows that that, to ensure debt sustainability under a reasonably wide range of states of the world, a much higher primary surplus than in the past is needed in the future (at least 2.5 percent of GDP per year on average) for the combined balance of the central government and central bank.

6. **Moreover, the downside risks of financial dollarization are not independent of debt sustainability concerns.** In effect, inflation volatility, which is a key driver of financial dollarization, is also a function of risk perceptions regarding the fiscal process—i.e., concerns that the government might have to resort to increasing inflation tax to finance the budget. Moreover, dollarization weakens the demand for domestic money, which is the base of the inflation tax. As a result, increases in inflation and dollarization can reduce monetary financing, requiring a higher than otherwise primary surplus to maintain debts sustainability. Additionally, to the extent that financial dollarization makes the financial system more vulnerable to crises, it raises the chances of government bailouts of depositors and, hence, the government's contingent liabilities. In all, the connections between inflation, dollarization, vulnerability to crises, money demand, and the scope for monetary financing creates strong interactions between dollarization and public debt sustainability.

7. **A better understanding of the nature and extent of the threats to growth posed by financial dollarization and public debt dynamics is thus needed, and it must inform growth-oriented policies.** The previous chapter in this CEM already signaled the advisability of considering macroeconomic and financial issues when discussing Costa Rica's growth potential. The empirical results therein suggest that, while structural reforms leading to greater trade openness have been a key driver behind the increase in per capita income growth from the decade of the 1980s to the decade of 1990s, real exchange rate overvaluation, growth volatility, and insufficient financial development have exerted a negative influence

on growth (see Table 1.6). This chapter will shed light on the channels through which problems in debt dynamics and risks associated with financial dollarization could exacerbate the adverse effects on growth of exchange rate overvaluation, output volatility, and financial shallowness.

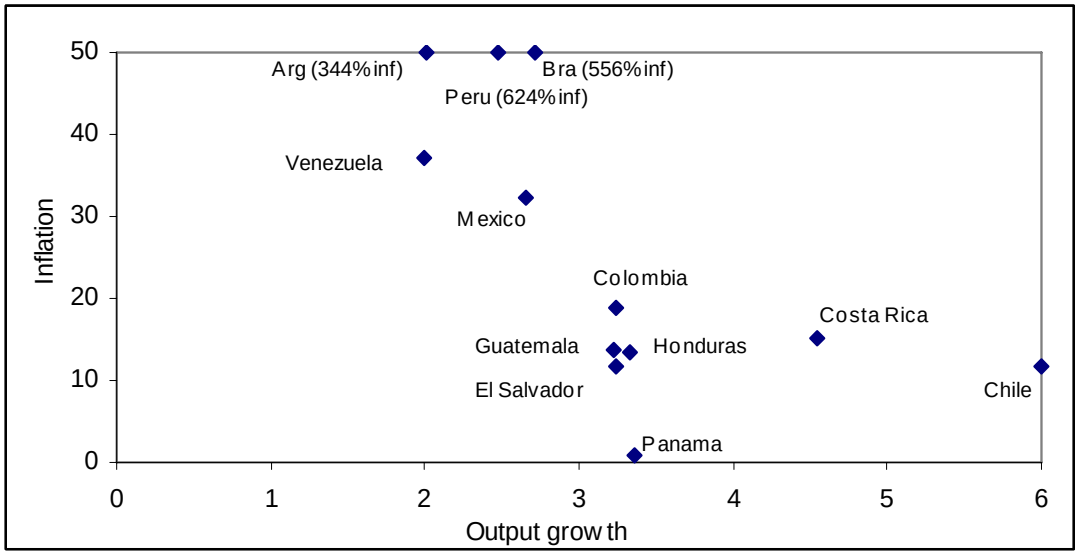
2.2 Relevant Stylized Facts and Trends in International Comparison

8. **This section describes stylized facts and trends that are relevant to macro-financial vulnerability in Costa Rica, placing them in international perspective**. In particular, it looks at developments in levels and volatilities of inflation, the real exchange rate, and output growth, as well as in financial dollarization, monetization, currency mismatches, and public sector debt. By doing so, this section sets the stage for the analysis of the potential downside risks to growth posed by financial dollarization and public debt dynamics.

2.2.1 *Macroeconomic Volatility*

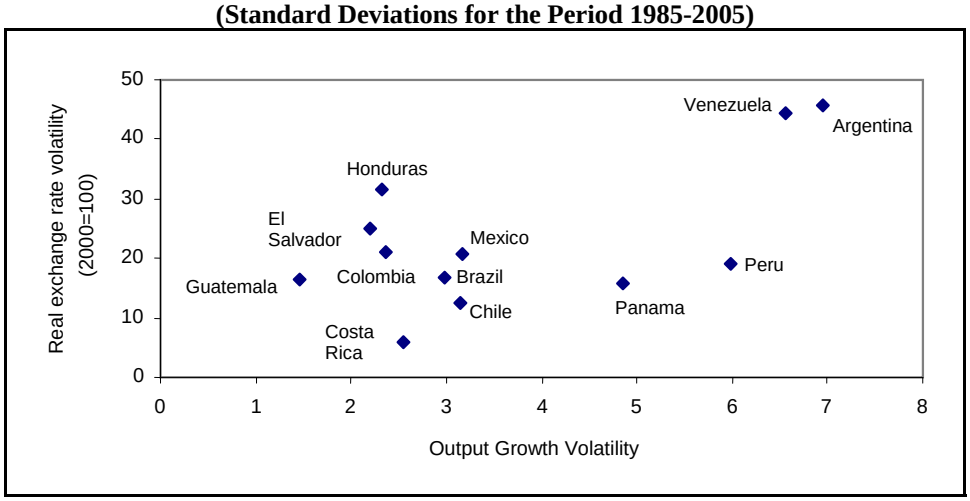
9. **Historically, Costa Rica has had a historical record of substantial output growth with relatively low macroeconomic volatility.** Costa Rica's comparative growth performance was examined in detail in the previous chapter. In this chapter it is of interest to note that such relatively strong growth performance over the past two decades was achieved at a relatively low inflation rate by Latin American standards (Figure 2.1). In addition, despite having been subject to relatively high volatility in its terms of trade, the volatility in output growth and the real exchange rate in Costa Rica have been low by regional standards (Figure 2.2). Moreover, Costa Rica has not suffered devastating currency or banking crises like other countries in the region. Since the early 1980s, and with the exception of a short-lived period of exchange rate float in the mid-1990s, there have not been any major jumps in the exchange rate, while adjustments in the peg have become rather smooth and nearly continuous since January 1985. This good growth performance with low macro-financial volatility has been anchored on a stable policy environment (with fiscal and monetary policies having avoided stop-go patterns) and a high and growing integration into the world economy.

Figure 2.1: Output Growth and Inflation, Various Countries
(Annual Averages for the Period 1985-2005, in Percent)



Source: WDI and IFS.

Figure 2.2: Growth and Real Exchange Rate Volatilities, Various Countries (Standard Deviations for the Period 1985-2005)

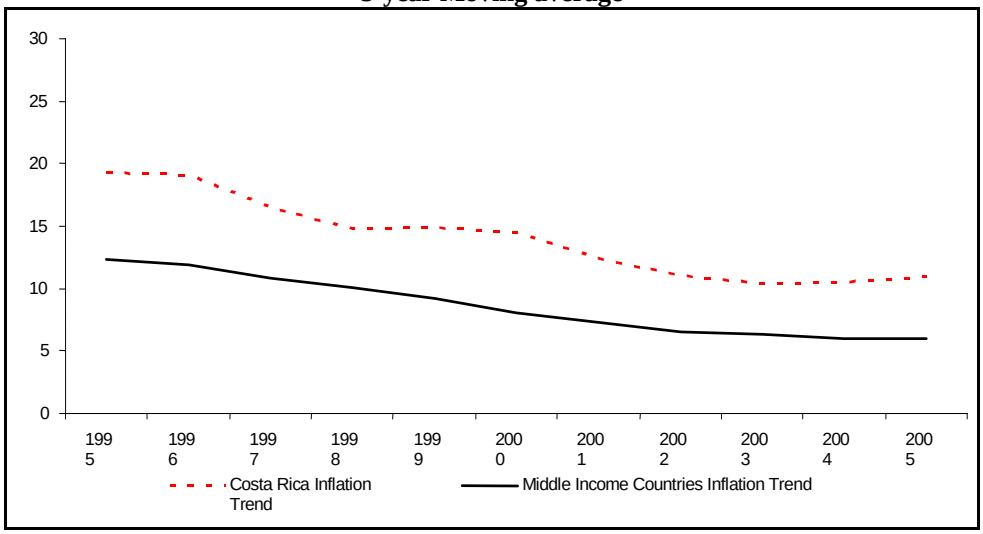


Source: WDI and IMF

2.2.2 Inflation

10. **Inflation has been on a declining trend since the late 1980s but reached a plateau in recent years, at around 12 percent, which is high relative to comparable middle-income countries**. To place Costa Rica's inflation performance in an international perspective, we use as peer group a set of 54 middle-income countries (with per capita income between 5,000 and 15,000 dollars) and consider the period 1990-2005. That group excludes countries with average inflation rates in excess of 50 percent for the period. The inflation trend (5-year moving average) in Costa Rica has declined over this period from about 20 to 12 percent, more or less in parallel with that of peer group, but has remained consistently above the peer group's trend by about 5 percentage points throughout the period (Figure 2.3).

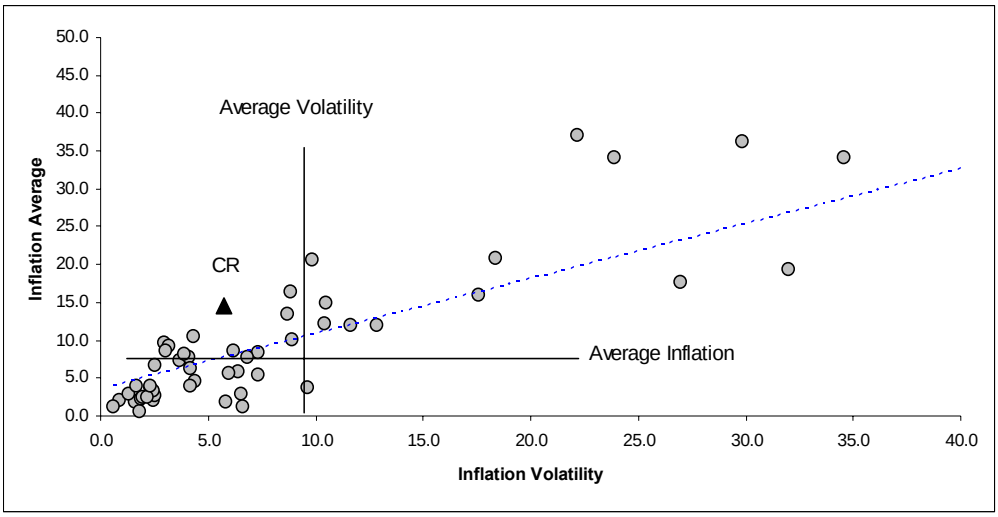
Figure 2.3: Inflation Trends: Costa Rica and Peer Group 5-year Moving average



Source: IMF WEO and IFS.

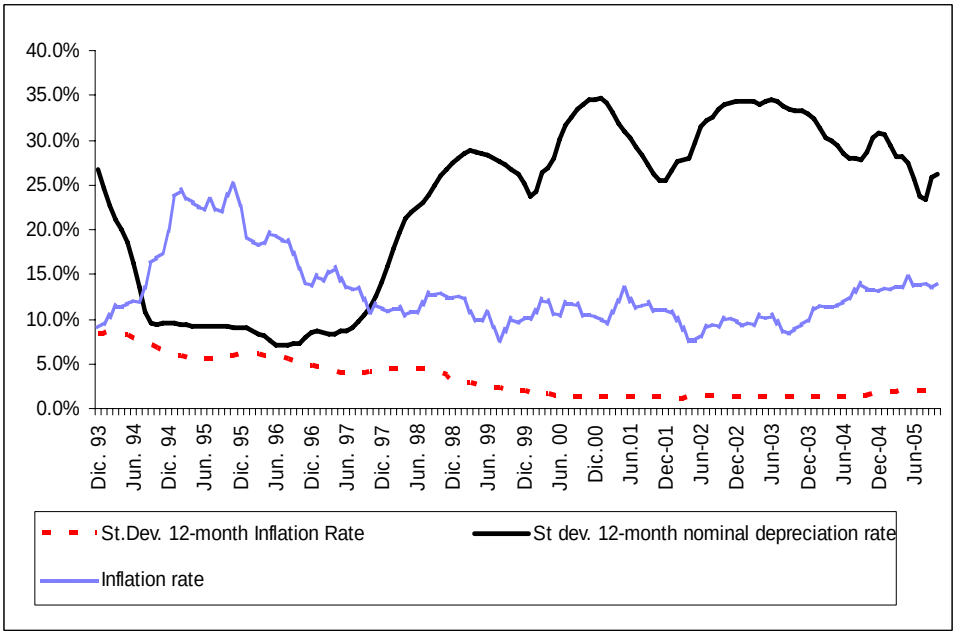
Given the well known correlation between the rate of inflation and its volatility (Figure 2.4), as Costa Rica's inflation has fallen, so has its volatility. In effect, the standard deviation of Costa Rica's inflation, using a three-year moving window, fell throughout the 1990s from around 8 percent to around 1 percent, although it started to increase in mid-2004 (Figure 2.5)

Figure 2.4: Inflation Average and Volatility in Middle Income Countries.



Source: IMF WEO and IFS

Figure 2.5: Costa Rica: Standard Deviation, 12-month inflation rate and 12-month Nominal Depreciation Rate and Inflation Level (Three Year Moving Window)



Source: IMF WEO and IFS.

2.2.3 Financial Dollarization and Un-hedged Currency Mismatches

11. **Financial dollarization is widespread in Costa Rica. At present, deposit dollarization in the combined offshore and onshore banking system stands at over 62 percent (Table 2.1).**[2] The share of dollar loans is even higher, around 70 percent, as dollar loans are funded not just through dollar deposits but also through other bank liabilities. The consolidated private banking system (adding the onshore and offshore segments) is much more dollarized than the public banking system—nearly 80 percent of private bank loans are in dollars, compared to less than 50 percent in the case of public banks. Deposit dollarization has grown despite a shift in interest rate differentials in favor of colón deposits caused in part by the relative abundance of local dollars. This increase in the funding cost of colón loans, together with high intermediation spreads in local currency, has raised the cost of colón loans, inducing dollar loans to expand across the board, including to consumer loans and mortgages. The higher debt service burden of colon loans (deriving from high nominal interest rates and flat amortization schedules) further depresses their demand. Financial dollarization extends beyond banking loan and deposit contracts. A large share of public sector debt is dollar denominated (see below), and so are the lion shares of mutual and investment fund assets.

Table 2.1: Costa Rica: Deposit Dollarization
(Ratios of Dollar Deposits to Total Deposits)

Year	Private Banks Onshore	Public Banks Onshore	Onshore Banking System	Private Banks Onshore and Offshore[1]	Banking System Onshore and Offshore
2000	46.77	42.66	43.59	70.80	52.43
2001	53.24	45.61	47.54	77.29	58.63
2002	59.68	42.91	47.27	78.84	57.31
2003	60.25	41.44	46.52	77.48	55.69
2004	62.48	49.97	53.29	78.33	60.88
2005	65.44	48.94	53.70	78.96	61.90

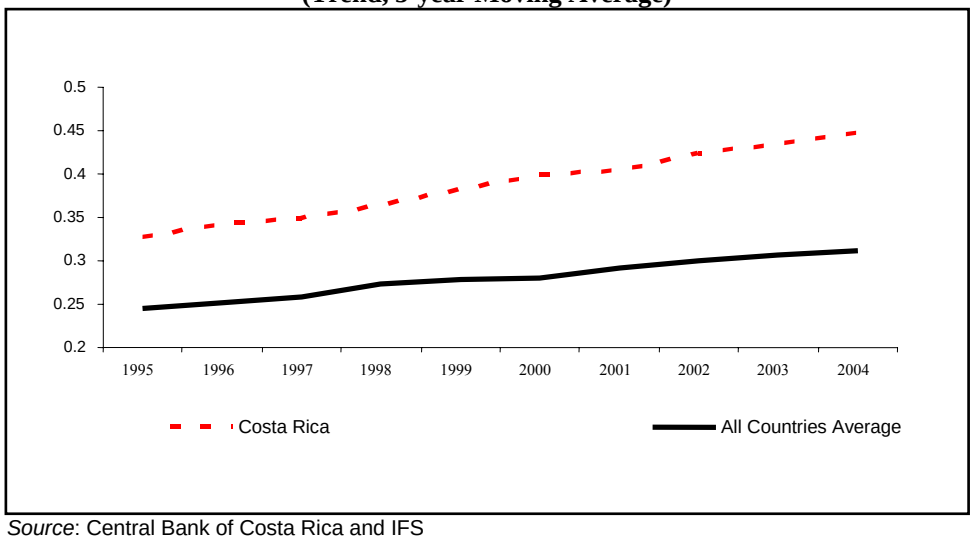
Note: (1) Mainly private banks have off shore deposits.
Source: Central Bank of Costa Rica

12. **Moreover, Costa Rica's financial dollarization is high by international standards and has been rising steeply over the past decade, although the use of banking system data alone overstates the steepness of the dollarization trend.** Due to data series limitations, however, we describe financial dollarization trends and international comparisons only in terms of onshore banking deposits. Costa

[2] In contrast with traditional offshore banking centers, which mainly serve non-residents, the Costa Rican offshore banking system serves mainly domestic residents. Costa Rica's is a relatively large offshore banking system, accounting for about one-fourth of total (onshore and offshore) banking assets. Costa Rica's offshore banks are licensed in foreign (mainly Caribbean) jurisdictions but conduct most of their deposit taking and lending activities with Costa Rican residents and are, therefore, fully woven into the country's domestic financial and economic activity. Offshore banking is a salient feature among private financial groups (assets of private offshore banks are almost of the same size are the assets of their corresponding onshore banks). Public commercial banks in Costa Rica—whose presence is unusually large as they account for nearly 70 percent of total onshore bank assets—have relatively minor offshore activities. As onshore banks are legally allowed to take dollar deposits and make dollar loans, offshore banks are currently mainly used for tax avoidance, regulatory arbitrage, and to better protect depositor identity. Offshore banks grew rapidly in the initial stages of private banking (the banking sector was a state monopoly until the mid-1990s), in response to high unremunerated reserve requirements (over 28 percent in 1995) and reflecting private banks' search for a competitive edge against public banks. However, offshore banks' growth seems to be tapering off (information on offshore banks is limited; it became available since end-2000), following a substantial reduction in reserve requirements, concerns about the negative connotations of offshore banking, and aggressive competition in the dollar funding market by mutual funds and public banks.

Rica's average ratio of dollar deposits to total deposits for the period 1990-2005 is well above the mean of its peer group of middle-income countries, ranking 21st among 58 countries. Among Latin American countries, furthermore, Costa Rica is the sixth more dollarized, following Uruguay, Peru, Paraguay, Argentina, and Suriname[3] (Annex 1 Table A1.4). The proportion of dollar deposits in total onshore deposits in Costa Rica rose from the equivalent of 10 percent of GDP (1995) to 20 percent of GDP in 2005. Note, however, that the jump in the bank deposit dollarization from 2003 to 2004 (Tables 2.1 and 2.2) does not necessarily reflect an increase in overall financial dollarization in the country. Rather, it seems to reflect mainly a major shift of dollars from mutual funds to bank deposits that took place between March and May 2004 as investors sought to avoid capital losses in the face of a decrease in the price of Costa Rican (central government and central bank debt). (Public sector debt accounts for the lion's share of mutual fund portfolios in Costa Rica.). On a trend basis (5-year moving average), Costa Rica's deposit dollarization has not only exceeded significantly that of the peer group, but the difference has been widening over time (Figure 2.6).

Figure 2.6: Ratio of Foreign Currency Deposits to Total Deposits (Trend, 5-year Moving Average)



Source: Central Bank of Costa Rica and IFS

13. **While there are no available data on un-hedged currency mismatches in debtor balance sheets, estimates of dollar-denominated loans to the non-tradable sector suggest that such mismatches are fairly substantial.**[4] Where financial savings, and hence bank deposits, are dollarized, banks have little choice but to lend in dollars to local residents (unless required by regulation to invest dollar deposits only in foreign assets). They do so as natural way to maximize their profit margin while avoiding currency mismatches in their own balance sheets. This effect is reinforced by typical prudential regulations that limit banks' direct exposure to currency risk. Hence, in financially dollarized countries, the problem of un-hedged currency mismatches normally resides not in banks but in the balance sheets of households and firms—which, of course, exposes banks to real exchange rate-induced credit risk.

14. **Costa Rica is no exception in this regard**. Available estimates suggest that, at present, over 50 percent of total onshore dollar loans (equivalent to more than 10 percent of GDP) are to households and firms whose income is derived from the non-tradable sector, and that the share of onshore dollar loans to

[3] This ranking excludes countries that have formally adopted the US dollar as their currency.

[4] The estimates of dollar loans to firms and households whose income is mainly derived from the non-tradable sector were obtained from a joint document by the Superintendency General of Financial Entities (SUGEF) and the Central Bank, written by Villanueva and Villalobos (2002).

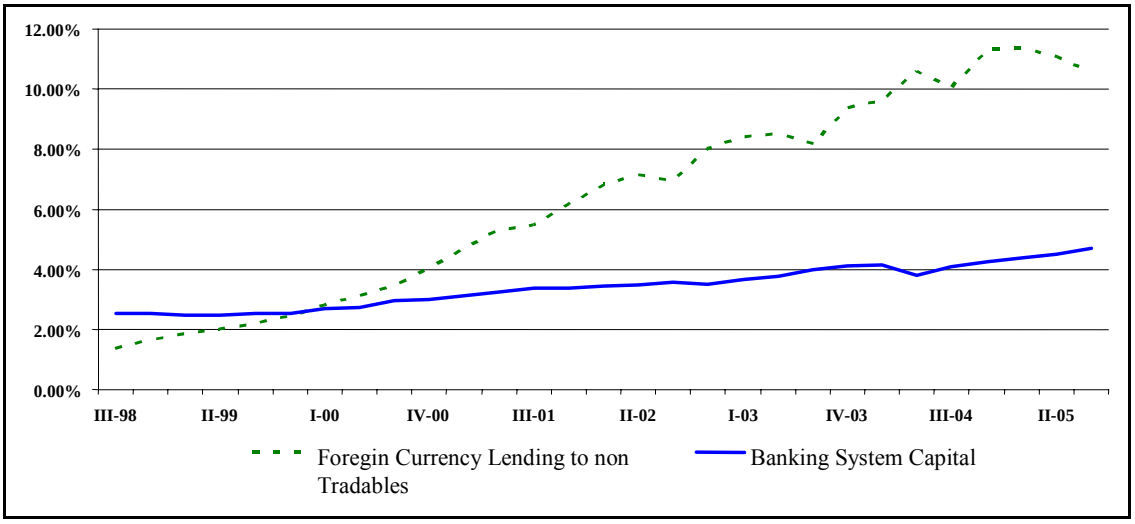
the non-tradable sector has been increasing fast over the past six years (Table 2.2). Given the undeveloped market for exchange rate derivatives, it is reasonable to assume that most of these loans imply an un-hedged exposure to real exchange rate risk in the respective debtors' balance sheets. The implied exposure of banks to real exchange rate induced credit risk is substantial, as dollar loans to the non-tradable sector are now more than twice banking system capital (Figure 2.7). Moreover, the estimate un-hedged currency exposure in debtors' balance sheets obtained indirectly, via onshore loans to the non-tradable sector, constitutes denominated in dollars) is widely acknowledged to go also to the non-tradable sector.

Table 2.2: Currency Mismatches in Onshore Debt to Banks (% of GDP)

Year	Deposits in Foreign Currency (1)	Bank Loans in Foreign Currency (2)	Net FC Bank Assets (2)- (1)	FC Loans to the Non-Tradable Sector
1995	9.02%	2.67%	-6.35%	
1996	10.38%	3.24%	-7.14%	
1997	10.60%	4.05%	-6.55%	
1998	12.04%	6.12%	-5.91%	1.64%
1999	11.57%	7.84%	-3.74%	2.44%
2000	12.64%	10.80%	-1.84%	4.03%
2001	13.93%	13.30%	-0.64%	6.17%
2002	15.16%	15.68%	0.52%	7.59%
2003	15.37%	16.98%	1.62%	8.79%
2004	20.64%	19.62%	-1.01%	10.46%
2005	21.61%	19.02%	-2.59%	10.43%

Source: Central Bank of Costa Rica and SUGEF

Figure 2.7: Onshore Foreign Currency Loans to the Non-Tradable Sector and Onshore Banking System Capital

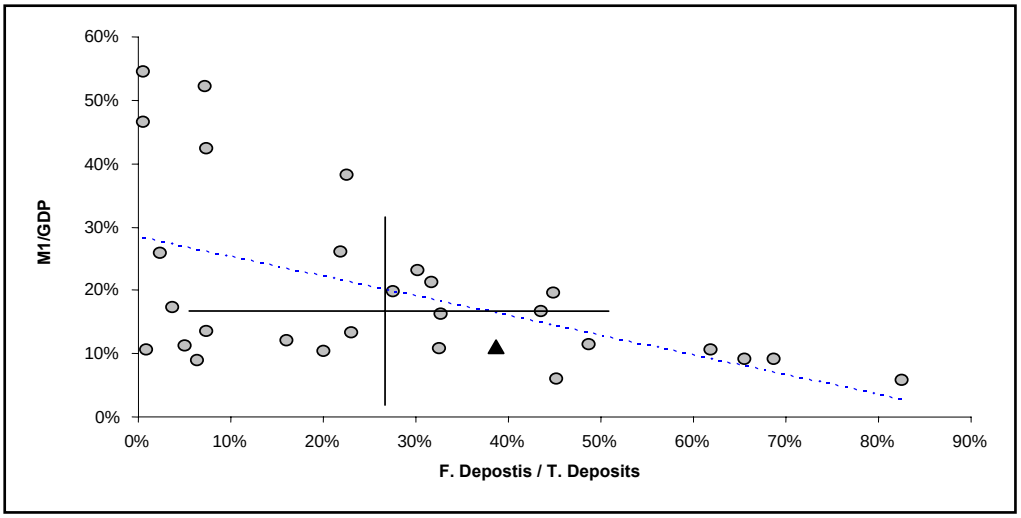


Source: Central Bank of Costa Rica.

2.2.4 Financial Dollarization and Monetization

15. **Financial dollarization in Costa Rica is higher than the mean of the peer group of middle income countries, and its monetization lower.** Monetization, as measured by the ratio of narrow money (M1) to GDP,[5] is lower in Costa Rica than the average monetization of the comparison group, and ranks 37th among the 58 middle income countries. To be sure, Costa Rica's monetization is relatively high among Latin countries (it ranks 6th in this subgroup), including countries that are much less dollarized. (Annex Table A1.4) Costa Rica is somewhat an outlier in this latter regard, given the well-known *negative relationship between monetization and financial dollarization in middle-income countries* (reflecting the displacement of the local currency from transactions and savings by the dollar). The high monetization in Costa Rica despite its high dollarization arguably reflects the fact that the region includes many dollarized countries and/or countries that have at some point in the past made intensive use of inflationary financing. Compared to the entire peer group of MIC, however, Costa Rica stands slightly above the mean in deposit dollarization and below the mean in monetization. Given its degree of deposit dollarization, Costa Rica's monetization is somewhat below the level that would be expected from international comparison and given its level of economic development (Figure 2.8).

Figure 2.8: Monetization (M1/GDP) and Dollarization (Foreign Deposits/Tot Deposits) in Costa Rica and the Peer Group*

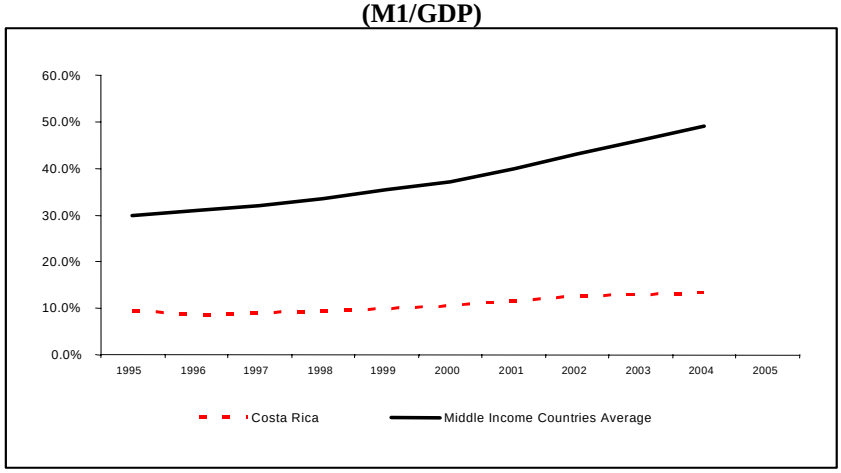


Note: *A peer group of 58 middle income countries.
Sources: IFS and Deposit Dollarization data assembled by E. Levy Yeyati.

16. **Moreover, monetization has been on an increasing trend in the peer group, in contrast with Costa Rica where it has been flat.** On a trend basis (5-year moving average), the average monetization ratio of the peer group rose from 30 to 50 percent of GDP in the last ten years (Figure 2.9). In Costa Rica, by contrast, this ratio has remained stable at around 10 percent of GDP during the same period. As a result, Costa Rica's monetization gap relative to the peer group has grown larger over time.

[5] Narrow money M1 includes currency in circulation and demand deposits.

Figure 2.9: Monetization Trends in Costa Rica and the Peer Group (M1/GDP)

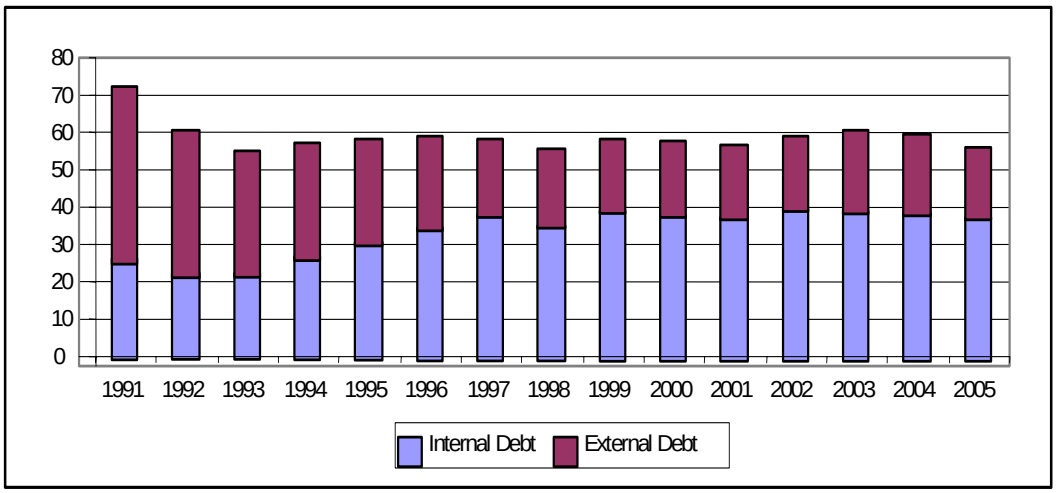


Sources: IFS and Deposit Dollarization data assembled by E. Levy Yeyati.

2.2.5 Public Sector Debt Level, Trends, and Composition

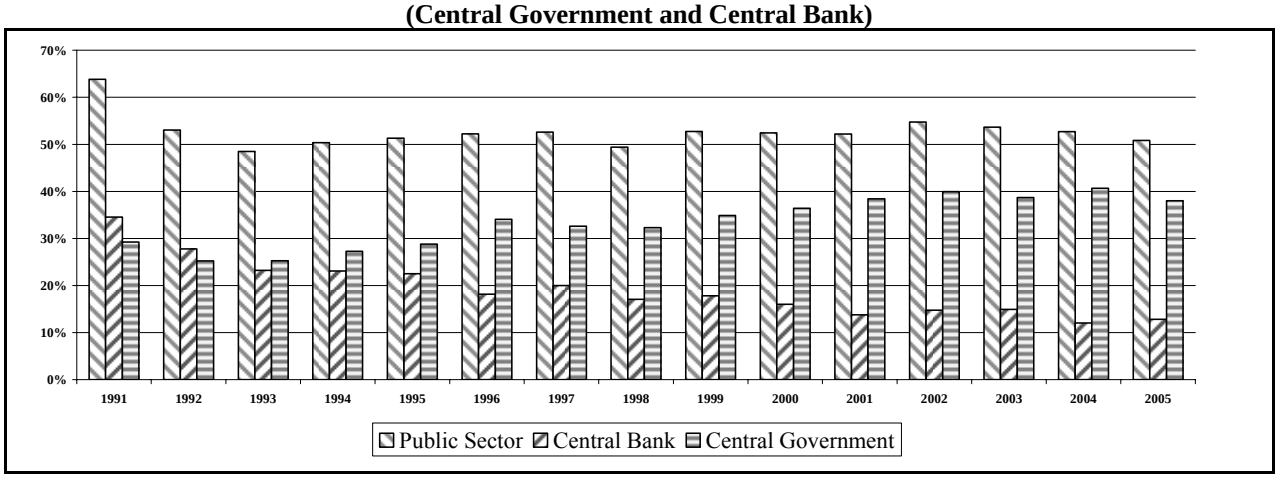
17. **Public sector (central government plus central bank) debt has remained in the range of 50-60 percent of GDP during the past decade, with a decline in central bank debt having been offset by increases in central government debt.** According to the Ministry of Finance and Central Bank's data, total public sector debt exceeded 70 percent of GDP at the beginning of the 1990s, prior to the external debt reduction negotiated under the Brady Plan. Thereafter, public sector debt has remained above 50 percent of GDP, and stands around 56 percent at present (Figure 2.10). The foregoing data does not include all the debt of public enterprises, which is not trivial, or the contingent government liabilities implicit in the pension system. *Henceforth, due to limitations in data series, the analysis of public sector debt in this report focuses only on its largest components, namely, the debts of the central government and the central bank*. Central bank debt has declined continuously, from under 30 percent of GDP in 1992 (after the Brady Plan) to around 12 percent in 2005, while central government debt has increased to offset this decline, from 25 percent of GDP in 1992 to just under 40 percent of GDP at present (Figure 2.11).

Figure 2.10: Total Public Sector Debt (As Percent of GDP)



Source: Ministry of Finance and Central Bank of Costa Rica.

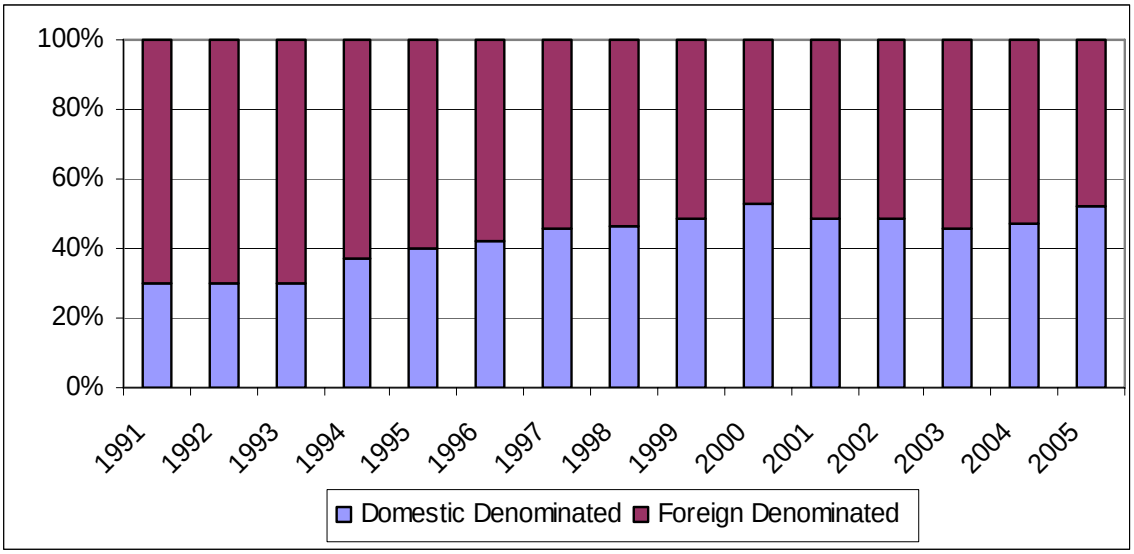
Figure 2.11: Public Debt to GDP ratio
(Central Government and Central Bank)



Source: Ministry of Finance and Central Bank of Costa Rica.

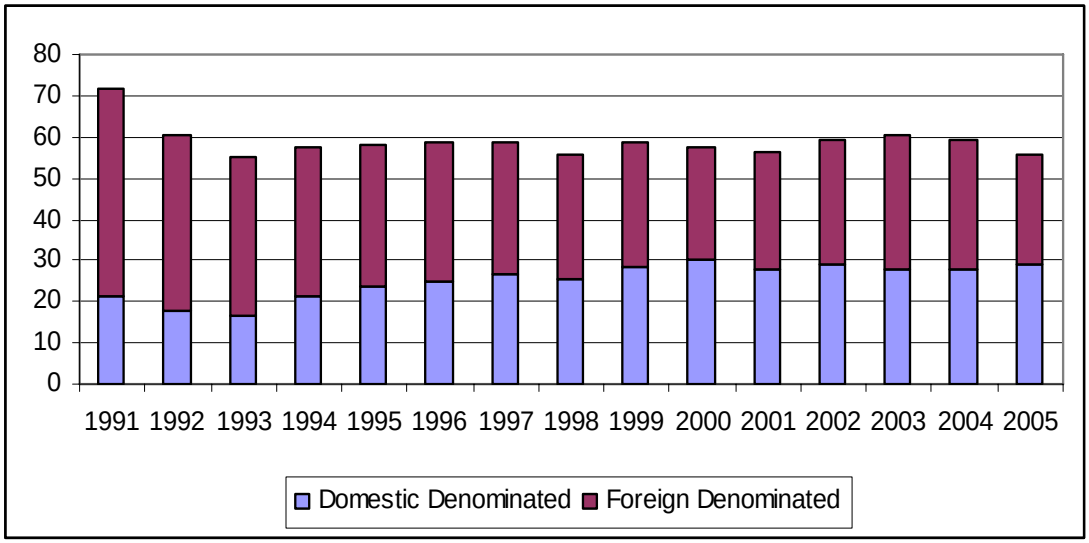
18. **Improvements over time in the composition of debt have reduced the public sector's liability exposure to rollover, interest rate, and exchange rate risk, although the latter remains relatively high.** While the share of the debt subject to the domestic jurisdiction has risen steadily, from under 40 percent in the early 1990s to about 67 percent at present, a significant proportion of internal debt is dollarized (Figures 2.12 and 2.13). Nevertheless, the share of local currency denominated debt in total (external and internal) debt has also risen overtime, from about 30 percent in the early 1990s, to nearly 50 percent at present. Public debt exposure to exchange rate risk has thus been mitigated in the last decade but still remains high, given that the government's income is mainly in local currency.

Figure 2.12: PS Debt Composition, by Currency
(In Percent of Total)



Source: Ministry of Finance and Central Bank of Costa Rica.

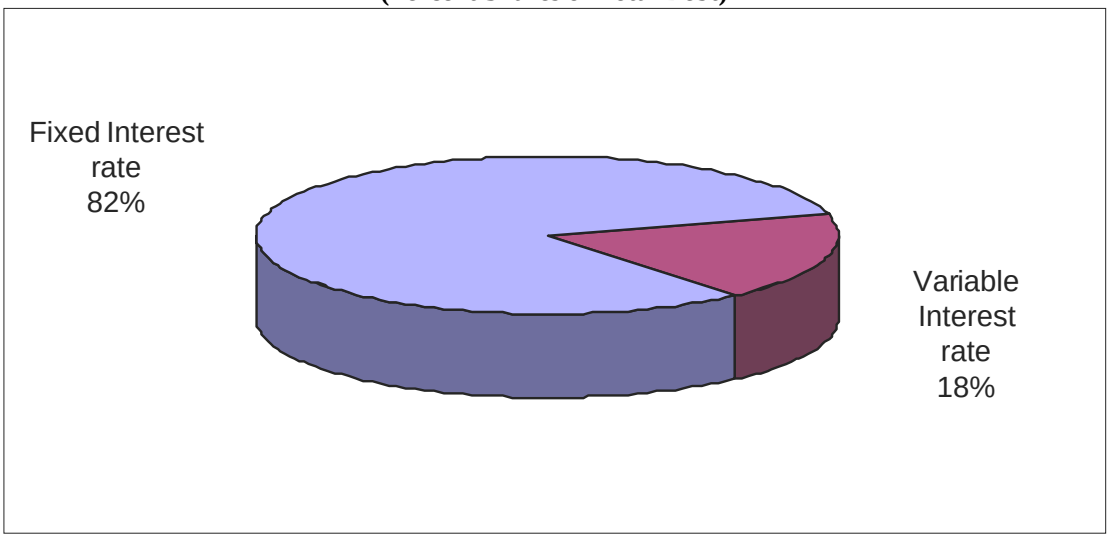
Figure 2.13: Public Sector Debt, by Currency
(As Percent of GDP)



Source: Ministry of Finance and Central Bank of Costa Rica.

19. **Exposure to interest rate has been reduced in the last five years.** In addition, the issuance of central government debt at variable interest rates has been suspended in the last 5 years, resulting in the share of fixed interest rate debt rising from 50 percent in 1999 to more than 80 percent in 2005 (Figure 2.14). This has reduced exposure to interest rate risk. Finally, the average maturity of central government debt has also increased—as of December 2005, it was 2.3 years for internal debt and 5.2 years for external debt—thereby mitigating rollover risk.

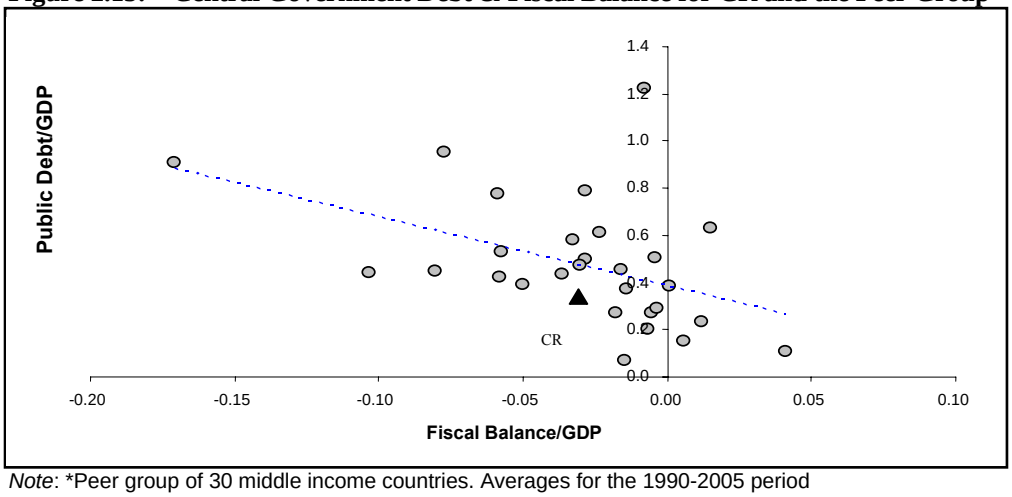
Figure 2.14 : Interest Rate Profile of Central Government Debt
(Percent Shares of Total Debt)



Source: Ministry of Finance.

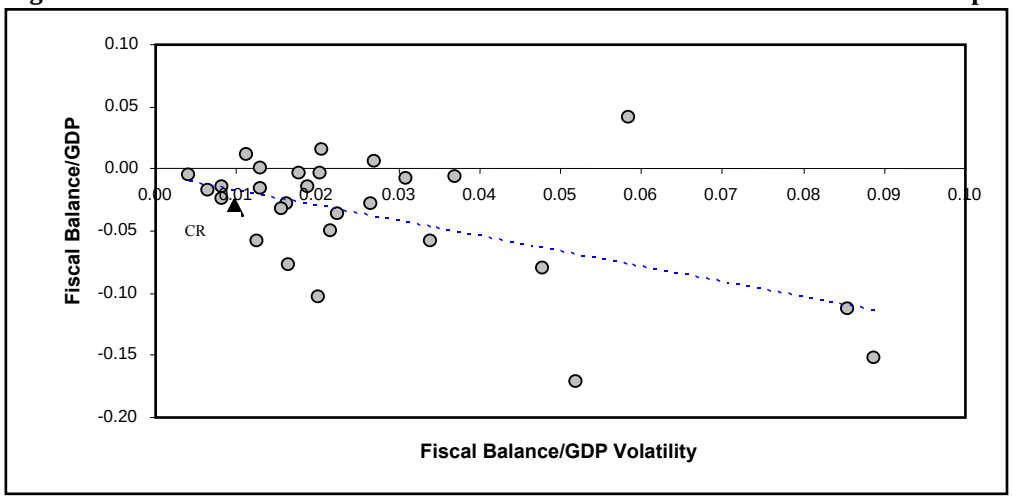
20. **Compared to the peer group of middle-income countries, Costa Rica's government debt level has been low while its fiscal deficit somewhat high; however, the volatility of its fiscal deficit has been notably low.** The peer group of 30 middle income countries for which IFS data are available illustrates the positive association between the average size of the fiscal deficits and the average debt to GDP ratio—where country averages are calculated over the 1990-2005 period.[6] Costa Rica's central government debt to GDP ratio is relatively low compared to the peer group, while its fiscal deficit is relatively high. As a result, Costa Rica's debt ratio is below the simple regression line that fits the scatter points in Figure 2.15, suggesting that, by international comparison, Costa Rica's debt ratio is lower than expected given the average fiscal deficit that it had over the past 15 years. While peer group countries with higher average fiscal deficits tend to also display more volatile deficits, the volatility of the fiscal balance in Costa Rica has been much lower compared to that of the peer group (Figure 2.16), corroborating the historical record of a sound and stable fiscal policy. In particular, Costa Rica's fiscal balance has had comparatively narrower oscillations around an average deficit of about 3 percent of GDP for the period under analysis.

Figure 2.15: Central Government Debt & Fiscal Balance for CR and the Peer Group*



Note: *Peer group of 30 middle income countries. Averages for the 1990-2005 period
Source: IMF WEO and IFS Databases.

Figure 2.16: Volatilities of Fiscal Balance & Debt to GDP for CR and the Peer Group*

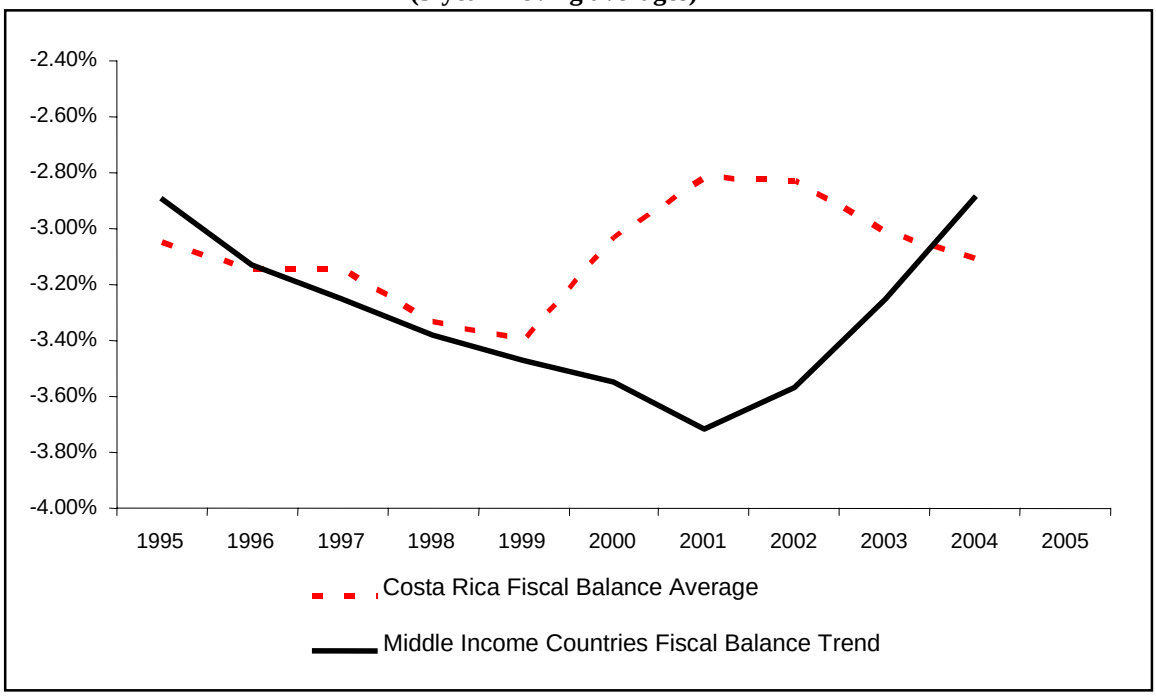


Source: IMF WEO and IFS Databases.

[6] To ensure cross-country data comparability, only central government debt is used.

21. **The trends of Costa Rica's fiscal balance and debt burden compare unfavorably to the trends for the peer group.** The fiscal deficit narrowed on a trend basis (3-year moving average) in the early 2000s but has been weakening since 2002, whereas the average fiscal position of the peer group has been on a significantly strengthening trend since 2001 (Figure 2.17). At present, Costa Rica's trend fiscal deficit is more than 3 percent of GDP, compared to an average trend deficit for the peer group that is below 3 percent. In addition, Costa Rica's ratio of central government debt to GDP has been on a rising trend since the mid-1990s, whereas that the peer group has been on a sharply declining trend (Figure 2.18). Moreover, the burden of the public sector debt, as measured by the ratio of interest payments to tax revenues, is high in Costa Rica relative to relevant comparator countries. The main reason for this is that Costa Rica scores very low among its peers in terms of its ratio of tax revenues to GDP.[7]

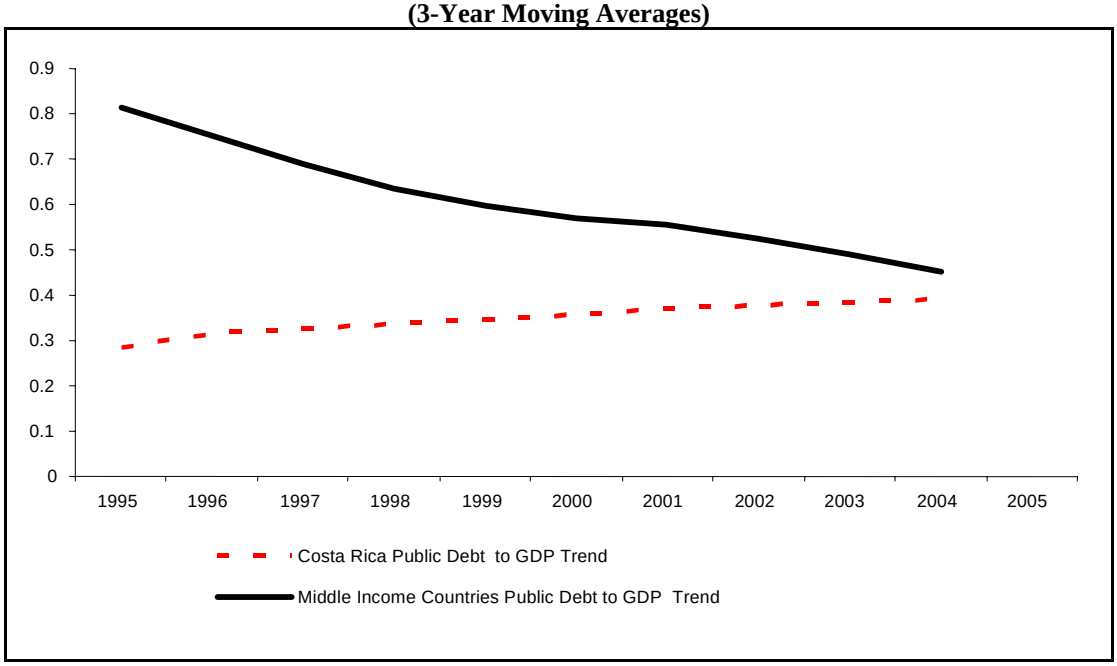
Figure 2.17: Fiscal Balance Trends for Costa Rica and the Peer Group*
(3-year moving averages)



Note: *Peer group of 30 middle income countries
Source: IMF WEO and IFS Databases..

[7] Costa Rica's central government had an average ratio of interest payments to tax revenues of 18 percent for the 1990-2005 period, which is the highest among countries with average GDP per capita in the US$ 3,500-4,000 range. At the same time, Costa Rica ranked second lowest (Panama was the lowest) among the same group of countries in terms of its tax revenue to GDP ratio, which averaged 12 percent over the same period.

Figure 2.18: Public Debt to GDP trend, CR and the Peer Group*
(3-Year Moving Averages)



Note: *Peer group of 30 middle income countries. See Annex 1.
Source: IMF WEO and IFS Databases..

2.2.6 Questions Raised

22. **The facts described above raise a number of analytical issues with significant relevance for policy.** In particular, what explains the high and rising financial dollarization in Costa Rica? Does it matter for future growth? Is so, why, in what sense, and to what extent? And what could be done to mitigate the risk consequences of dollarization, if any? Similarly, should Costa Rica's fiscal and debt trends be a source of concern? If so, why, in what sense, and to what extent? Should Costa Rica aim at a higher permanent primary surplus to avert the downside risks of a less resilient debt viability Finally, are financial dollarization and debt viability issues linked and, if so, how? What is the appropriate policy agenda to mitigate whatever downside risks to growth that may stem from these two areas? In the next sections of this chapter we attempt some answers to these questions. First we start with the analysis of financial dollarization, its determinants and attendant risks.

2.3 Financial Dollarization: Determinants and Downside Risks

23. **This section attempts to identify and measure the determinants of Costa Rica's rising financial dollarization and assess its downside risks.** It first discusses the possible range of determinants as identified in recent theoretical research on financial dollarization. It then runs some empirical tests, finding that ratchet effects and inflation are key to understand past dollarization. Based on these estimates, future paths of financial dollarization are subsequently projected for alternative inflation scenarios. Afterwards, the various risks of financial dollarization are assessed, especially, real exchange rate-induced credit risk and liquidity risk. Finally, we argue that inflation expectations and financial dollarization are, to a large extent, rooted in fiscal and debt viability issues and caught up in some self-reinforcing dynamics. This suggests that a de-dollarization policy, which is arguably desirable, cannot be solely based on changes in monetary policy (gradually towards a regime of inflation targeting cum exchange rate flexibility) and prudential policy (towards regulations that contribute to a better

internalization of currency-related credit risk). It necessarily has to be underpinned by a strengthening of the fiscal process and certain reforms of contractual institutions.

2.3.1 Explaining Financial Dollarization

24. **Theory points to the crawling peg regime as a proximate determinant of financial dollarization in Costa Rica.**[8] The revealed objective of Costa Rica's exchange rate policy has been to preserve external competitiveness, subject to the constraint of ensuring the credibility of the crawling peg through an adequate level of international reserves. To this end, Costa Rica has followed since the early 1980s a somewhat flexible exchange rate crawl, with the rate of crawl regularly adjusted (usually on a yearly basis) to compensate for differentials of past inflation between Costa Rica and its main trading partners. In addition, the central bank has adjusted interest rates upwards to defend international reserves in difficult times. This regime has thus tended to strengthen inflationary inertia and the pass through from changes in the exchange rate to changes in domestic prices. It has at the same time resulted in a relative stability of the real exchange rate while leaving the price level without a firm anchor. In such an environment, investors would naturally expect inflation to be more volatile than the real exchange rate. As a result, they would tilt their portfolios in favor dollar assets, to smooth out future real income by minimizing the volatility of real portfolio returns (see Ize & Levy Yeyati, 2003; and De la Torre and Schmukler, 2004). The portfolio thus constituted would be a minimum variance portfolio (MVP). In sum, the key hypothesis here is that it is not the expected inflation rate, nor the difference in expected returns of the colón and the dollar (embedded in their interest rate differential) that drive financial dollarization. Rather, the hypothesis is that it is the ex-ante perception of the relative volatilities of these variables that constitute a first-order, macroeconomic explanation of financial dollarization.

25. **Given that dollarization has been on a rising trend, however, theory also suggests that fundamental factors beyond the exchange rate regime are at work.** Even though Costa Rica's inflation and the real exchange rate have registered comparatively low volatility, as described earlier, concerns about public sector debt viability may be increasing perceptions of future inflation volatility, further increasing dollarization. For instance, the political impasse in recent years regarding tax reform, together with rising pressures to expand public investment in infrastructure, may be creating the perception that a permanent increase in the primary surplus is politically unfeasible. This would exacerbate doubts regarding debt sustainability in a non-inflationary environment, raising perceptions of a volatile inflation going forward and, hence, boosting dollarization. In addition, as dollarization increases, is may set into motion certain self-reinforcing dynamics that make a high degree of dollarization a stable equilibrium that is increasingly difficult to reverse (Ize, 2006). For example, monetary policy can become endogenous at high levels of dollarization—for the central bank may feel increasingly compelled to accommodate its monetary policy to minimize the probability of exchange rate-induced financial system distress. This would intensify the fear of floating and raise interest rate volatility, further feeding the preference for dollar loans over colón loans. Additional reinforcement can stem from perceptions of increasing monetary policy asymmetry—i.e., a nominal depreciation perceived as more likely to happen to correct for real exchange rate overvaluation than a nominal appreciation would be to correct for undervaluation. Such asymmetry would further reward the dollar by making it a one-sided bet. Finally, certain features can also reinforce dollarization. That is the case, for instance, where bankruptcy proceeds are allocated proportionally among all creditors at the exchange rate prevailing at the time of bankruptcy. Under such circumstances, it is optimal for creditors to denominate loans in dollars.

[8] Financial dollarization concerns the use of the dollar as a store of value. It is different than real dollarization (i.e., the indexation of domestic prices and wages to the dollar), which concerns more the use of the dollar as a unit of account and/or means of payment. While real dollarization reinforces financial dollarization, the determinants of each type of dollarization are different (see Ize and Parrado, 2002). In effect, the intensive use of the dollar as store of value can coexist with the intensive use of the local currency for payment transactions, as illustrated, for instance by the cases of Bolivia, Perú, Guatemala, Perú, Uruguay, and also Costa Rica. The analysis in this chapter focuses mainly on financial dollarization.

26. **The high pass through from currency depreciation to inflation is a contributing factor to dollarization in Costa Rica.** As noted, a high pass through is a measure of real dollarization. While dollarization could in principle obtain without real dollarization, the latter, if present, reinforces Dollarization. It does so by exacerbating inflation inertia and volatility and, thus, enhancing the role of the dollar as a hedge against inflation risk (see Levi Yeyati, 2003; and Ize and Levi Yeyati, 2005). To estimate the relevance and extent of the pass through in Costa Rica, an OLS regression exercise was conducted with monthly data for the period 1991-2005, using the following functional form:

$$\pi_t = f(\pi_{t-1-i}, \pi^*_{t-i}, \Delta \log E_{t-i}, (y_{t-i} - y^P{}_{t-i}),\ Seasonal - Dummies) \quad , \ for\ i = 0,\ldots,n \tag{1}$$

where the dependent variable is the consumer price inflation (π), and is regressed against current and lagged inflation, nominal depreciation rate (Δlog E), foreign inflation (measured by the US CPI, π^*), the real GDP gap ($y - y^p$) in logarithms, and seasonal dummies for January and September.[9] The regression results are reported in Table 2.3. The value of the coefficient for Δlog E, i.e., was estimated at 0.56. This effect builds overtime: a 1 percent currency depreciation leads to an increase (pass-through) in inflation of 0.46 percent in the first month; thereafter, the impact increases further reaching a maximum of 0.64 in the second month after the depreciation; then it declines to finally converge to 0.56 (Figure 2.19). The initial impact of the pass through to inflation can be interpreted as an instantaneous revision of expectations. The main implication is that, in Costa Rica, any real depreciation must involve important effects on inflation—for example, to achieve a 1 percent real depreciation would required more than 2 percent in nominal depreciation, as more than half of the original depreciation is diluted through inflation.

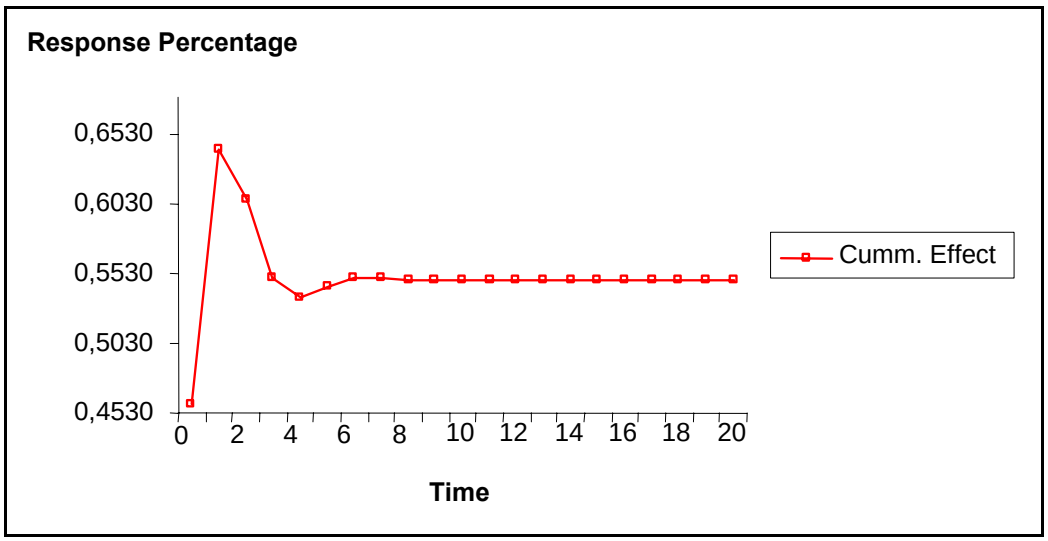
Table 2.3: Inflation Responses and the Pass-Through

Sample: 1992M8 2005M10 **Dependent Variable: D LOG IPC**			
	Coefficient	**t-statistic**	**P-value**
C	0.004	3.376	0.001
D1	0.006	4.120	0.000
D9	-0.005	-3.281	0.001
DLOGIPC(-1)	0.398	5.370	0.000
DLOGIPC(-2)	-0.236	-3.115	0.002
GAP(-8)	0.071	2.361	0.020
DLOGTCN	0.460	2.913	0.004
R-Squared	0.350		
Durbin-Watson	1.781		

Source: Calculations based on Equation (1) with data from the Central Bank of Costa Rica.

[9] y is the logarithm of the 12-month moving average of the Index of Monthly Economic Activity (IMAE) and y^p is the IMAE trend obtained by applying the Hodrick Prescott filter. The selected estimate considers lagged values for inflation and the GDP gap. The significance of the GDP gap is obtained only at the eight lag. All the estimated coefficients in the final specification have statistically significant effects on inflation and the expected signs; and the residuals are well behaved without cyclical patterns.

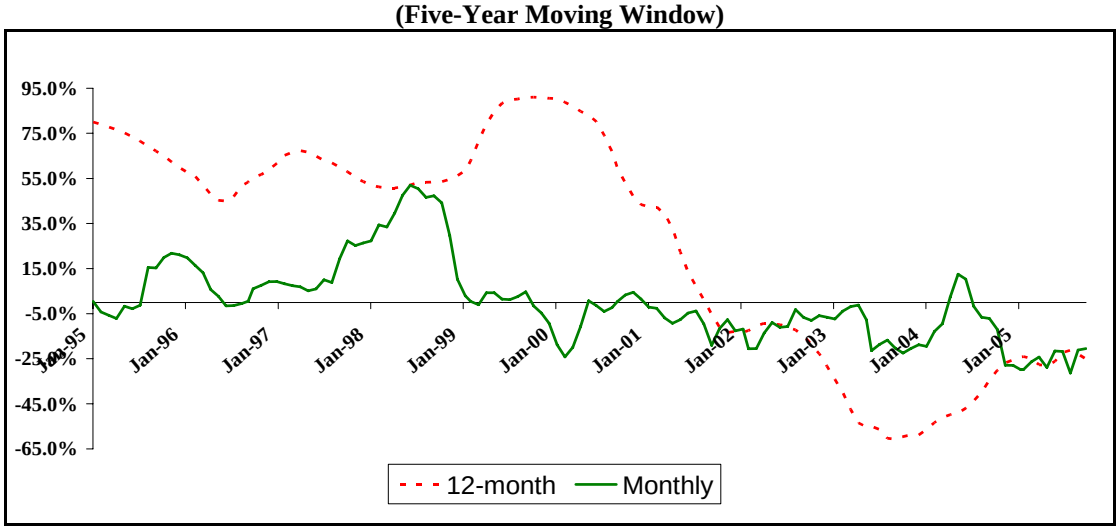
Figure 2.19: Inflation Pass-Through, Monthly Dynamics*
Cumulative Effect of a 1% Devaluation over inflation



Note: *Pass through coefficient estimated with equation (1).
Source: Staff Calculations.

27. **However, the pass though in recent years seems to have been falling even as financial dollarization has been rising.** Data limitations prevent us to test if the pass through coefficient has increased or not over time. However, the simple correlation between inflation and depreciation does not support the view that the pass through coefficient has been rising. Rather, when using 12-month inflation and depreciation, the correlation coefficient shows a sharp decline since 2000, becoming negative in more recent years (Figure 2.20). This could reflect that inflation is driven by variables other than currency depreciation. Given the crawling peg regime, it is possible that this negative correlation reflects attempts to curb inflation by delays in the exchange rate adjustment. This may be justified to the extent that the acceleration of inflation in trading partners may be compensating the slower nominal depreciation.

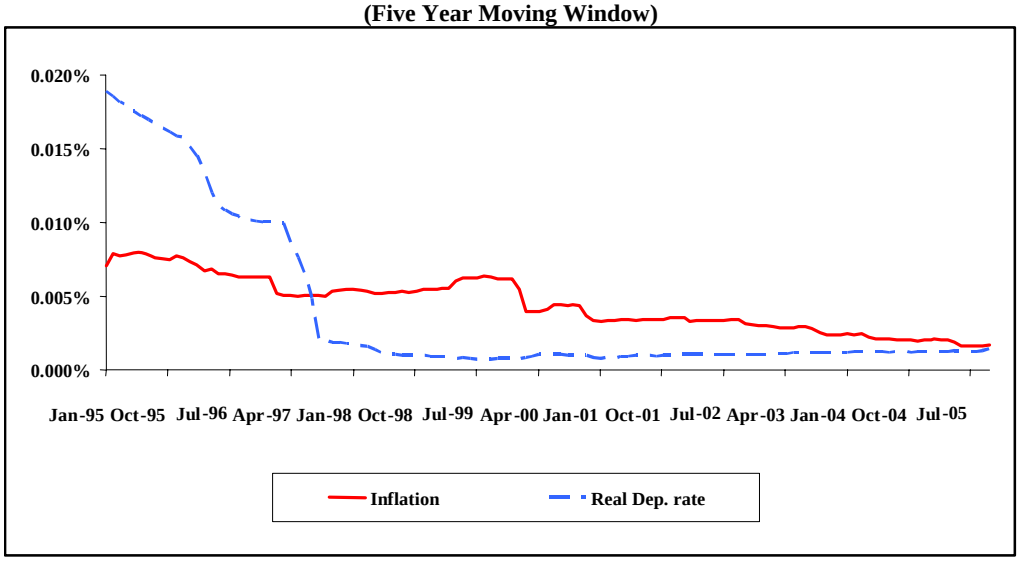
Figure 2.20: Correlation Coefficients Inflation and Nominal Depreciation*
(Five-Year Moving Window)



Note: *Monthly and 12-month Inflation and Depreciation Rates
Source: Staff calculations based on Central Bank of Costa Rica data.

28. **The fact that financial dollarization has continued to rise while inflation has fallen in Costa Rica confirms the theoretical argument that what matters are the second moments—i.e., expected volatilities.** As noted, the recent literature highlights the relative *expected* volatilities of inflation and real exchange rate depreciation as a key macroeconomic determinant of financial dollarization. The "underlying financial dollarization ratio"—that is, the ratio warranted by relative expected volatilities—is captured in the so-called "minimum variance portfolio" (MVP), as defined in Ize and Levy-Yeyati (2005).[10] The MVP measured on the basis of the *observed* relative volatilities has been shown to be a significant determinant of financial dollarization in cross-country regressions (De Nicolo, Honohan, and Ize, 2005). In the case of Costa Rica, inflation volatility (5-year window) has remained consistently above the volatility of the real exchange rate since 1997 (Figure 2.21),[11] which is consistent with an explanation of this country's rising financial dollarization based on second moments and the MVP. However, the underlying dollarization ratio expected on the basis of the observed MVP (5-year window) has not tracked closely or systematically the actual ratio, with the former displaying wide shifts that have not been generally followed by the latter (Figure 2.22). Hence, we need to go beyond these two dimension graphs to a multivariate econometric analysis of the factors behind financial dollarization in Costa Rica.

Figure 2.21: Variance of Monthly Inflation and Real Depreciation Rates
(Five Year Moving Window)

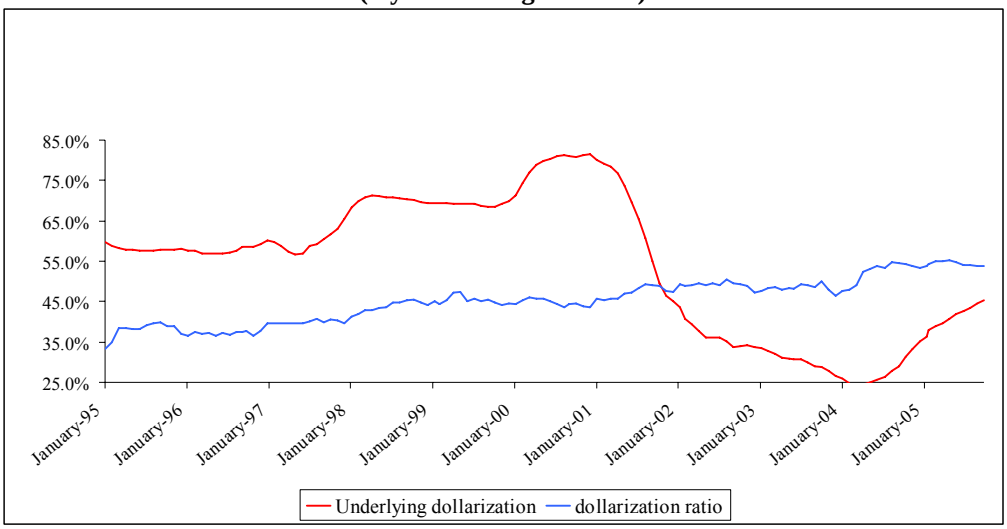


Source: Staff calculations based on Central Bank of Costa Rica data

[10] The underlying dollarization ratio dd* given by the MVP is defined as follows: $dd^* = [\sigma\pi\pi + \sigma\pi\rho] / [\sigma\pi\pi+\sigma\rho\rho+2\sigma\pi\rho]$, where each σij represents the variance-covariance of i and j.

[11] Real depreciation was defined as the difference of nominal depreciation and domestic inflation, excluding any reference to international inflation as it is done in the definition of ρ, variable used in the next section..

Figure 2.22: Underlying Dollarization Coefficient and Dollarization Ratio (5-year Moving Window)



Source: Staff calculations based on Central Bank of Costa Rica data.

29. **Regression analysis was used to gauge the determinants of financial dollarization in Costa Rica.** To this end, we used quarterly data for the period 1999-2005 to run an OLS regression based on equation (2) below. In it, the degree of deposit dollarization (*dd*) depends on "underlying" deposit dollarization (dd*), past deposit dollarization , the volatility of inflation, the rate and volatility of currency depreciation, the domestic and international interest rates, and dummies for the short-lived period of exchange rate float in the mid-1990s. The regression results are reported in Table 2.4.

$$(2) \qquad dd_t = f(dd^*_t, dd_{t-1-i}, Var(\pi_{t-i}), Var(\Delta \log E_{t-i},), \Delta \log E_{t-i}, r_{t-i}, r^*_{t-i}, Dummies) \quad , \; for \; i = 0,\ldots,n$$

30. **The regression results suggest that dollarization is difficult to reverse and is driven mainly by the volatility of inflation, which suggests a strong link between dollarization and risk perceptions regarding the fiscal process.** Deposit dollarization is found to be very much affected by its previous maximum value—the so-called ratchet effect is highly significant—which suggests that dollarization would not be reversed without a structural break. Beyond that, the degree of dollarization is found to respond positively to the volatility of the inflation rate—with the respective regression coefficient being not just statistically significant but also large. The colon interest rate appears to be a kind of a deterrent against the progress in the degree of dollarization. Unexpectedly, an estimation that included the MVP instead of inflation volatility (equation 3 in Table 2.4) [12], while yielding a significant coefficient, caused the overall significance and fit of the regression to deteriorate. The best fit was obtained with equation 1 in Table 2.4, suggesting that the absolute volatility of inflation has been a major driver of deposit dollarization. This arguably implies that deposit dollarization is closely linked to risk perceptions regarding the fiscal process—i.e., concerns that the public sector might have to resort to the inflation tax to raise resources in the future.

[12] Including inflation volatility and the MVP simultaneously in the regression equation yields a statistically non-significant coefficient for the MPV, reflecting the problem of multicollinearity .

Table 2.4: Explaining the Financial Dollarization Ratio

Costa Rica Dollarization
Sample: 1999.01 2005.03

Dependent Variable: Foreign Currency Deposits/Total Deposits

	Equation 1 Coefficient [P-value]	Equation 2 Coefficient [P-value]	Equation 3 Coefficient [P-value]
DOLLARIZATION(-4)	-0.132	-0.123	-0.168
	[0.0404]	[0.062]	[0.168]
RATCHET	1.123	1.106	1.116
	[0.000]	[0.000]	[0.000]
ST.DEV.12 MONTH INFLATION (-1)	3.625	3.217	--
	[0.001]	[0.008]	[--]
LENDING INTEREST RATE (C$)	-0.108	-0.144	-0.129
	[0.031]	[0.050]	[0.126]
12 MONTH NOMINAL DEPRECIATION (-1)	0.275	0.292	0.186
	[0.007]	[0.007]	[0.093]
12 MONTH NOMINAL DEPRECIATION (-4)	-0.325	-0.337	-0.180
	[0.003]	[0.003]	[0.079]
WARRANTED DOLLARIZATION dd*	--	0.016	0.050
	[--]	[0.481]	[0.034]
D4	-0.017	-0.016	-0.018
	[0.000]	[0.000]	[0.000]
R-Squared	0.9878	0.9881	0.9825
Durbin-Watson	1.7419	1.7128	1.4433

Source: Staff calculations based on Central Bank of Costa Rica data.

2.3.2 Projecting Financial Dollarization and Currency Mismatches

31. **The key message from the empirical analysis—that dollarization appears fundamentally tied to the volatility of inflation—is used to project plausible future paths of dollarization.** The previous regression results imply that the continuation of moderate (two-digit) inflation rates would continue to fuel dollarization, and that a structural break towards low and much more stable inflation is a necessary condition to hold the dollarization process. To illustrate the possibly contrasting dollarization dynamics, we use the regression coefficients that capture the well known positive association between inflation rate and inflation volatility, as embedded in Costa Rica's inflation data (results are in Table 2.5). We then project deposit dollarization under two alternative inflation scenarios. The first assumes that inflation stabilizes at around the current level of 15 percent into the future, and the second assumes a successful policy shift that would reduce inflation to the low single digits. The scenarios used for the dollarization projections are shown in Figure 2.23

Table 2.5: Relation Between Inflation Level and Volatility

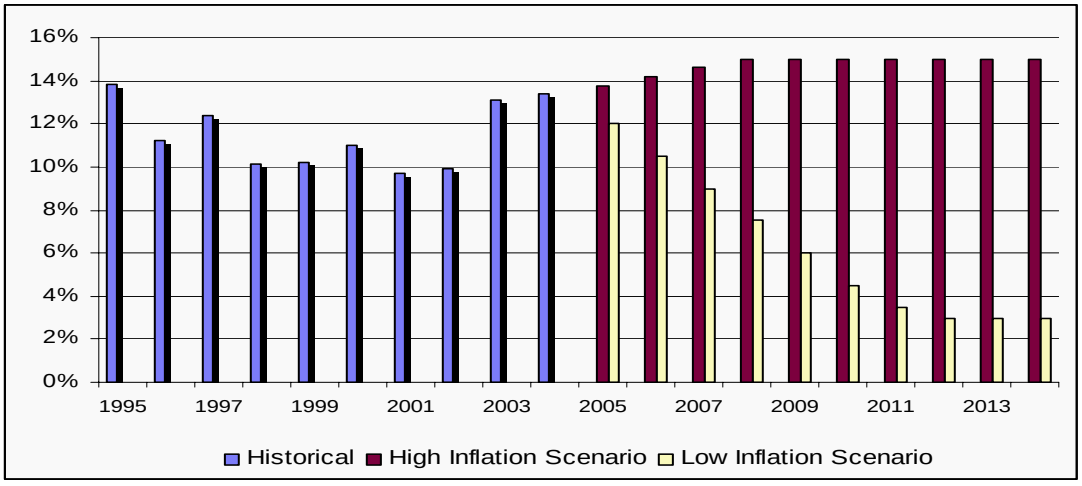
Costa Rica Inflation Volatility Estimation
Sample: 1991Q3 2005Q3

Dependent Variable: ST.DEV.12 MONTH COSTA RICA INFLATION

	Coefficient	t-statistic	P-value
ST.DEV.12 MONTH COSTA RICA INFLATION (-1)	1.066	8.545	0.000
ST.DEV.12 MONTH COSTA RICA INFLATION (-2)	-0.311	-2.818	0.007
12 MONTH COSTA RICA INFLATION	0.026	3.917	0.000
12 MONTH COSTA RICA INFLATION (-1)	-0.016	-2.276	0.027
R-Squared	0.778		
Durbin-Watson	1.924		

Source: Staff calculations based on Central Bank of Costa Rica data.

Figure 2.23: Alternative Inflation Scenarios
(percent per year)

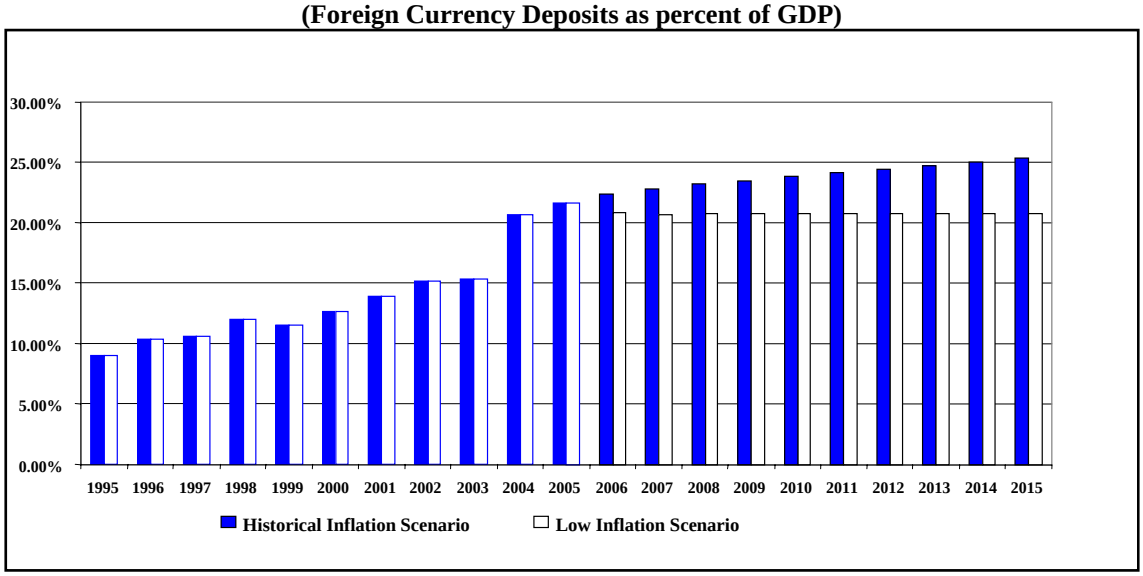


Source: Staff calculations based on Central Bank of Costa Rica data.

32. **Projections based on the estimated parameters suggest that the persistence into the future of current inflation levels would cause financial dollarization to increase further, but a switch to low and stable inflation could reduce the dollarization process.** To the extent that fiscal and monetary policies are not modified and the perception of inflation risk continues, the dollarized share of onshore

deposits would continue to increase from the current level of 54 percent (22 percent of GDP), reaching 61 percent (or 25 percent of GDP) in a matter of few years (Figure 2.24).[13]

Figure 2.24: Deposit Dollarization under Alternative Inflation Scenario
(Foreign Currency Deposits as percent of GDP)



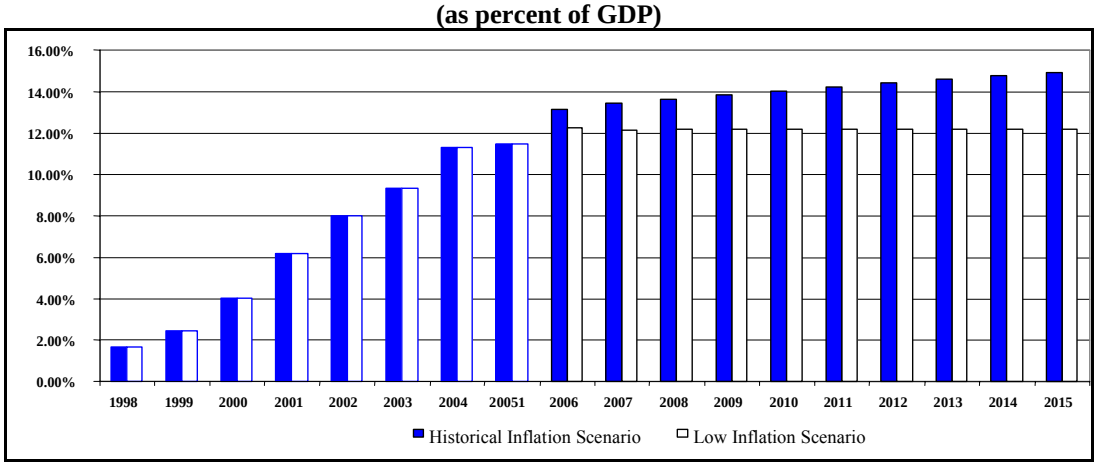
Source: Staff calculations based on Central Bank of Costa Rica data.

33. **Under a scenario of a declining inflation path, towards the low single digits, deposit dollarization is projected to stabilize at around the current level of slightly above 20 percent of GDP.** That dollarization is projected to remain at current levels despite such a major switch to low inflation reflects the fact that financial dollarization is path dependent, which is indirectly captured by the ratchet effects in the dollarization regression, as discussed above. This result should not lead to excessive pessimism, however. It is in effect conceivable that a structural break represented by the establishment of a credible record of low and stable inflation, especially if accompanied by greater exchange rate flexibility and a durable strengthening of fiscal solvency, may dislodge the high dollarization equilibrium and revert its trend, moving the system towards a more intensive use of the colón in financial contracting.

34. **The projection of rising financial dollarization under the continuation of present inflation levels implies that the extent of currency mismatches in debtor balance sheets would also raise relative to GDP.** If the ratio of total deposits to GDP remains constant, it is reasonable to project a rise in currency mismatches (as proxied by dollar-denominated lending to the non-tradable sector) more or less in line with increases in the ratio of dollar deposits to GDP. That such growing exposures would remain un-hedged is arguable given that the persistence of current inflation levels into the future also assumes the continuation of the crawling peg regime, which would impede the development of a market for exchange rate derivatives. Under this scenario, the stock of dollar loans to the non-tradable sector is projected to reach 15 percent of GDP towards the end of the decade, compared to about 10.5 percent at present (Figure 2.25). As a result, the banking system's exposure to real exchange rate-induced credit risk would be more than 3 times its capital, assuming that banks' capital to GDP remains constant.

[13] Recall that the jump in deposit dollarization between 2003 and 2004 does not necessarily reflect an increase in overall financial dollarization in Costa Rica, as explained in footnote 4 above.

Figure 2.25: Projecting Currency Mismatches
(as percent of GDP)



Source: Staff calculations based on Central Bank of Costa Rica data.

2.3.3 Consequences and Risks of Financial Dollarization

35. **We assess the downside potential of financial dollarization along three key dimensions: credit risk, liquidity risk, and the erosion of monetization.** First, dollarization-related credit risk is arguably the most important source of systemic vulnerability stemming from financial dollarization. Such credit risk arises from the combination currency mismatches in debtor balance sheets, on the one hand, and the probability and magnitude of adverse shocks to the real exchange rate, on the other. Second, liquidity risk can be exacerbated by the limitations that dollarization imposes on the central bank's ability to act as a lender of last resort through non-destabilizing money printing. Third, the erosion of monetization induced by dollarization reflects the contraction in demand for local money as a means of payment, which is tantamount to a reduction in the base from which fiscal resources could be raised via the inflation tax. In what follows we consider each of these three potential downside risks separately.

(i) Credit Risk

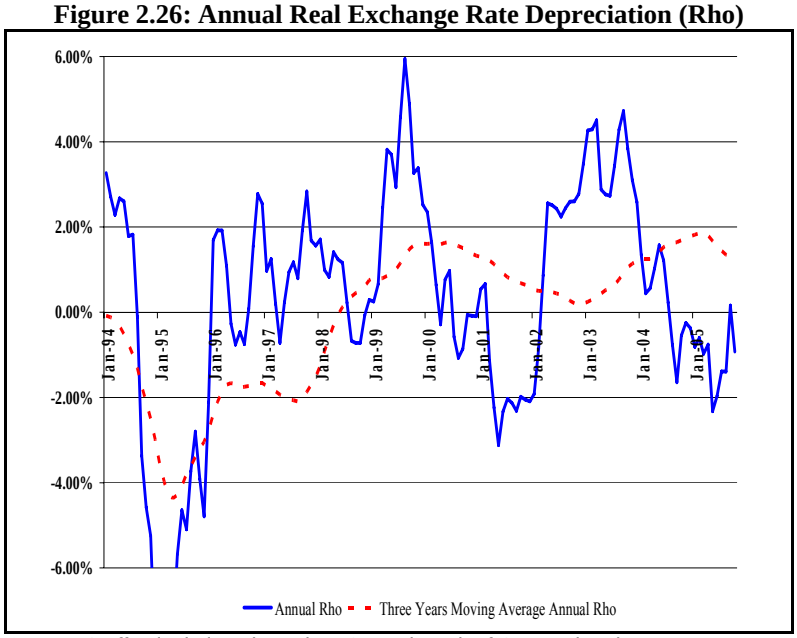
36. **While the extent of currency mismatches is, as noted earlier, quite high in Costa Rica, the actual systemic risk it poses depends on the volatility of the equilibrium real exchange rate, which is independent of the monetary and exchange rate regime in place.** In the extreme case of an optimal currency area there would be no need for the equilibrium real exchange rate of an individual country to adjust to absorb shocks—for all countries in such an area would be subject to symmetric shocks. Analogously, the equilibrium real exchange rate would be highly stable over time in a country that is completely open—so that its non-tradable sector is negligible compared to its tradable sector Costa Rica is by no means at such extremes—it is subject to shocks that are not always symmetric to the shocks that affect its trading partners (including potential Costa Rica specific capital flow reversals) and it has a sizeable non-tradable sector. Hence, Costa Rica's equilibrium real exchange rate should in principle be subject to a significant degree of fluctuation. It is of crucial importance to note that the equilibrium real exchange rate is determined by fundamental factors and is independent of the exchange rate regime in place, be it a floating regime, a hard peg, or a crawling peg.[14] Volatility in the equilibrium real exchange rate, for its part, raises systemic solvency concerns, as a large and sustained real devaluation in the

[14] Of course, the short-run fluctuations in the real exchange rate as well as the particular path and speed of adjustment towards the equilibrium rate are not independent of the exchange rate regime in place. In particular, as demonstrated in the Annex 2, a Costa Rica-style crawling peg—where the rate of crawl is adjusted to achieve external competitiveness and a desired NIR level—dampens short-term real exchange rate fluctuations, as international reserves help absorb shocks. Short-term real exchange volatility would therefore increase under a movement away from the crawl and towards greater exchange rate flexibility. That would help discourage financial dollarization while increasing credit risk during the transition.

context of high liability dollarization would lead to widespread defaults among debtors and this could result in a banking crisis. Given these considerations, the questions to ask include the following. How volatile is Costa Rica's equilibrium real exchange rate in reality? How serious should be the concern about systemic exposure to real exchange rate risk? How much should these concerns matter for a possible transition to a more flexible exchange rate policy? The following paragraphs analyze the data to try to provide some answers to these questions.

37. **Costa Rica's rate of real depreciation has historically fluctuated within narrow bands which, at first glance, mitigates the concerns regarding the vulnerability of the system to real exchange rate-induced credit risk.** Although the annual rate of real exchange depreciation (ρ) touched a maximum of 6 percent around 2000, it was only once since 1995 and for very for short period. A quick reversal of real depreciation would not seriously affect financial stability, as dollar debts in the non-tradable sector could be rolled over and repaid when the real exchange rate appreciates back. A more sustained and large real depreciation is what would be harmful to systemic solvency.[15] To capture the sustained rate of real depreciation we also present the 3-year moving average for ρ in Figure 2.26—according to this measure, real depreciation has not exceeded 2 percent in the last 10 years or so—a low volatility indeed. To take the empirical discussion one step further we note that, according to the Monte Carlo simulation of the VAR model described later (and used to assess debt sustainability), the probability of the moving average rate of real depreciation exceeding 2, 3, and 4 percent is 33, 15, and 5 percent, respectively (Figure 2.27). It is thus difficult to argue based on historical data that real exchange rate volatility is a particularly acute source of systemic vulnerability in Costa Rica, despite the widespread currency mismatches. At first glance, therefore, the threat to systemic solvency posed by real exchange rate-induced credit risk appears as a low-probability event, especially if the authorities continue to avoid, as they have in the past, large overvaluations of the currency.

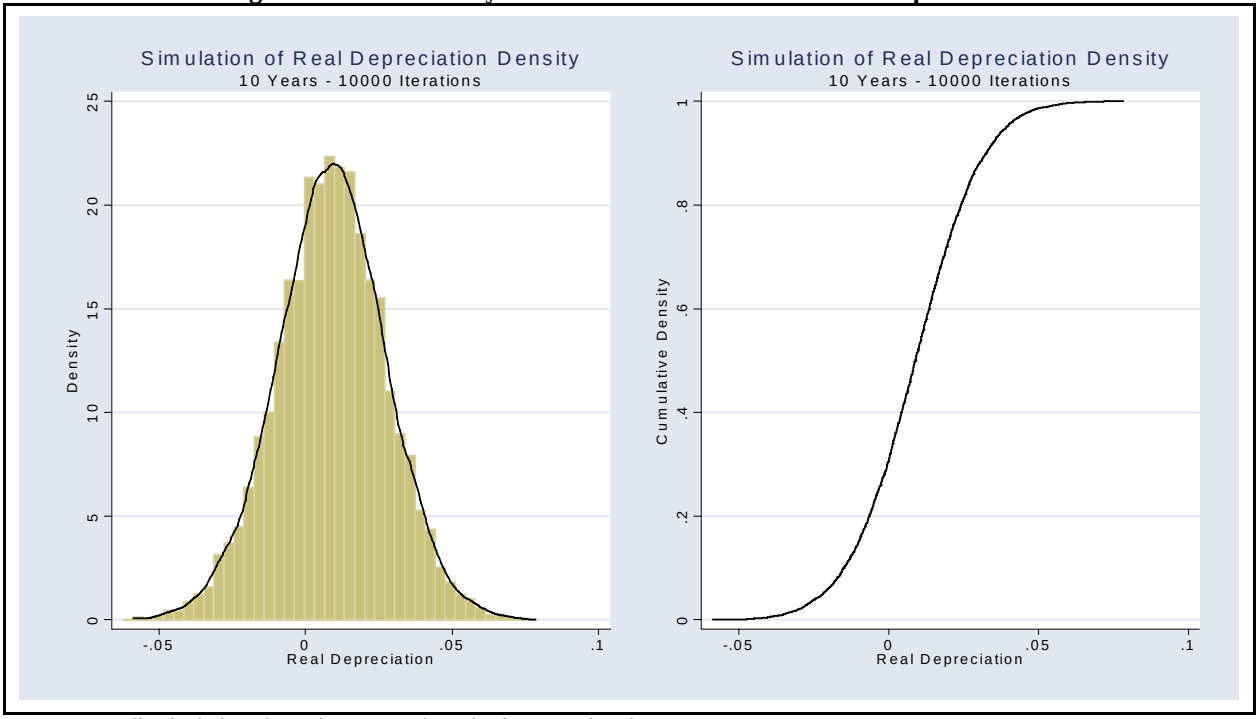
Figure 2.26: Annual Real Exchange Rate Depreciation (Rho)



Source: Staff calculations based on Central Bank of Costa Rica data.

[15] Note that postponing a needed real depreciation would also be damaging to debtor solvency, as overvaluation would keep economic activity low, hampering payment capacity and, hence, systemic stability.

Figure 2.27: Probability Distribution for the Rate of Real Depreciation



Source: Staff calculations based on Central Bank of Costa Rica data.

38. However, there are other strong reasons leading to the conclusion that financial dollarization is a much larger source of systemic vulnerability in Costa Rica than suggested by the low historical volatility of the real exchange rate. First, even accepting for argument's sake that the threat to systemic solvency posed by financial dollarization is in the nature of low-probability event, it would be a low-probability high-cost event. Although the probability of a banking crisis may be low, its costs can be immense. Second, a weakening of fiscal sustainability can add to real exchange rate volatility that, in turn, an complicate debt sustainability, especially considering the explicit government guarantee behind the liabilities of public commercial banks as well as the potential exposure of the government to losses in the case of widespread failures among private banks. Third, the probability of sharp real exchange depreciation is ultimately not independent of the extent of currency mismatches in the system. Such mismatches can bring the system to the "danger zone" where self-fulfilling attacks are more likely—as mismatches increase, the possibility of very large losses and a catastrophic event in the banking system can alert sophisticated market participants, who may run against banks and the currency, thus bringing about the crisis that they feared but that would not have happened had they not run.[16] The foregoing reasons indicate that the underlying volatility of the real exchange rate in Costa Rica may be considerably higher than that observed in recent history. There is therefore no room for complacency and the large extent of currency mismatches in debtor balance sheets should be an important source of policy concern.

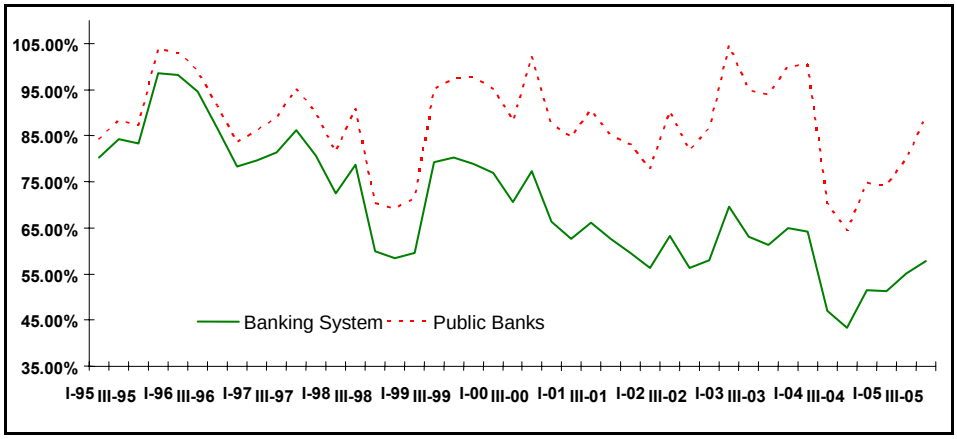
(ii) Liquidity Risk

39. **Financial dollarization reduces the role of the central bank as lender of last resort, increasing systemic liquidity risk and complicating debt sustainability.** A credible central bank in a non-dollarized financial system can use its lender of last resort function to fend off liquidity shortfalls and contagion when runs are not originated in fundamental insolvency problems, and it could do it without inflationary costs. However, when financial savings are largely in dollars, the lender of last resort function is

[16] In effect, empirical research by Calvo et. al. (2003) finds that the probability of a sudden stop in capital flows rises with the degree of financial dollarization.

severely hindered, as the central bank cannot print dollars. The central bank can assist the banking system only to the extent that it has international reserves. Thus, systemic liquidity risks can rise with financial dollarization, forcing banks to hold higher levels of liquid dollar assets than otherwise. This, in turn, can raise the costs of bank intermediation. Hence, in a dollarized system, the international reserve coverage of dollar deposits is important to mitigate systemic liquidity risk. In Costa Rica, this coverage ratio remains strong—at around 50 percent—although it has been declining in recent years, due to the rapid increase in deposit dollarization, which is particularly significant in private banks (Figure 2.28). To maintain the NIR coverage of foreign currency deposits, the accumulation of reserves would have to go in line with the increase in deposit dollarization. Holding a high level of NIR as a proportion to GDP is, however, costly—the central bank has to finance them mostly with debt, as the ability of collecting inflation tax "revenues" is constrained by money demand. Hence, managing liquidity risks in a dollarized system imposes a fiscal burden that, in the absence of fiscal adjustment, complicates debt sustainability at low inflation.

Figure 2.28: NIR Coverage of Foreign Currency Deposits



Source: Central Bank of Costa Rica

(iii) Erosion of Monetization

40. **By reducing money demand, which is the base on which the central bank can raise resources at zero interest rate cost, dollarization complicates public debt sustainability.** Monetary financing (*mf*) is defined as the increase in the issue of nominal money by the central bank relative to nominal GDP (equation 3). Monetary financing can be used to cover the central bank quasi-fiscal losses, accumulate international reserves, or reduce central bank debt. It has played a relevant role in the financing of the public sector in Costa Rica—it has kept public debt from rising at the expense of a two-digit inflation rate. After some algrebra, *mf* can be expressed by equation (4), where inflation is represented by π, the growth rate of real GDP by λ, and the demand for real money balances (as percent of GDP) by *m*, which is the base for monetary financing. The inflation rate acts as a tax applied to such base and has a first-order impact on the size of *mf*. In turn, the base, *m,* is a negative function of the interest rate and of the degree of dollarization (*dd*), as in equation (5). The key point is that money demand shrinks in the context of a sustained dollarization process that substitutes local money with dollars, thereby reducing the base for monetary financing. This association between dollarization, money demand, and the scope for monetary financing provides a link between dollarization and public debt sustainability. The higher the dollarization ratio, the lower the demand for real money balances, and the consequent decrease in the ability to raise monetary financing requires a higher primary surplus to maintain debt sustainability.[17]

[17] The theoretical statement in equation 5 that base money (m) is a negative function of the degree of dollarization (dd) does not imply, however, that we should expect to observe that when deposit dollarization goes real money base goes down. In effect, both can be observed to go up without undermining the validity of equation 5. Costa Rica is a case in point—Figure 2.9 shows

$$(3) \quad mf_t = \frac{M_t - M_{t-1}}{Y_t} = m_t - \frac{m_{t-1} Y_{t-1}}{Y_t}$$

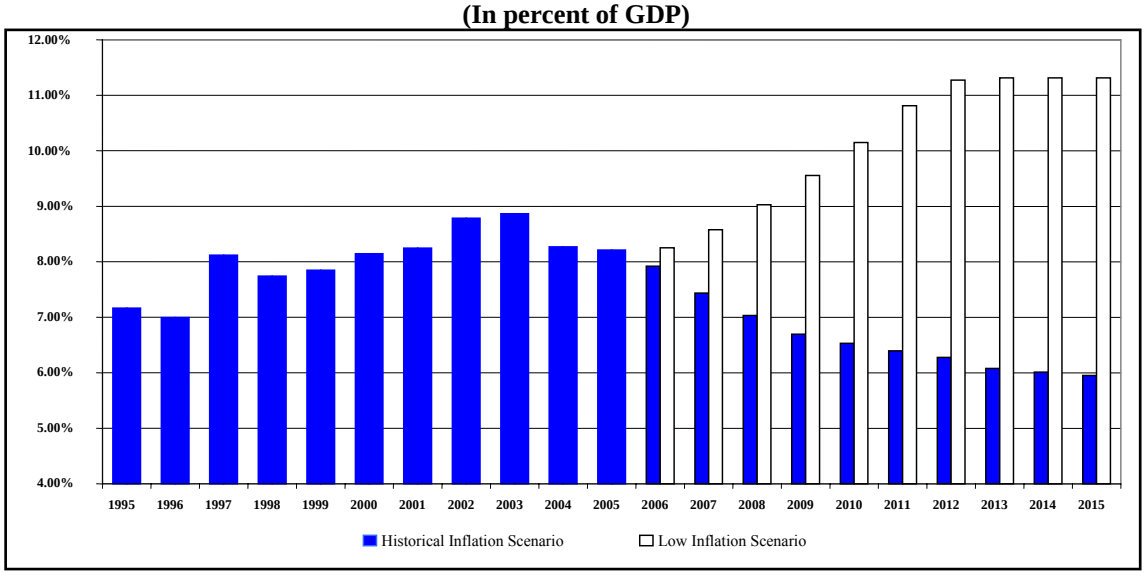
$$(4) \quad mf_t = \frac{m_t(\lambda_t + \pi_t + \lambda_t \pi_t) + \Delta m_t}{(1 + \lambda_t)(1 + \pi_t)}$$

$$(5) \quad m^d{}_t = f(\pi_t + r_t, dd_t); dd_t = DU_t\$ / D_t$$

41. **Monetization—i.e., the trend of real money balances as a percent of GDP—was projected under different inflation scenarios.** The demand for money started first as an OLS association with partial adjustment (traditional money demand approach), then proceeded to search for a long term relationship using co-integration.[18] The results yielded statistically significant coefficients with the expected signs and gave us grounds to assume that the income elasticity of money demand is equal to one, so that the trend of monetary balances is given by equation (6). Such trend was projected under the two inflation scenarios mentioned and depicted in Figure 23, which yielded very different trajectories for the degree of monetization (Figure 2.29). Under the historical or high inflation scenario, money demand is eroded by rising dollarization and by the gradual convergence of inflation and real interest rates to their historical averages; as a result, monetization falls from 8 percent to 6 of GDP over the next 10 years. In contrast, under the low inflation scenario, the dollarization process is detained, helping stabilize the demand for money. Furthermore, the gradual reduction in inflation reduces the cost of holding money, thus increasing the degree of monetization from 8 percent to 11 percent of GDP in about 5 years.

$$(6) \quad Log\ m_t = 1.5728 - 1.6150\ dd_t - 0.0486\ (r_t + \pi_t)$$

Figure 2.29: Monetization in Two Scenarios
(In percent of GDP)



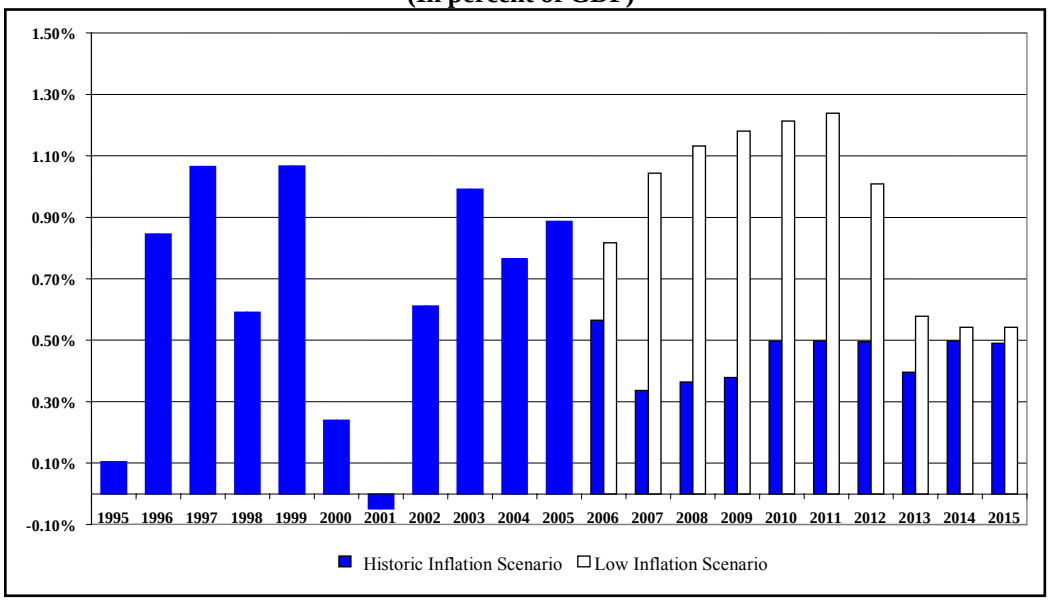
Source: Central Bank of Costa Rica

that monetization (the ratio of base money to GDP) has been rising modestly even as deposit dollarization has been rising steeply. But this differential speed is all that suffices for equation 5 to hold. The implication is that monetization would have risen faster in Costa Rica in the absence of dollarization.

[18] The technical aspects to the money demand estimation for M1 are presented in Annex VII.

42. **A lower inflation scenario would boost monetary financing during the transition, thereby enhancing debt sustainability.** Monetary financing was also projected under the two inflation scenarios, using equations (4) and (6). The results are reflected in Figure 2.30. Under the historical inflation scenario, a transitional shrinkage of monetization reduces the inflation tax base, which leads to a temporary decrease in monetary financing of the order of 0.3-0.4 percent of GDP, after which monetization increases to around 0.6 percent of GDP. Under the low inflation scenario, monetary financing increases in the transition towards higher monetization and then stabilizes around 0.6 percent of GDP.[19] Both inflation scenarios eventually lead to a similar long-term monetary financing of the order of 0.6 percent of GDP. In the low inflation scenario, monetary financing is reduced by the lower tax rate applied but increased by the higher tax base, with the latter effect dominating over the transition period. Although long-run monetary financing stabilizes around 0.6 percent of GDP under the low inflation scenario, average monetary financing for the first ten years is just under 1 percent of GDP per year.

Figure 2.30: Annual Monetary Financing Scenarios
(In percent of GDP)



Source: Staff calculations based on Central Bank of Costa Rica data.

2.4 Debt Sustainability under Uncertainty

43. **In this section we assess the fiscal primary surplus that would be required to ensure resiliency of public sector debt viability (defined as a non-increasing path for the debt to GDP ratio) under uncertainty.** In order to derive the required primary surplus we hold inflation, monetization, dollarization, and monetary financing constant at their initial levels, while allowing key endogenous macroeconomic variables—the real interest rate, the rate of output growth, and the rate of real exchange rate depreciation—to vary over time. We first present results based on a deterministic approach—assuming alternative but predetermined paths for the macroeconomic variables. We then move towards deriving the required primary surplus under a more probabilistic approach, where the historical mean and standard deviations of the endogenous macroeconomic variables are used to create a probability distribution for their future paths. Finally, we calculate a probability distribution for the required primary

[19] The transitional dynamics reflect a stock adjustment—that is, the adjustment to a new real money base stock. This generates a transitional increase in monetary financing because asset prices (the exchange rate and the interest rate) adjust instantaneously to clear the money market while the price level adjusts gradually over time until M/P reaches the new desired stock level.

surplus under uncertainty by using Monte Carlo simulations of a small macroeconomic vector auto-regression (VAR) model in order to forecast stochastic trajectories for the relevant macroeconomic variables. This third approach allows us to estimate the permanent fiscal adjustment needed to attain debt sustainability with different degrees of certainty. This approach better represents the endogeneity of the macro variables, the structure of relationships among them, and the complexities associated with uncertainty.[20]

44. **Lack of data circumscribes our analysis to the combined accounts of the central government and central bank, but this actually helps highlight the institutional barriers to the transfer or resources from public enterprises (and other autonomous public entities) to the central government.** For example, under the current legal framework, the central government cannot tax the income of the public electricity company, ICE, or require it to pay dividends. This segmentation implies that a saving effort in ICE cannot be easily used to finance an increase in, say, central government investment in transport infrastructure or education. The central government could, in principle, borrow from ICE, but ICE has strong incentives to rather use the surpluses it generates to increase its own investment. Hence, barring a shift towards concessions or the privatization (at the margin) of investments in sectors controlled by public enterprises, the central government has to increase its own income in order to increase investment in sectors under its responsibility, such as transport, education, and health. This reality is automatically incorporated in the debt viability analysis described below, given that it considers only the central government and central bank, leaving out of the analysis the accounts of public enterprises and other autonomous public entities.

45. **A first building block for the debt sustainability exercises is to model the historical dynamics of public sector (central bank and central government) debt.** The actual dynamics of central bank debt can be reasonable represented by equation (7), which yields values that track relatively well the observed evolution of such debt (Figure 2.31). Basically, central bank debt is a function of: its debt in previous period (in dollars, *bcu$*, and colones, *bcc$*, respectively); the real interest rates in domestic and foreign currency (r and r^*, respectively); the sovereign spread (δ); the nominal depreciation rate (ρ); the rate of real GDP growth (λ); international reserves (*nir*) and their accumulation, including valuation changes;[21] monetary financing (*mf*), and the central bank's primary surplus (*psc*)—with all the level variables expressed as ratios to GDP. For its part, the central government debt evolves in line with equation (8), which also tracks well the historically observed trajectory (Figure 2.32**).** It depends on: its debt in the previous period (in dollars, *bgu$*, and colones, *bgc$*, respectively); the domestic and foreign real interest rates (r and r^*); the rate of real depreciation (ρ); the sovereign premium (δ); the rate of real GDP growth (λ); and the CG primary surplus (*psg*).[22] Combining the debts of the central bank and the central government yields equation (9).

[20] We follow recent work at the IMF by Tanner and Samake (2005) and to some extent Celasum, Debum, and Ostry (2005). This work criticizes the use of discretionally selected scenarios to represent macroeconomic uncertainty, arguing instead in favor of estimating a VAR and Monte Carlo techniques to project stochastic trajectories of macroeconomic variables. For simplicity and to distinguish variables that are under the control of the authorities from those that are endogenous to the model, we do not include fiscal variables in the VAR.

[21] Valuation changes in international reserves are not included in the official statistics of the central bank's quasi-fiscal balance because it is presented in cash terms. However, valuation changes need to be explicitly incorporated to an adequate track of debt dynamics for the central bank.

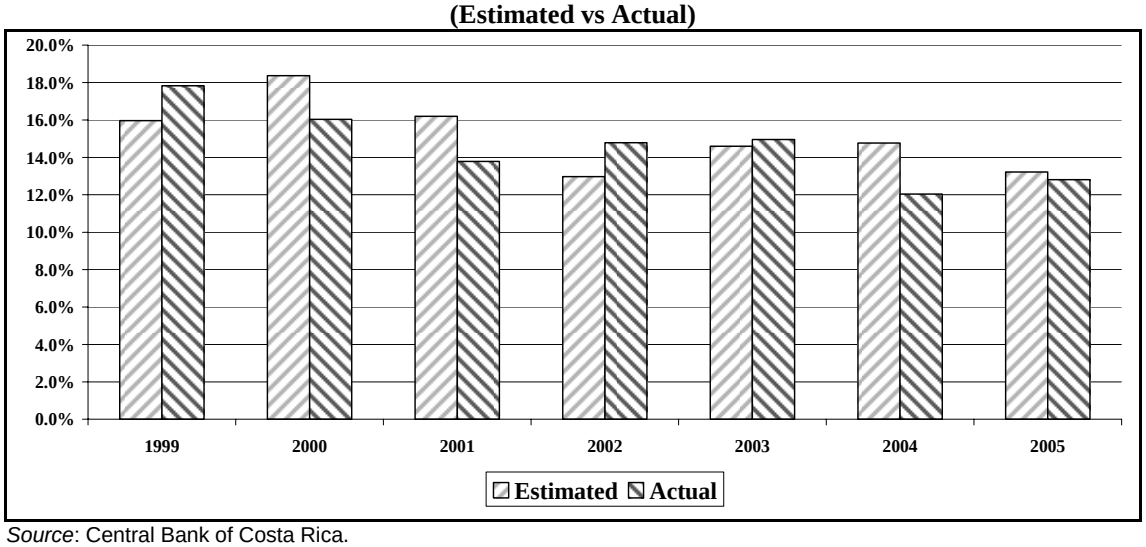
[22] The derivation of equations (7), (8) and (9) can be found in Annex 3. Lack of information on the currency breakdown of interest payments for the central government forced us to assume that the implicit interest rate in foreign currency was the same for the central government and central bank.

$$bc_t = bcc\ \$_{t-1}\frac{[1+r_t]}{(1+\lambda_t)} + bcu\ \$_{t-1}[\frac{1+r^*_t+\delta_t+\rho_t}{(1+\lambda_t)}] - \frac{nir_{t-1}[-\lambda_t+r^*_t+\rho_t]}{(1+\lambda_t)} + \Delta nir_t - mf_t - psc_t \quad (7)$$

$$bg_t = bgc\ \$_{t-1}\frac{[1+r_t]}{(1+\lambda_t)} + bgu\ \$_{t-1}[\frac{1+r^*_t+\delta_t+\rho_t}{(1+\lambda_t)}] - psg_t \quad (8)$$

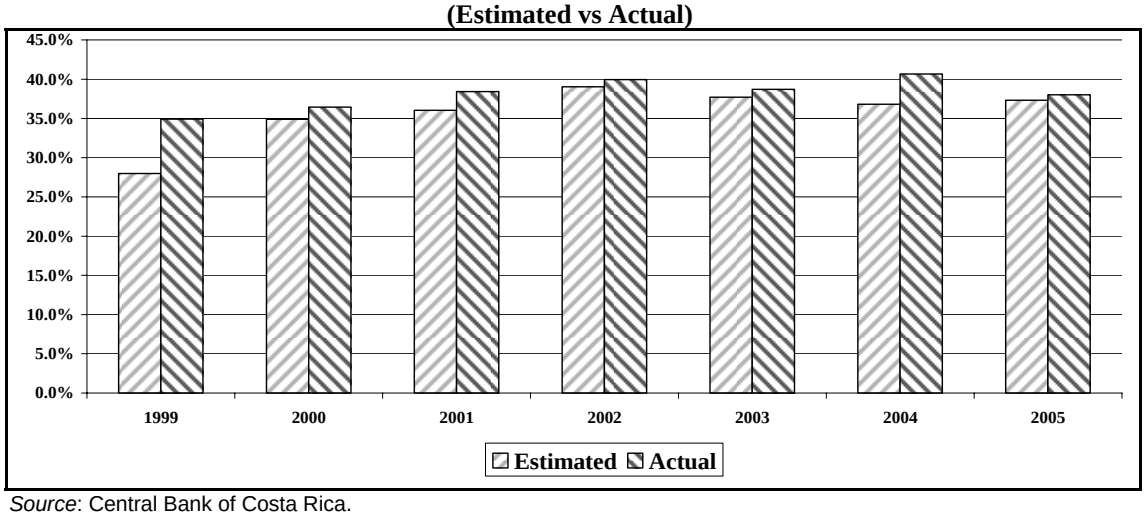
$$bp_t = bpc\ \$_{t-1}\frac{[1+r_t]}{(1+\lambda_t)} + bpu\ \$_{t-1}[\frac{1+r^*_t+\delta_t+\rho_t}{(1+\lambda_t)}] - \frac{nir_{t-1}[-\lambda_t+r^*_t+\rho_t]}{(1+\lambda_t)} + \Delta nir_t - mf_t - psg_t - psc_t \quad (9)$$

Figure 2.31: Central Bank Debt to GDP Ratio
(Estimated vs Actual)



Source: Central Bank of Costa Rica.

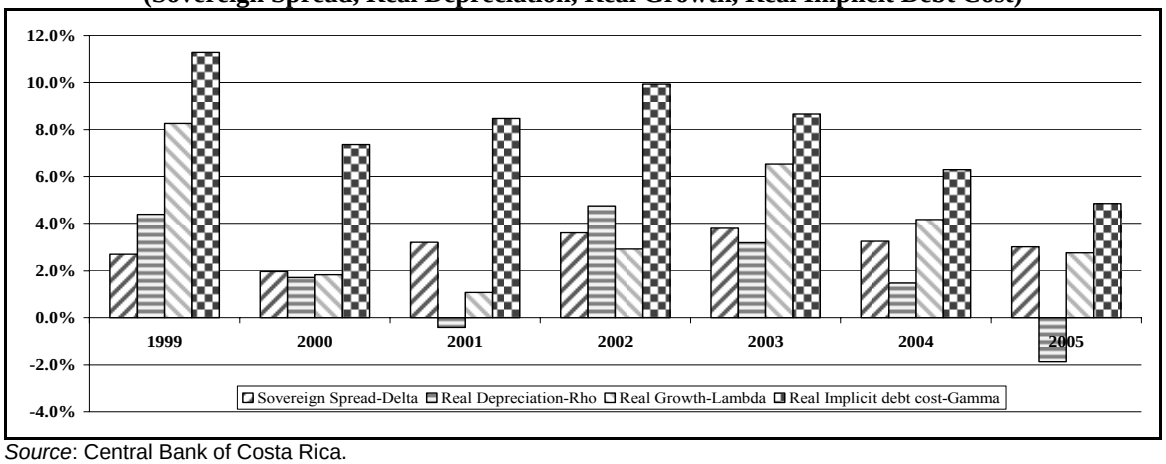
Figure 2.32: Central Government Debt to GDP Ratio
(Estimated vs Actual)



Source: Central Bank of Costa Rica.

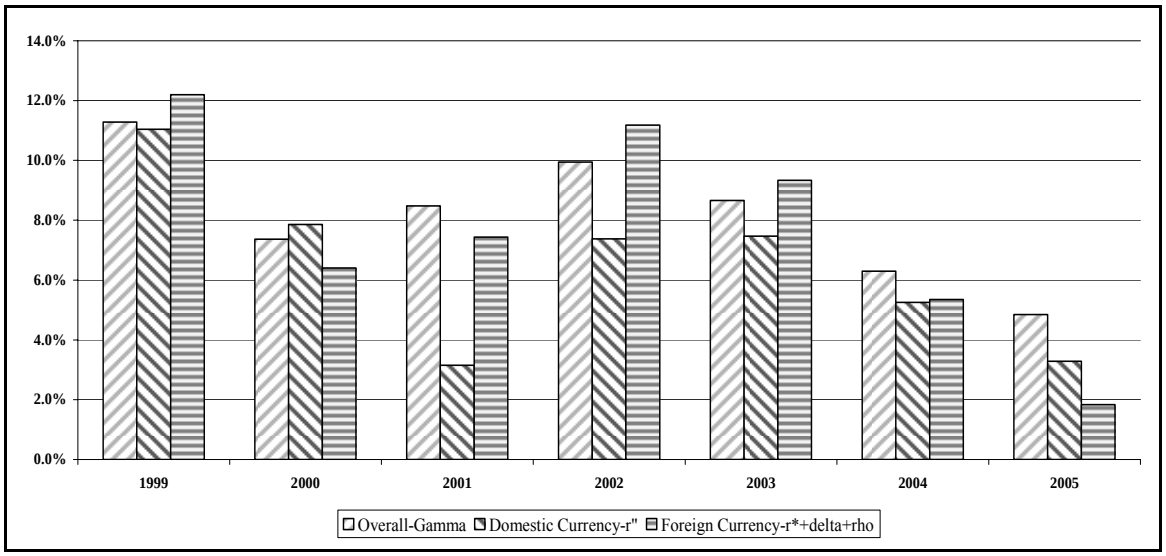
46. **Hence, public sector debt evolves as a function of policy variables under the control of the authorities—*nir, mf, psc, and psg*—as well as endogenous variables that are subject to macro uncertainty—*r, r*, δ, ρ,* and *λ*.** To be sure, the variables that are under greater control of the authorities have some endogenous responses to macro conditions, but they can be controlled or targeted to a significant extent through macroeconomic policy. The initial values are the average values of the policy variables, namely, *mf* of 0.6 percent of GDP; and change in *nir* of nearly zero (with initial *nir* of around 10 % of GDP). The endogenous variables outside the control of the authorities are subject to uncertainty in the future and have been subject to varying degrees of fluctuation in the past. In particular, real economic growth (λ) over the last 5 years has been as high as 6 percent and as low as 1 percent; the sovereign spread (δ) has fluctuated between 200 and 400 basis points; the rate of real depreciation (ρ) has varied between +4 percent and -2 percent. (Figure 2.33). Lastly, a variable that will proxy for the real interest rates—under the assumption that the composition of public debt by currency remains constant—is the implicit average real interest cost of public debt (γ); it has been as high as 10 percent in 1999, and was last year at its lowest level of 5 percent (Figure 2.34).

Figure 2.33: Macroeconomic Variables for Debt Dynamics
(Sovereign Spread, Real Depreciation, Real Growth, Real Implicit Debt Cost)



Source: Central Bank of Costa Rica.

Figure 2.34: Implicit Real Interest Rate Cost of Public Debt



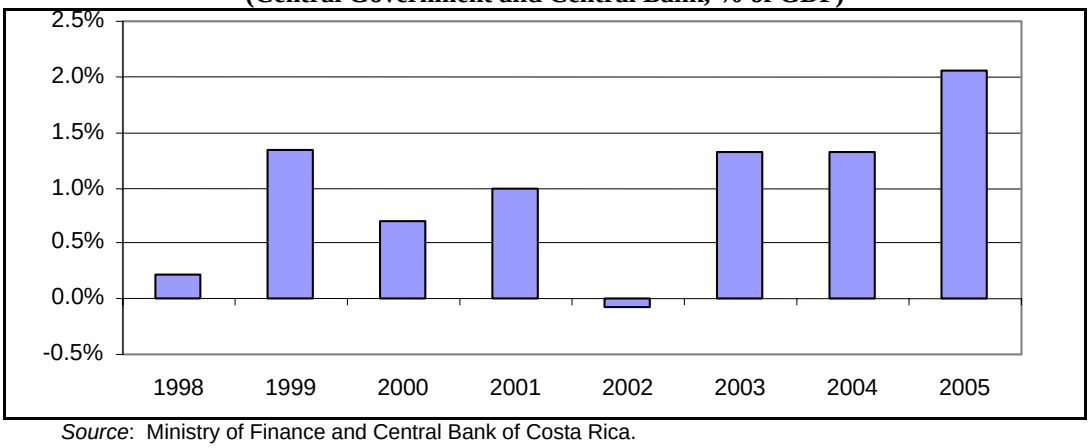
Source: Central Bank of Costa Rica.

47. **We finally arrive at an expression to calculate the primary surplus required to ensure public debt sustainability (i.e., a non-increasing debt ratio).** After some derivations explained in Annex 3, we arrive at a usable expression to assess debt sustainability, given by equation (10). As we are interested in trend policy targets that will deliver stability, the primary surplus, the change in international reserves, and monetary financing will be used at their trend or permanent values. The required primary surplus is an increasing function of the level of public debt (*bp*) and the average cost of real debt in excess of economic growth (γ - λ). It is a decreasing function of net international reserves (*nir*), of the rate of return on international reserves in terms of local currency and in excess of the growth of the economy (r* + ρ – λ), and of trend monetary financing (*mf*). Accordingly the required primary surplus varies over time, depending on the values taken by the other variables, including those subject to macroeconomic uncertainty and are out of the control of the macroeconomic authorities (λ, γ, $r*$, ρ) and those that can be targeted through policies (Δnir and *mf*). To simplify the exercise, we will assume that the trend *mf* is given by a policy target for the inflation rate, and that Δnir is equal to zero. The required primary surplus would be thus different under different levels of initial debt and under different policy strategies that define the level of monetary financing.

$$(10) \qquad pps = \frac{bp_{t-1}(-\lambda + \gamma)}{(1+\lambda)} - \frac{nir_{t-1}[-\lambda + r^* + \rho]}{(1+\lambda)} - mf$$

48. **The historical primary surplus, which was sufficient to stabilize the public sector debt ratio, may be difficult to sustain in the future and, even if it were, it would not be sufficient to ensure debt sustainability under a reasonably ample range of possible macroeconomic outcomes.** As described earlier, public sector debt as defined in this report has remained stable at around 50 percent of GDP. The stability of the debt ratio has been achieved through a primary surplus that has averaged 1 percent of GDP over the past 5 years (Figure 2.35).[23] Such a surplus has been mostly the result of the central government efforts, as the central bank has been generating a small primary deficit. The current primary surplus position, however, is not a comfortable level going forward, since it has been achieved mainly through expenditure compression, which is not sustainable. In particular, public sector investment has been squeezed for a good number of years—with arguably adverse effects on growth (see Chapter 1)—and this is bottling up social and political pressures that will have to be acknowledged sooner or later through increases in education, health, and infrastructure investment.

Figure 2.35: Public Sector Primary Surplus
(Central Government and Central Bank, % of GDP)

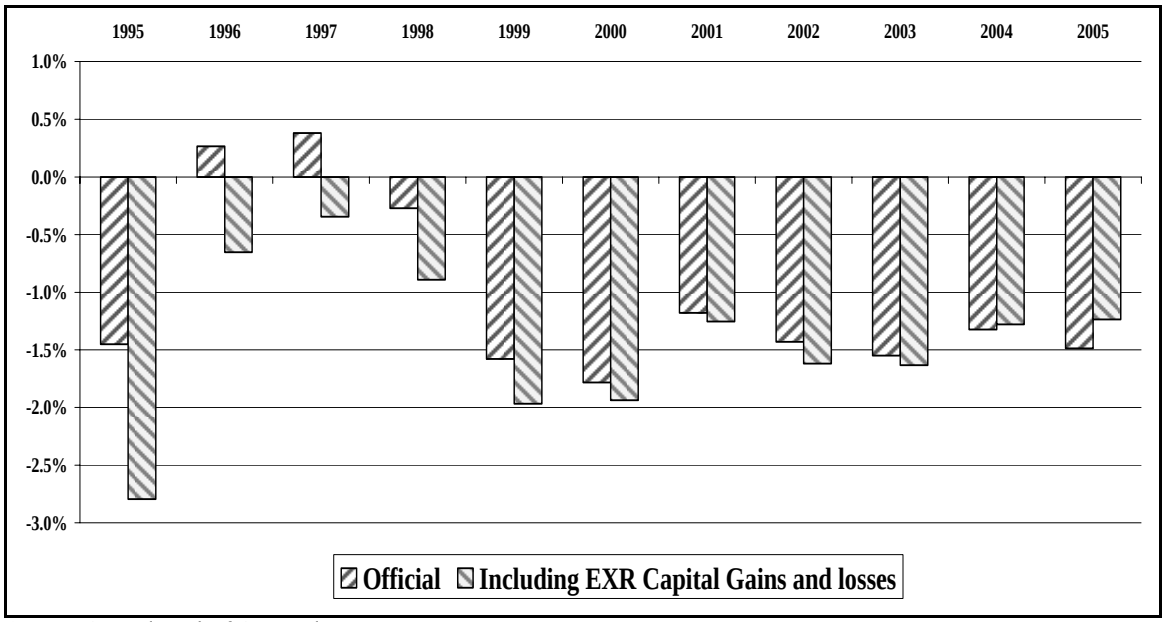


Source: Ministry of Finance and Central Bank of Costa Rica.

[23] The primary surplus of 2 percent in GDP achieved in 2005 is an outlier in the series and is widely considered by the Costa Rican authorities as the result of a series of transitory factors, with underlying expenditure pressures building up.

49. **On an overall basis, the central bank has been generating sustained quasi-fiscal losses, which have been around 1.4 percent of GDP per year in the recent past (Figure 2.36).** Quasi-fiscal loses are the result of weaknesses in asset selection and past activities as a development bank; more recently, they have been complicated by a sustained accumulation of international reserves. The central bank losses are a burden for debt sustainability, since they require the use of monetary financing to limit the increase of central bank debt. Monetary financing has been of the order of 0.6 percent of GDP per year, thereby covering less than half of the average annual quasi-fiscal losses. However, monetary financing sets a floor to the inflation rate.

Figure 2.36 Central Bank Quasi-Fiscal Balance
(in percent of GDP)



Source: Central Bank of Costa Rica.

50. **Furthermore, the buildup of pressures to increase public investment has coincided with the absence of political consensus to secure a sorely needed tax reform**. Hence, without a tax reform, the ability of the government to maintain a primary surplus of at least 1.5 percent for the future is in serious doubt. Moreover, even if a tax reform were approved, it would be politically difficult to allocate a significant portion of the additional revenues to increasing the primary surplus, given the mentioned pressures to raise public investment. This is even more worrisome considering that—as will be argued in the rest of this section—a primary surplus of at least 2.5 percent of GDP would be prudent and highly recommendable to ensure resiliency in fiscal solvency under a reasonable range of states of the world. This requires fiscal adjustment now, to avoid the greater pain of having to adjust by a larger amount later and through pro-cyclical fiscal contraction if such adjustment has to be instrumented in bad times.

51. **To make the case for a permanent strengthening of the primary surplus position, we conduct debt sustainability exercises under three approaches.** The methods, assumptions, and results of the three approaches are summarized and compared in Table 2.8

52. **Under the first approach, we derive the required primary surplus assuming a deterministic path for the endogenous macroeconomic variables.** The first approach is applied to four deterministic scenarios. The first two scenarios are based on historical values—one for "central" values, i.e., at their historical averages; the second for "stress" values, i.e., where variables deviate from their historical average by 1.6 times their historical standard deviation. In the "central" historical scenario, the required

primary surplus would be 1.3 percent of GDP, only 0.3 percent of GDP above its historical average. Under the "stress" historical scenario—with GDP growth at slightly below zero, the domestic real interest rate at 12 percent, the international real interest at about 4 percent, and the real exchange rate depreciating by 6.5 per year—the required primary surplus would be 4 percent of GDP per year, which is much larger than its historical average of 1 percent. The two additional deterministic scenarios took into account a passive versus a more active policy attitude. These yielded results contained within the bounds of the two previous historical scenarios: a required primary surplus of 1.9 and 2.7 percent of GDP for the active and passive scenario, respectively.

53. **The deterministic scenarios can also be used to illustrate the significant costs of postponing fiscal adjustment.** They show that delaying adjustment can significantly complicate debt sustainability. Every year that the adjustment is postponed and the existing fiscal policy is kept unchanged, the level of public debt increases and consequently the required primary surplus goes up. Assuming that default will always be avoided through fiscal adjustment, it is easy to show that the adjustment size will rise with the length of the delay in adjustment, especially under stressful circumstances. For example, if the adjustment were to be postponed for 5 years in the context of the historical "stress" scenario, the required primary surplus would increase from 4 to 6 percent of GDP.

54. **The deterministic approach suffers from at least two drawbacks: neither does it provide a basis to gauge the likelihood of the bad scenarios, nor does it explicitly capture the relationship structure between the macro variables.** To address these shortcomings we use two additional approaches. The first is a step in the direction of incorporating probabilities for the macroeconomic variables, without explicitly considering the relationship structure between such variables. Incorporating probabilities, even if tentatively, will help drive home the key message that risks exist and there are no guarantees that a "central" scenario will materialize. The second approach uses Monte Carlo simulations of a small vector auto-regression (VAR) macro model to generate a large sample of alternative scenarios to capture the relationship structure (given by the variance-covariance matrix) between the macro variables and the probability distributions for the alternative scenarios.

55. **A second approach is used to incorporate a probabilistic view for the trajectory of the endogenous macro variables.** The strategy is to create probability distributions for the trajectories of some of the macro variables using their historical means and standard deviations. As this simplified approach cannot accommodate more that two stochastic variables, we chose the real average interest cost of public debt (γ) and the growth rate of real GDP (λ). This choice is justified by the fact that these two are the more volatile of the macro variables and, according to their historical volatility, they have the largest impact on debt sustainability.[24] Consequently, ρ and r^* are kept constant at their historical averages and, as before, trend monetary financing is also treated as a constant.[25] Given that the histograms for λ and γ indicate a rather irregular distribution (Figure 2.37), rather than using their historical frequencies, we generated probability distributions for γ and λ by assuming a 40 percent probability for their mean values, a 20 percent probability for their values away from the mean by 0.8 times their standard deviations, and a 10 percent probability for their values away from the mean by 1.6 times their standard deviations.[26] The resulting range of required primary surpluses in this probabilistic scenario is presented in Table 2.6 that shows that if the interest rate cost were to stay at the historical average of around 8 percent, a 3 percent primary fiscal surplus would suffice to ensure debt sustainability,

[24] Nonetheless, we also ran the model with probability distributions, based on historical volatility, for r^* and ρ, while keeping constant γ and λ. The results point to much lower bounds for the required primary surplus.

[25] Of course, the risk of a fall in monetary financing associated with a burst in inflation and dollarization cannot be ignored. This issue was analyzed in the previous section.

[26] The probability distributions for γ assume that the sovereign premium (δ) remains constant at 3 percent.

irrespective of the value of the growth rate. Similarly, if the growth rate were to stay at its historical average of 4 percent, a 3 percent primary surplus would be sufficient for any realization of interest rates.

Figure 2.37: Histograms for Real GDP Growth and the Real Interest Cost of Public Debt

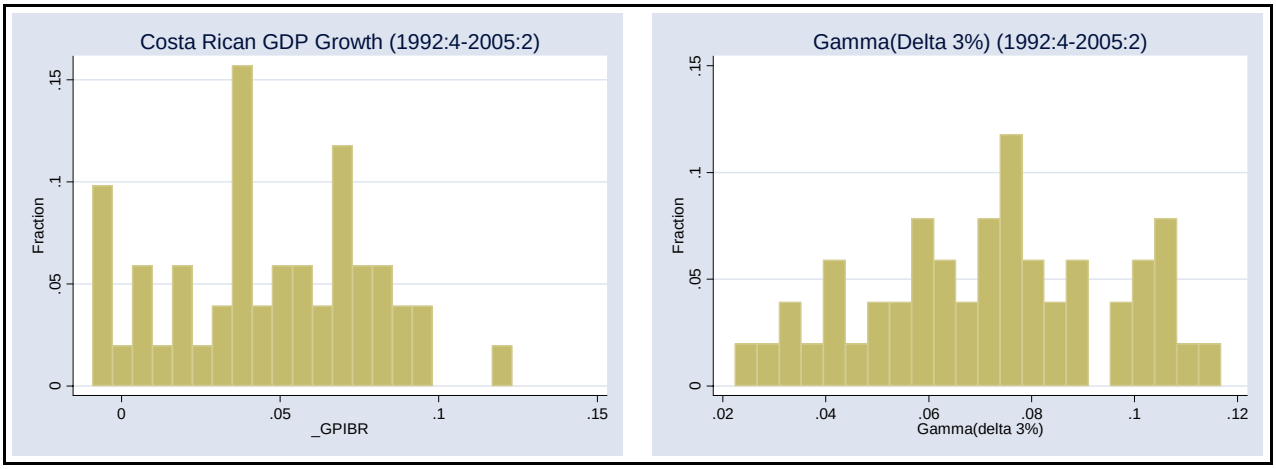


Table 2.6: Required Primary Surplus Under a Probabilistic Scenario For GDP Growth and the Interest Cost of Public Debt

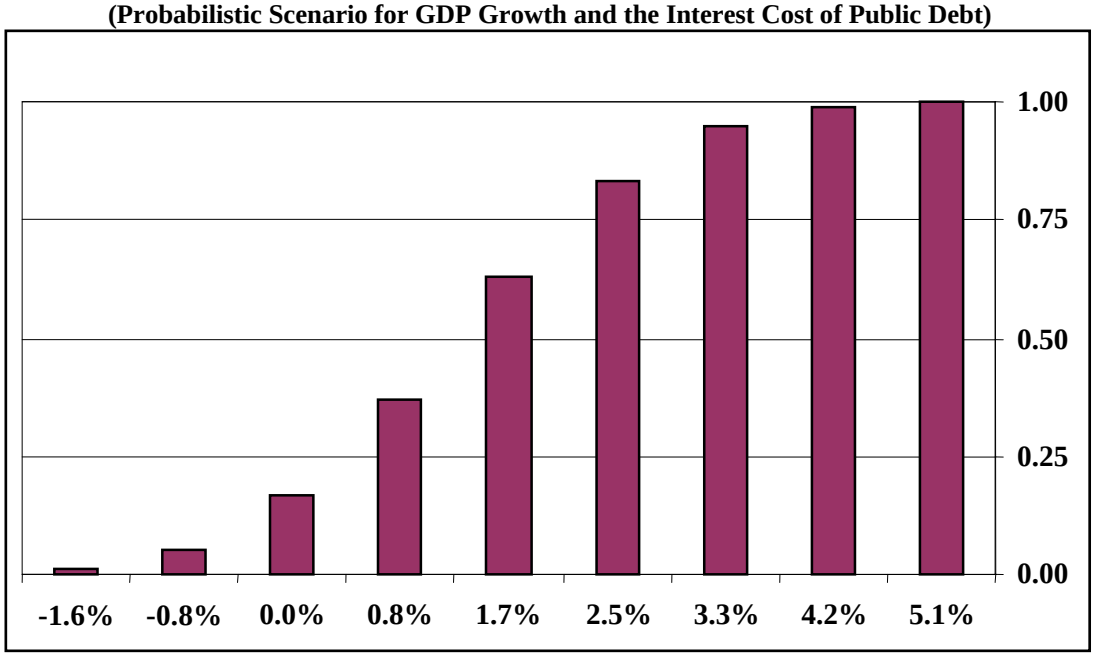
				Required Primary Surplus				
Debt / GDP (%) =	**50.8%**							
NIRt / GDP (%) =	**11.7%**			Real growth rate (lambda)				
mf (%) =	**0.6%**			Probability				
r* (%) =	**1.3%**			Cumulative probability				
rho(%) =	**1.1%**		lambda	**-0.2%**	**1.9%**	**3.9%**	**6.0%**	**8.1%**
				0.1	**0.2**	**0.4**	**0.2**	**0.1**
		gamma		0.1	0.3	0.7	0.9	1
		4.6%	**0.1** 0.1	**1.6%**	**0.7%**	**-0.1%**	**-0.9%**	**-1.6%**
Real interest rate cost (gamma)		**6.4%**	**0.2** 0.3	**2.4%**	**1.6%**	**0.8%**	**0.0%**	**-0.8%**
Probability		**8.1%**	**0.4** 0.7	**3.3%**	**2.4%**	**1.6%**	**0.8%**	**0.0%**
Cumulative probability		**9.9%**	**0.2** 0.9	**4.2%**	**3.3%**	**2.5%**	**1.6%**	**0.8%**
		11.6%	**0.1** 1	**5.1%**	**4.2%**	**3.3%**	**2.5%**	**1.7%**

Source: World Bank Staff Calculations.

56. **This second approach suggests that a primary surplus above 2.5 percent of GDP would be required to ensure debt viability at a reasonable confidence level.** The confidence interval is associated with a given probability (α) that the primary surplus would exceed what is required for public debt to remain sustainable. To this end, we build the cumulative probability distribution for the required primary surplus (Figure 2.38), using the assumed probability distributions of the macroeconomic variables. The key messages of are the following: To generate a confidence level that approaches certainty (α = 99 percent), the primary surplus would need to be kept permanently at above 4 percent of GDP. To be confident that debt would be sustainable 75 percent of the times, a primary surplus of 2.5 percent of GDP would be required. The historical average primary surplus of 1 percent of GDP would be

associated with a probability of 40 percent that debt would remain sustainable. This implies that the chances that the historical primary surplus would ensure debt sustainability are worse than the chances that a flipped coin would land heads up. The historical primary surplus of 1 percent of GDP was able to stabilize the combined debt of the central government and central bank at around 50 percent of GDP partly due to good luck—with relatively favorable macroeconomic outcomes—and partly at the expense of a higher-than-otherwise inflation rate. (As noted, the debt level would have been higher had the central bank chosen to finance all of its losses via debt issuance.)

Figure 2.38: Cumulative Probability Distribution for the Required Primary Surplus (Probabilistic Scenario for GDP Growth and the Interest Cost of Public Debt)



Source: Staff Calculations.

57. **A third approach is used to better capture the joint dynamics of the endogenous macroeconomic variables, the direct and indirect effects of exogenous shocks, and the consequences for debt sustainability of macroeconomic uncertainty.** This approach is based on Monte Carlo simulations of a small macroeconomic VAR model, which has several advantages.[27] First, the VAR technique is useful to generate the best predictor for the joint dynamics of the macro variables, without having to specify a structural model for the causality relationships among such variables. Second, it allows us to gauge the effects of exogenous variables and shocks, including terms of trade shocks, which by affecting the joint macro dynamics will have an indirect effect in the required primary surplus. Third, even if some variables are not included, the VAR may summarize their effect.[28] The use of Monte Carlo simulations of a VAR macro model allows us to derive, within a consistent setting, a probability distribution for the required primary surplus considering a wide array of stochastic trajectories for the endogenous variables, and in a way that captures their relationships, through the variance-covariance matrix.[29]

[27] A complete description of the vector auto-regression (VAR) procedure used in this paper can be found in Annex 3.

[28] For example, while the oil price is not included in the VAR model, its impact on the required primary surplus is picked up through changes in the terms of trade and through the endogenous real depreciation dynamics.

[29] The macroeconomic VAR model is a practical instrument to generate the forecasts needed to evaluate macroeconomic vulnerabilities. It is, however, subject to major caveats. In particular, it ignores structural elements of the Costa Rican economy and may be a limited representation of the tradeoffs.

58. **Key features, assumptions, and results of the estimated VAR model include the following.** The VAR model is given by the equation system (11) with the results reported in Annex 3 (Table A3.2). It considers as endogenous variables real GDP growth (λ), the real interest rate (r), and the rate of real depreciation (ρ). It also incorporates as exogenous variables the foreign currency real interest rate (r*), GDP growth in the U.S. ($\lambda*$), and changes in the terms of trade (τ).[30] Due to lack of data, the sovereign premium (δ)— which is in reality an endogenous variable—was subject to special treatment under two alternatives: first, holding it constant at its historical value of 300 basis points; second, using a stress level of 500 basis points.[31] The exogenous variables (r*, $\lambda*$, $\Delta\tau$) were forecast on the basis of their historical values and assuming a gradual convergence to their trends. The share of foreign currency debt in total debt (ϕ) was assumed constant at 46%. The ratios of NIR and monetary financing to GDP (*nir* and *mf)* were kept constant at 11.7 and 6%, respectively. The initial ratio of public debt to GDP was set at 51%, although an alternative scenario with an initial public debt of 60 % was also considered. The VAR was estimated using quarterly data for the period 1992:Q4-2005:Q2. Noteworthy results include the large effects on Costa Rica's economic growth of changes in the terms of trade and growth in the U.S. In addition, and surprisingly, the real interest rate was found not to have significant effects on growth.

$$
\begin{aligned}
(11)\quad \lambda_t &= f(\lambda_{t-1-i}, r_{t-i}, r^*_{t-i}, \delta_{t-i}, \rho_{t-i}, \Delta\tau_{t-i,}, \lambda^*_{t-i}) \\
\rho_t &= f(\lambda_{t-i}, r_{t-i}, r^*_{t-i}, \delta_{t-i}, \rho_{t-1-i}, \Delta\tau_{t-i,}, \lambda^*_{t-i}) \\
r_t &= f(\lambda_{t-i}, r_{t-1-i}, r^*_{t-i}, \delta_{t-1-i}, \rho_{t-i}, \Delta\tau_{t-i,}, \lambda^*_{t-i}); (i = 0,\ldots,n) \\
\delta_t &= \bar{\delta}
\end{aligned}
$$

59. **Monte Carlo simulations of the VAR model were used to generate probability distributions of the endogenous macro variables for each point in time, which enabled projecting both trends and deviations from trend for these variables**. The number of simulations used to generate the stochastic forecast was 5000. The forecast steady state values and associated standard deviations for the macro variables are presented in Table 2.7. The forecasts represent simulation results for the 40th quarter (ten years ahead). The simulation results are presented in the form of fan charts, which depict the whole distribution of outcomes for each period with shades of colors. The results indicate central trend values of 5.2 for GDP growth, 0.9 percent for real depreciation, 11 percent for the real interest rate in domestic currency, and 7.7 percent for the foreign real interest rate. Assuming a sovereign debt premium of 300 basis points, these results imply a 9.6 percent average real interest cost of public debt. With a foreign premium of 500 basis points, the average real cost of public debt increases to 10.5 percent. The distribution of λ, ρ and r are depicted in the Annex 3, with their projected central values represented by the dark line and the different intervals by the fan charts. It is clear that macroeconomic uncertainty is of significance, with all the variables subject to relatively wide confidence intervals.

[30] It was our intention to include also a productivity proxy, but this was not possible owing to limitations in employment data.

[31] There is no EMBI for Costa Rica and, consequently, any statistical series on sovereign risk has to be constructed using domestically issued bonds in foreign currency. Since they do not trade in the same markets and under similar regulations, other risks are also included in the interest rate differential, which contaminates the information content of the variable.

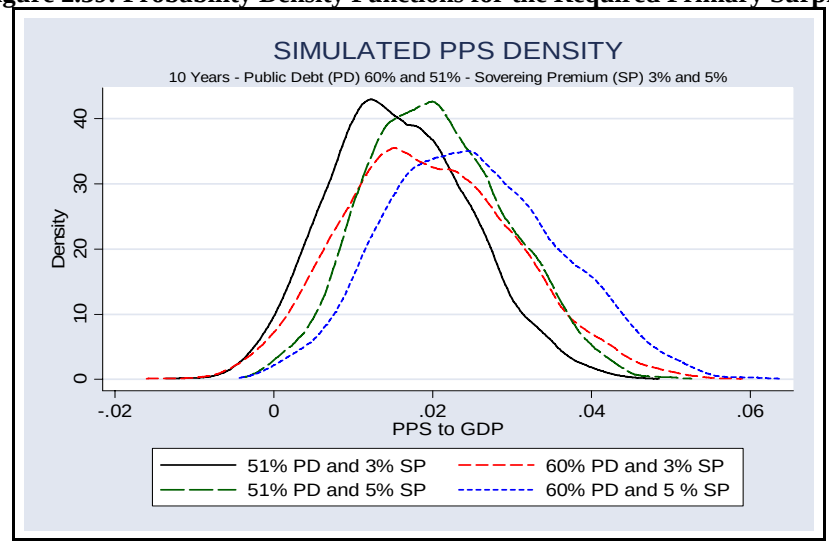
Table 2.7: VAR Simulated Values for the Macroeconomic Variables

Steady State Values (10 years)					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
λ	5000	5.2%	2.0%	-1.7%	11.5%
ρ	5000	0.9%	1.9%	-6.1%	6.6%
r	5000	11.2%	2.1%	2.4%	18.4%
δ=3%					
γ	5000	9.6%	1.3%	4.7%	14.1%
$r^*+\delta+\rho$	5000	7.7%	1.9%	0.7%	13.4%
δ=5%					
γ	5000	10.5%	1.3%	5.4%	15.1%
$r^*+\delta+\rho$	5000	9.7%	1.9%	3.3%	16.3%

Note: $r^* + \rho + \delta$ is the real interest rate of the debt denominated in foreign currency.
Source: Staff Calculations.

60. **This third approach also suggests that, to be on the safe side, a permanent primary surplus of at least 2.5 percent is needed to ensure resilient debt viability.** The thrust of the results under the third approach are, therefore, consistent with those of the second approach. Note that under the third approach the required primary surplus is not a single value; it is a probability distribution that reflects the uncertainty in the trajectories of the macro variables. The resulting probability distributions of the required primary surplus under the third approach are summarized in Figures 2.39 and 2.40 and are presented for different assumptions regarding the sovereign premium (300 and 500 basis points) and the initial public debt to GDP ratio (51 and 60 percent). The worse set of these two assumptions is used to illustrate the effects a postponing adjustment. The peak of the bell shaped probability density functions in Figure 2.39 represent the level of primary surplus that would give a 50-50 chance for the public debt to remain sustainable. This is, of course, a type of gamble that no prudent policy maker would be willing to make. Such a policy maker would prefer to have an insurance cushion to enhance the likelihood of debt sustainability, taking into account the macroeconomic volatility to which Costa Rica is subject.

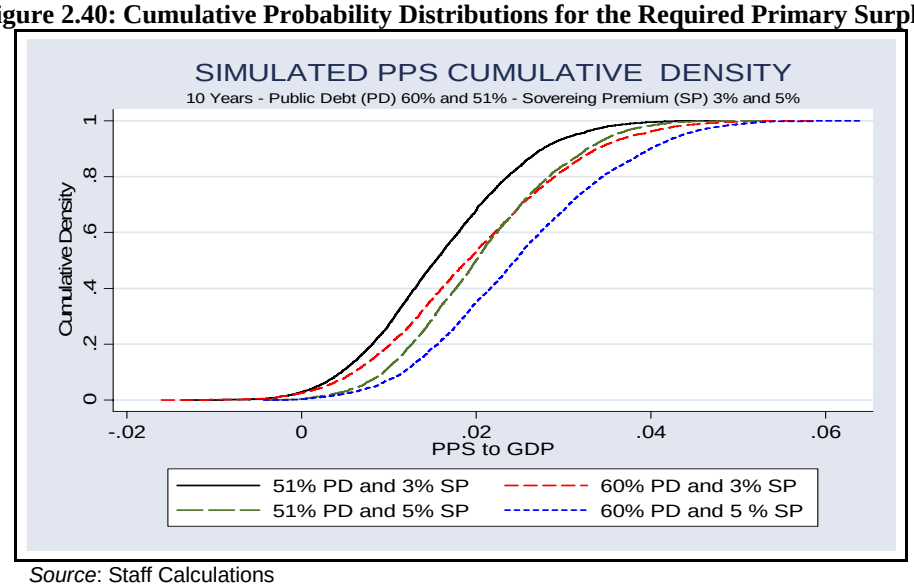
Figure 2.39: Probability Density Functions for the Required Primary Surplus



Source: Staff Calculations

61. **Figure 2.40 illustrates the choices faced by the policy maker**. It shows, that if the objective is to ensure at least an 80 percent probability that debt would be sustainable, a primary surplus of the order of 2.5 percent of GDP should be targeted. However, if fiscal adjustment is postponed and conditions deteriorate so that the initial debt ratio becomes 60 percent and the sovereign risk premium rises to 500 basis points (from 300 basis points), the required primary surplus would be 3.5 percent of GDP.

Figure 2.40: Cumulative Probability Distributions for the Required Primary Surplus



Source: Staff Calculations

62. **Note, finally, that the problem of the quasi-fiscal losses of the central bank is not automatically solved by raising the primary surplus; it would require, in addition, a direct capital injection.** Simulations performed using trend values for the macroeconomic variables, as obtained from the VAR model, and the monetary financing derived form the low inflation scenario indicate that the quasi-fiscal losses will continue to be a problem even with a permanent primary surplus of 2.5 percent of GDP. In effect, assuming such a primary surplus and a constant ratio of NIR to GDP, the level of central bank debt would stabilize at 11 percent of GDP, slightly below its current value, and the quasi-fiscal deficit would be reduced but not eliminated—it would stabilize at around 0.5 percent of GDP. To address

this problem, the central bank would need to receive a capital injection equivalent to 2 percent of GDP.[32] This would make the central bank debt converge to 5 percent of GDP under the mentioned scenario, and ensure that the quasi-fiscal loses are replaced over time by quasi-fiscal profits that would converge to 0.2 percent of GDP. Assuming that CB administrative expenditures remain constant as a percent of GDP, such profits would be transferred to the government beginning in 2022. The recapitalization of the central bank does not change in any fundamental manner the analysis of debt sustainability presented above.

2.5 Policy Discussion and Recommendations

63. **The preceding analysis has established the need for policies to mitigate the important downside risks to growth stemming from financial dollarization and public debt dynamics.** As regards financial dollarization, the analysis showed that the advance of dollarization would result in rising currency mismatches in the balance sheet of debtor firms and households that derive their incomes from the non-tradable sector. This would in turn increase banking system vulnerability to real exchange rate-induced credit risk, increasing the potential for a costly financial crisis In addition, currency mismatches may raise the probability of sudden capital flow reversals and self-fulfilling runs, exacerbating the liquidity risk already made high by the constraints that dollarization imposes on the central bank's ability to act as lender of last resort. Moreover, by eroding money demand, increases in dollarization would complicate further the viability of public debt, by exposing the public sector to a larger than otherwise debt accumulation and/or a higher required primary surplus. As regards public debt, the analysis made it clear that the emerging difficulties in maintaining the current level of the primary surplus (due to political impasses regarding tax reform and growing pressures increase public investment) are even more worrisome considering that, when macroeconomic uncertainty is adequately taken into account, a permanent increase in the primary surplus is the only prudent course of policy action.

64. **Policies to stop, and hopefully reverse, the rising dollarization trend must address the fiscal roots of the problem, and do so in earnest.** At the root of the dollarization phenomenon are systemic risks (particularly inflation risk) that create incentives for investors to prefer the dollar over the local currency. The policy effort should therefore focus on eliminating inflationary risk, which would necessarily entail the durable achievement of a stronger primary surplus. Moreover, if fiscal adjustment is postponed and dollarization continues to increase, a threshold of high dollarization might be reached that might render exchange rate flexibility and prudential actions powerless to prevent dollarization from becoming virtually complete (see Ize, 2006). Hence, there is a strong case for beginning in earnest with the implementation of a coordinated and multidimensional de-dollarization policy package.

65. **A convergence over the medium term towards a new monetary regime—characterized by inflation targeting cum exchange rate flexibility—is recommended but emphasis should be given to establishing the necessary preconditions.** Two preconditions are crucial in this connection. The first was already mentioned—a credible strengthening of the inter-temporal fiscal position, necessary to dispel perceptions of inflation risk as well as ensure that monetary policy is not encumbered by fiscal dynamics. The second precondition is maintaining and strengthening the independence of the central bank, subject to appropriate transparency and accountability standards. Such independence is necessary for the central bank to adhere steadfastly to its inflation objectives in the midst of political dissatisfaction. For instance, under the current favorable external environment, a flexibilization of exchange rate policy is likely to result in an appreciation of currency that would generate strong opposition from exporting lobbies. The more independent the central bank, the easier it would be to resist such pressures.

[32] This injection need not be in cash; to achieve it, the central bank could receive central government bonds or the central government could assume central bank debts.

66. **The gradual move towards inflation targeting and greater exchange rate flexibility requires a carefully designed and managed transition, as well as complementary policies in the prudential and debt fronts.** The transition should proceed very much along the lines set out in the recently published inflation report of the central bank. The use of bands for the exchange rate (or other forms of systematic currency intervention) can prove useful during the transition, but should be abandoned in favor of additional exchange rate flexibility as the inflation rate is reduced and when sharp conflicts arise between the inflation target and other objectives. This gradual move towards greater exchange rate flexibility and a firmer inflation anchoring should be complemented by prudential policies geared at ensuring that banks internalize better the dollarization risks. Several options could be considered in this regard, including the introduction of explicit provisioning or capital requirements to confront loan losses associated to currency mismatches, and/or the explicit incorporation of dollarization risks in the banks' own risk management activities. De-dollarization policies should also include sustained actions to foster the development of markets for local-currency and CPI-indexed debt instruments. CPI-indexed contracts could be promoted by introducing a CPI-indexed unit of account and encouraging pension funds and insurance companies to invest in such instruments. In addition, an appropriate framework should be put in place to ensure the integrity of the calculation of the CPI-indexed unit, on the one hand, and the enforceability of the associated financial contracts, on the other.

67. **The achievement of a stronger primary fiscal surplus—of the order of 2.5 percent of GDP—should be at the top of the policy priorities.** This policy objective is justified on many fronts—it would ensure debt sustainability under a wide range of macroeconomic outcomes, while facilitating de-dollarization and inflation reduction under a more independent monetary policy. *Moreover, by increasing the resiliency of fiscal sustainability, a higher primary surplus may give rise of a virtuous circle*—leading to greater investment confidence that would lift growth, which would in turn help the government grow out of debt and further fortify the primary surplus by enhancing tax revenues. The fact that the historical primary surplus of 1 percent of GDP was enough to stabilize the combined debt of the central bank and central government should not be a source of comfort. As noted, that was the case in part because of good luck and in part at the expense of higher-than-otherwise inflation. The 2.5 percent of GDP target, by contrast, would be ensure viability even under a relatively wide range of adverse scenarios and would be consistent with a low and stable inflation rate. To achieve a permanent improvement in the primary surplus position, the authorities should consider a strategy focused on strengthening fiscal institutions. This would be entail the establishment of enforceable budgetary rules that would protect fiscal solvency inter-temporally and reduce its pro-cyclicality—by inducing fiscal savings in good times to be used to stabilize spending in bad times. The authorities should also consider targeting the higher (2.5 percent of GDP) primary surplus without including the temporary increase in central bank seniorage revenues (discussed earlier). If such an increase were to materialize, it should be used to lower the level of debt directly

68. **The recapitalization of the central bank should constitute a separate policy priority, complementary to the objective of increasing the primary surplus, as it would significantly enhance the central bank's credibility in the fight against inflation.** As discussed earlier, the achievement of a stronger primary surplus is not likely to be, in and of itself, sufficient to eliminate the quasi-fiscal losses of the central bank. This problem should be addressed head on, through a capital injection from the government which, as noted, need not be in cash—it can be done via the issuance of central government bonds. This decision, while admittedly difficult politically, would enhance the fight against inflation because it would remove the pressure on the central bank to avoid adding to the debt problem by financing part of its losses via money printing. While the law prohibits the central bank to monetize the deficits of the central government, it does not require it to avoid monetizing its own deficits. Hence, as long as the central bank makes losses, investors would remain concerned that the central bank might engineer an inflation surprise to finance such losses. The capitalization of the central bank would also make the fiscal constraints more transparent not only to lawmakers but also to citizens at large. In

particular, by putting the associated interest costs explicitly in the government's budget, it would make it clearer that part of the additional revenues secured through an eventual tax reform would have to be used by the central government to pay additional interest payments (the interest payments on the debt issued to recapitalize the central bank) rather than deviated towards funding increases in central government non-interest expenditures. In other words, by making public sector accounts more transparent, the recapitalization of the central bank would enhance the chances that an appropriate portion of new revenues from a tax reform would be actually directed towards the needed increase in the primary surplus

TABLE 2.8: COSTA RICA SUMMARY OF RESULTS OBTAINED UNDER DIFFERENT APPROACHES

	METHODOLOGY	SCENARIO ASSUMPTIONS	RESULTS: REQUIRED PRIMARY SURPLUS
Approach I: Deterministic Scenarios	The required primary surplus for debt sustainability (i.e. debt remains constant at 50.8% of GDP) is calculated using deterministic assumptions of the main macroeconomics variables.	Common assumptions to all scenarios: Initial debt ratio (50.8% of GDP) and initial net international reserves (NIR) GDP ratio (11.7% of GDP) corresponding to the last available information for 2005; monetary financing (0.6% of GDP) and effective primary surplus (1.0% of GDP) representing historical averages for the last 5 years.	
		a) Historical Scenario: Macroeconomic variables remain equal to their 5 year average: GDP growth at 3.9%, real interest rate on debt at 8.1%, real international interest rate at 1.3% and real depreciation at 1.1%	Required Primary Surplus of 1.6% of GDP to maintain public debt at 51% of GDP, implying an adjustment of 0.6% of GDP from current levels. If the adjustment is postponed for 5 years, the required increase would be 0.7% of GDP.
		b) Stress Scenario: Macroeconomic variables deviate from the baseline by 1.6 times their historical standard deviations, always in an unfavorable direction: GDP growth is -0.2%, real interest rate on debt increases to 11.6%, real international interest rate increases to 3.9% and real exchange rate depreciation is 6.5%.	Required Primary Surplus of 4.1% of GDP to maintain public debt at 51% of GDP. This implies a fiscal adjustment of 3.1% of GDP from current levels (1%), or an adjustment of 5.3% of GDP from current levels if reforms are postponed for 5 years.
		c) Active Policy Scenario: GDP growth is 3.3% on average, while the real international interest rate is 1.4%. The rest of the variables are set equal to their historical averages as indicated in (a) above.	Required Primary Surplus of 1.9% of GDP to maintain public debt at 51% of GDP. This implies a fiscal adjustment of 0.9% of GDP from current levels (1%), or an adjustment of 1.0% of GDP from current levels if fiscal reforms are postponed for 5 years.
		d) Passive Policy Scenario: Real interest rate on debt is 9.1% on average, while the real depreciation rate is -1.8% (i.e., a real appreciation takes place over the period). The rest of the variables follow the same assumptions as indicated in (c) above.	Required Primary Surplus of 2.7% of GDP to maintain public debt at 51% of GDP. This implies a fiscal adjustment of 1.7% of GDP from current levels (1%), or an adjustment of 2.2% of GDP from current levels if fiscal reforms are postponed for 5 years.
Approach II: Historical Probability Distributions	The required primary surplus for debt sustainability is calculated using probability distributions assumed on the basis of historical averages and standard deviations for two variables: the average real cost of debt and real GDP growth. A probability of 40% was associated with the mean of the variable, a probability of 20% was associated with each, the mean plus 0.8 times the standard deviation and the mean minus 0.8 times the standard deviation, and a probability of 10 percent was associated with the mean plus and minus 1.6 times the standard deviation.	Real depreciation (1.1%), real international interest rate (1.3%) and monetary financing (0.6% of GDP) are kept at their historical averages (Historical Scenario above). Initial debt ratio (50.8% of GDP) and initial NIR ratio (11.7% of GDP) corresponding to the last available information for 2005.	Required Primary Surplus could be as low as -1.6% of GDP and as high as 5% of GDP depending on the value of the two endogenous macroeconomic variables (real interest rate of debt and GDP growth). If the real interest rate stays around 8%, a 3% of GDP primary fiscal surplus would suffice to ensure debt sustainability at any GDP growth level. If the GDP growth rate stays at its historical average of 4%, a 3.3% primary surplus would be sufficient for any given value of the real interest rate. The historical primary surplus of 1% of GDP is associated to the probability between 40 and 50% of debt remaining sustainable (fifty-fifty change). Finally, to endure 99% certainty of debt remaining sustainable under given policies, the primary surplus should be kept permanently above 4.1% of GDP.
Approach III: Forecasted Probability Distributions	The required primary surplus for debt sustainability is based on the forecasted probability distributions of the relevant macroeconomics variables and their uncertainty using Monte Carlo simulations. The simulation was based on a quarterly (1992:4 - 2005:2) vector autorregression (VAR) macro model of the Costa Rican economy. The simulations of VAR model using the forecasted exogenous variables allowed the model to generate projection for the endogenous variables both for their medium and long term trends, and for deviations from trend. The VAR results indicate mean trend values of 5.2% for GDP growth, 0.9% for real depreciation and 9.6% for real interest rate cost of public debt. The required primary surplus distribution could be presented as a bell shaped density function based on the simulated distributions of the macroeconomics variables.	The endogenous variables of the VAR model are GDP growth, real interest rate and real depreciation rate. The exogenous variables are the real international interest rate, GDP growth in the US and terms of trade growth. The exogenous variables will be forecasted on the basis of their historical values and assuming a non linear 5-year convergence to their long term trends as follows: US GDP convergence to 2.8%, international interest rate to 3.8% and terms of trade growth to 0%. The sovereign premium on pubic debt was assumed constant at 3% (base case) ad in the alternative stress scenario at 5% (worst case). Finally, the net international reserves GDP ratio was kept at 11.7% of GDP and the initial level of the public debt to GDP ratio was 51% (base case) or 60% (worse case). The required primary surplus distribution is conditional to the level of the sovereign premium and the initial level of debt for each case.	In the base case, the peak of the density function for the required primary surplus is obtained at 1.5% of GDP. With a permanent primary surplus of 1.5% of GDP there is a 50% probability for public debt to remain sustainable. In the worst case scenario, the mean of the distribution for the required primary surplus is 2.5% of GDP. To almost eliminate the probability of unsustainable debt, under the base case (worst case) the primary surplus would have to be around 4% (6%) of GDP. Under the base case, a 50% probability of sustainable debt is obtained with a primary surplus of 1.5% of GDP, and a probability of 80% is associated with a surplus of 2.5% of GDP. Under the worst case, an 80% probability of debt remaining sustainable is associated with a primary surplus of 3.5% of GDP. Therefore, the adjustment required to attain an 80% probability of sustainability would be in the order of 1.5% of GDP.

General assumptions: 1) Public Debt was defined as comprising the debt of the Central Government and the Central Bank. 2) Central Bank does not provide any financing to the government nor accumulates other forms of domestic credit. 3) Foreign Currency Debt represents a constant fraction of the total debt (46%).

Chapter 3 Costa Rica's Infrastructure: Contributor or Bottleneck to Growth?[1]

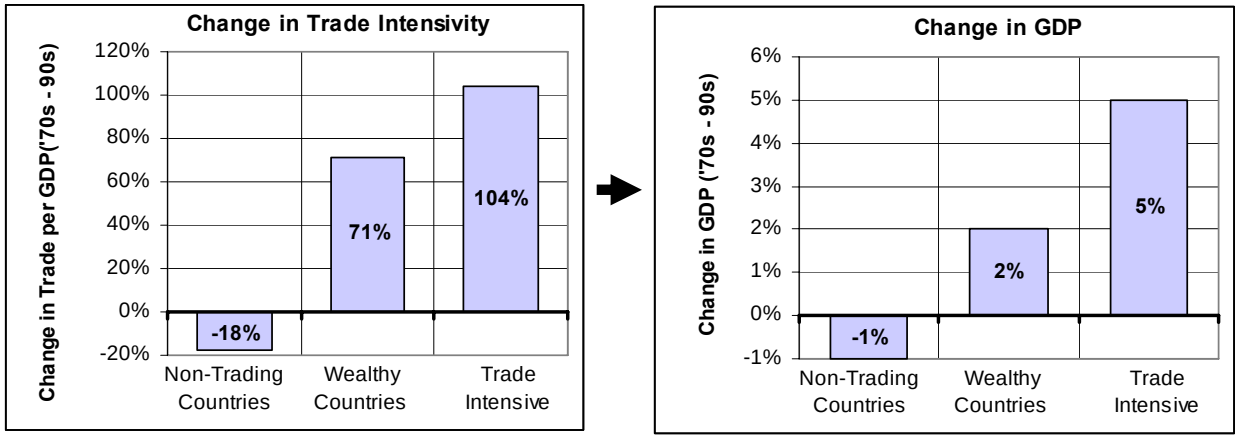
3.1 Introduction: Infrastructure for Trade and Growth

1. **This chapter investigates the role that infrastructure plays in economic growth.** It provides a summary of the arguments that link infrastructure, trade and growth as well as an overview of Costa Rica's infrastructure endowment and service quality. The objective of this chapter is to help prioritize the areas of intervention that will be needed in order for infrastructure to remain a key contributor, rather than a bottleneck, to growth.

3.1.1 Trade and Growth

2. **Trade has been an important element of economic growth for developing countries as varied as China, Bangladesh and Chile** (Figure 3.1). In fact, a division of the world's countries into three groups—developing countries that do not trade, wealthy countries, and developing countries that are trade-intensive—and an analysis of their growth rates from the 1970s to the 1990s illustrate the importance of trade for long-term economic growth[2]. Simply put, economies that are more open to trade grow faster, while those that are sheltered from trade grow slowly.

Figure 3.1: Relationship between Trade "Intensiveness" and Economic Growth



Source: Adapted from D. Dollar, World Bank (2002)

3. **Of course, trade alone does not account for all growth. High-level analyses of trade, such as the one above, capture variables correlated to trade activity, such as macro-economic and political stability that also contribute to growth.** What becomes clear from more targeted analysis is that opening up an economy to trade is important, but it is the ease at which capital and labor can shift out of low productive firms to higher productive firms as well as the underlying conditions of firm productivity which have at least as much impact on growth.

[1] This chapter was written by Jordan Schwartz (World Bank) based upon important contributions from Juan Navas-Sabater, Tito Yepes, Ada Karina Izaguirre, Emanuel Salinas, Juan Galarza Tohen and Daniel Chodos (World Bank) as well as Alejandro Vivas and Justin Pierce (consultants).

[2] Trade intensivity is defined here as the ratio of trade (exports + imports) to Gross Domestic Product. Growth in that ratio would therefore suggest that trade levels are growing faster than the GDP overall.

Available and efficient infrastructure is one such condition to firm productivity. An analysis of the factors that were important for Central America's growth from the 1980s to the 1990s suggests that infrastructure has had about as much impact on growth as increasing trade openness (Table 3.1).[3]

Table 3.1: Reasons for Changes in Growth, 1990s versus 1980s

	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua
Structural determinants					
Education	0.15	0.42	0.46	-0.10	0.48
Financial depth	-0.10	0.13	-0.06	-0.16	0.41
Trade openness	0.41	0.37	0.21	-0.07	0.30
Government burden	0.26	0.65	0.43	0.44	1.00
Infrastructure	0.35	0.63	0.41	0.60	0.37
Other	0.05	-0.11	-1.45	0.10	-0.72
Change in growth 1990s vs 1980s					
Predicted	1.13	2.09	2.44	0.82	1.84
Actual	3.80	4.14	3.05	0.84	4.40

Source: "DR-CAFTA: Challenges and Opportunities for Central America" World Bank (2005) as adapted from Loayza, Fajnzylber and Calderón (2002).

4. **Just as strong trade policies and efficient infrastructure can contribute to growth, trade barriers and poor infrastructure can stymie growth**. In Costa Rica's case, direct barriers to trade **such** as duties and quotas appear to be less constraining than physical bottlenecks in the production and movement of goods. Indeed, 52 percent of Costa Rican firms surveyed for the ICS found infrastructure to be a major or very severe constraint to their investment climate while only 7 percent of firms found trade regulations to be a major or very severe constraint. When asked in more detail about the infrastructure constraints, 42 percent found transportation to be a major constraint while 28 percent identified electricity and telecommunications services.

3.1.2 Infrastructure and Growth

5. **A wide range of empirical studies supports the conclusion that infrastructure is, in its own right, a major contributor to economic growth, particularly for developing countries**. The approach to understanding the linkage has varied, with different analyses considering:

- the impact of infrastructure on aggregate Total Factor Productivity (Krugman, 2004);
- the impact of individual sectors on growth (Roller and Waverman for telecommunications or Fernald for roads);
- the region-specific impact of infrastructure stocks across sectors; (Calderón and Servén, 2003); and
- the separate impact of service quality on growth as opposed to just infrastructure endowment (Esfahani and Ramírez, 2002 and Calderón and Servén, 2004).

6. **The cumulative result of this literature is a robust demonstration of infrastructure's role as a driver of growth**.[4] Underlying the "direct linkage literature" (infrastructure and growth), is the

[3] Trade and infrastructure also complement each other in their joint impact on growth. Efficient infrastructure helps trade to boost growth while increasing trade leads to greater demand for infrastructure allowing for greater investment, lower per unit costs and higher firm productivity.

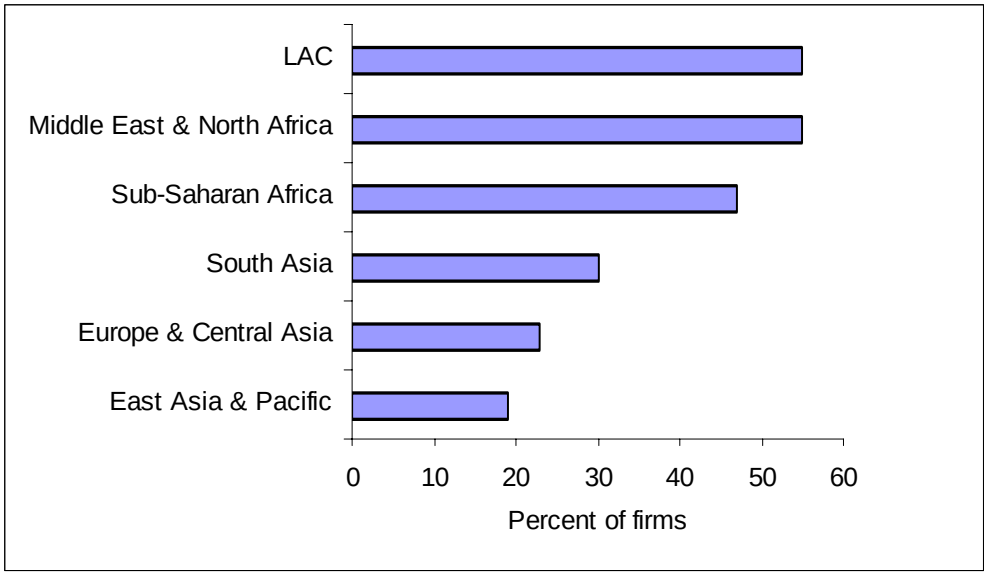
recognition that infrastructure is an important determinant of firm productivity. That is, the supply, quality and price of infrastructure are defining elements of firm cost structure and competitiveness. With trade liberalization spreading, logistics and transport costs alone tend to be higher than duties imposed on imports as well as the cost of quotas and other non-tariff barriers.

3.1.3 Infrastructure and Firm Competitiveness

7. **This micro or firm-level perspective on the importance of infrastructure for competitiveness can be captured two ways: through perception-based surveys of firms and investors; or through firm-level analyses that evaluate the costs of doing business.** Many surveys--such as the World Economic Forum's Business Competitiveness Index--query observations of firm managers and investors about infrastructure services. Other surveys, such as the World Bank's Investment Climate Surveys, extract and compile financial and trade data from individual firms to illustrate the relative importance of each element of production, including transport services, customs, electricity and telecommunications. When aggregated, the surveys reveal infrastructure-related impacts such as bottlenecks to the shipment of goods; the impact of delays and lost, damaged or stolen cargo on shipment values; and the cost impact of energy and telecommunications service problems.

8. **Across Latin America, the importance of infrastructure on firm competitiveness has been confirmed in survey after survey** (Figure 3.2). Over half of all firms in the region questioned as part of the Investment Climate Surveys, considered infrastructure to be a major obstacle to the operation and growth of their business. That level, shared by the Middle East and North Africa, is the highest in the world.

Figure 3.2: Business That View Infrastructure as a Serious Problem (% of Firms)



Note: Figure shows the share of firms that report electricity, telecommunications, and/or transportation as "major" or "severe" obstacles to the operation and growth of their business.
Source: World Bank 2004 based on Investment Climate Survey data.

[4] Synthesized from Fay and Morrison (2005), and Calderón and Servén (2004b) with input from Briceño-Garmendia, Estache, Shafik (2004)

9. **Beyond perceptions of managers, the detailed cost results of the ICS suggest that competitiveness is affected by poor infrastructure**. Indeed, an in-depth cross country analysis of the ICSs confirms that infrastructure is a major determinant of Total Factor Productivity (TFP) [5]: The cumulated effect of infrastructure-related variables on TFP adds up to about 55 percent for the countries studied.[6] Infrastructure variables with the highest impact on average productivity include poor electricity and transport services.

10. **Perhaps more importantly, the analysis also found that the poor conditions of infrastructure in Latin America affect firms' integration into global markets**. Poor infrastructure affects the capacity of firms to export, as well as the ability of countries to attract foreign investments. It thus reduces opportunities for greater international integration, higher competitiveness and enhanced technology and innovation. Because of the importance of infrastructure in the physical movement of goods, bottlenecks contribute to high logistics costs which, in turn, lead to high inventory levels in Latin America and the Caribbean. Average logistics costs through the region range from a low of 15 percent of product value in countries such as Chile to a high of 34 percent, in Peru. Unreliable infrastructure will result in higher losses in transit, the need to hold higher inventory rather than order just-in-time, and generally higher cost of transport.

11. **The Logistics Survey conducted for this study focused on three high value-added goods and found the range of logistics costs as a percent of value to be 13 to 15 percent.** This suggests that the national average, which would include the movement of low value goods (such as cement—the primary import into Puerto Caldera), is considerably higher.[7] How does that compare with industrialized countries which should serve as the benchmark for Costa Rican competitiveness?

12. **The average share of all logistics costs to product value in OECD countries is around 10 percent**.[8] This average includes the full range of high value and low value shipments suggesting that Costa Rican firms are faced with a significant cost disadvantage when competing against firms in industrialized countries. Much of this extra logistics cost burden that has been placed on Costa Rican products can be attributed to differences in infrastructure quality and reliability—particularly in transport. Poor quality and reliability result in damaged goods, demurrage charges, lost sales and higher inventory levels. While U.S. businesses typically hold inventories of around 15 percent of GDP, inventories in Latin America and other developing regions are often twice that (Guasch 2004). Such levels are expensive to maintain, principally because they tie up capital which has a high cost in most of LAC. This significantly increases unit costs, diminishing competitiveness and productivity. Guasch estimates that, assuming an interest rate for financing holdings of 15-20 percent, the cost to an economy of additional inventory holdings is more than 2 percent of GDP.

13. **For Costa Rica, this lesson is of critical importance: In order to unlock the benefits of trade, infrastructure must be available, reliable and cost effective and a wide range of firms must have access to that infrastructure.** The aim of this chapter is to evaluate the performance of the physical infrastructure and logistics services as integral parts of the production chains of Costa Rican firms. By focusing on the bottlenecks to trade that are revealed through this process, policy makers can address the country's competitiveness and potential to achieve higher growth rates.

[5] Escribano and Guasch (2005)

[6] Based on ICS data for El Salvador, Honduras and Nicaragua.

[7] Transport costs alone often represent more than 50 percent of the delivered cost of low-value goods such as cement, coal, coke, grains and other products shipped in bulk.

[8] See L. Guasch, The World Bank (2002)

3.1.4 Infrastructure-Related Constraints and the Competitiveness of Costa Rica's Firms

14. **The infrastructure chapter uses sectoral diagnostics, the Investment Climate Survey as well as a product-level Logistics Survey to understand the infrastructure-related bottlenecks to trade that Costa Rican firms have identified.** The Investment Climate Survey (ICS) questions a wide range of manufacturing firms about a number of constraints to doing business in Costa Rica—including cost inputs such as electricity, telecommunications and transport services. The Logistics Survey conducted specifically for the CEM and ICA is aimed at a critical mass of firms in three specific sub-sectors of activity, each vital to the diversification of Costa Rica's exports: processed foods, cut flowers and medical equipment.

15. **The results of the sectoral diagnoses and the surveys tell a remarkably consistent story across infrastructure sectors about the unique paradox that Costa Rica now faces:**

- *On one hand*: The country possesses a tremendous endowment of infrastructure forged from a legacy of responsive public agencies. That is, access to infrastructure in a broad sense is excellent in comparison with neighboring countries.
- *On the other hand*: Service and infrastructure quality are suffering from underinvestment, lack of innovation and weak regulation and that is impacting firm competitiveness.

16. **Over decades of steady investment, Costa Rica built an extensive network of infrastructure in nearly all productive service areas**. The financing of this infrastructure has mostly relied on public funds and the management and operations of the services has relied on public institutions. These transport, electricity and telecommunications networks were allowed to develop in the context of a profound sense of "social compact" felt by taxpayers toward public service providers. That public trust has largely been reciprocated through the decades by the public institutions which provide basic services. The resulting infrastructure endowment has contributed to Costa Rica's high and stable growth levels

17. **Despite past successes in building out infrastructure networks, public expenditure levels have recently become uneven by sector and some of the public service providers have been unable to keep up with sectoral innovation**. The private sector has not been allowed to play a compensatory role because of the long-established position of public authorities and agencies as integrated owners, operators, investors and managers of infrastructure services. The result has been a decline in the quality of services across sectors--even as connectivity remains high. That quality slippage is beginning to affect firm competitiveness, particularly for small and medium-sized manufacturers.

18. **In addition the immediate impact on firm competitiveness, Costa Rica's reputation as an attractive investment location may also be impacted by the faltering quality of infrastructure services.** A recent survey of major industrialists gave Costa Rica low marks in the quality of its transport infrastructure (Table 3.2). Costa Rica ranked poorly in most categories of transport infrastructure in the survey of business executives contained in the World Economic Forum's Global Competitiveness Report 2004-2005. In regards to ports, Costa Rica was tied with Guatemala for the lowest ranking in its peer group. Air transport was the only category in which Costa Rica's score exceeded the peer group average.

Table 3.2:Comparative Survey on the Quality of Infrastructure

	Overall infrastructure quality	*Port infrastructure quality*	*Air transport infrastructure quality*
Argentina	3.6	3.6	4.1
Brazil	3.5	3.1	5.1
Chile	4.9	4.8	5.7
Colombia	2.9	3	4.4
Costa Rica	**3**	**2.5**	**4.8**
El Salvador	4.4	3.3	5.6
Guatemala	2.7	2.5	3.5
Honduras	3	3.8	3.3
México	3.4	3.3	5
Panamá	4	5.7	5.2
Indonesia	4.2	4.4	4.4
Philippines	2.5	2.6	3.9
Thailand	4.6	4.2	5.3
Average	**3.6**	**3.6**	**4.6**

Note: Survey based subjective evaluation on scale from 1-"poorly developed and inefficient" to 7-"among the best in the world".
Source: World Economic Forum, Global Competitiveness Report 2004-05

19. **The rest of this chapter examines the state of Costa Rica's productive infrastructure using international comparisons to highlight areas of strength and weakness**.[9] Results of the Investment Climate and Logistics Surveys are used to incorporate the perspective of firms and to identify the impact on competitiveness and trade caused by infrastructure bottlenecks. The chapter begins with **an** analysis of the endowment of productive infrastructure in Costa Rica. That section is followed by a comparison of the quality of services available in transport, electricity and telecommunications. The fourth section provides an analysis of the flow of investment in infrastructure as well as a diagnostic of financing challenges related to infrastructure services. The final section of the chapter provides sectoral recommendations for policies to address the supply, quality and financing challenges raised in the earlier section.

3.2 The Endowment of Costa Rica's Infrastructure

20. **A high-level review of Costa Rica's transport, electricity and telecommunications endowment reveals a country that is a regional leader in productive infrastructure.** Across all of Costa Rica's primary, productive infrastructure backbone—roads, electricity and telecommunications—the country has made remarkable achievements in providing access to a large portion of its citizens and businesses. In transportation, Costa Rica leads its peer group in road density, **measured** as the length of total or paved roads per worker. Indeed, it has 30 percent more paved roads per worker than the next most densely paved country in Latin America. In electricity, the reach of the network and connection rates are among the highest in the region while the country ranks third in electricity capacity per capita. Costa Rica has made impressive progress in the availability of information and communication technology (ICT), ranking first among its peers in mainline teledensity as well as personal computer density and second in Internet usage.

21. **Growth in the endowment of most of Costa Rica's productive infrastructure has begun to wane in recent years**. In transport, Costa Rica's paved road density has declined each year since a high

[9] For purposes of this chapter, productive infrastructure is defined as paved roads, port and airport quality, electricity generation capacity, teledensity, availability of personal computers and Internet access.

in 1998 as growth in paved roads was offset by more rapid growth in the labor force. While this trend **reversal** is not alarming in itself, it is a reflection of declining investment in the sector. Indeed, the maintenance of such an extensive network has proven to be a core challenge for the Government of Costa Rica—a point which is discussed in more detail in the following section on infrastructure quality. Similarly, efforts to increase the capacity of the ports through a concessioning program in Calderas and a rationalization of operations at Limon and Moin have not progressed, forcing about 60,000 containers per year to move through Panama's ports. Likewise, an upgrading of the international airport has been on hold while the awarded concession has battled through the court systems.

22. **In electricity, generation expansion has stopped over the last few years and shortages loom in the future without a rejuvenation of the investment program.** Mobile telephony has also has not kept up with neighbors, competitors or the potential of Costa Ricans to utilize the new technology. As for the quality of services, the ICS reveals that Costa Rican businesses suffer from surprisingly frequent outages and long waiting periods for connections in both electricity and fixed line telephony.

3.2.1 Transport Infrastructure Endowment

Figure 3.3: Main Road Corridors of CR

Source: Ministry of Transport

23. This section focuses on the Costa Rica's main transport assets: the primary intercity road network, the ports of Limón Moín and Caldera, and the international airport (Figure 3.3). Unlike many other countries, Costa Rica retains a single large supply and demand center—the Central Valley around San Jose—making its primary logistics network easier to define. The inter-oceanic corridors that pass through Greater San José, and, to a lesser degree, the two parallel corridors that connect Costa Rica to its neighbors serve as the main axes of transport infrastructure and underpin the competitiveness of Costa Rica's trade. The inter-oceanic corridor is made up of two segments connecting each coast with the Central Valley where the main cities are located. The logistics corridor of San Jose-Limón and the access to Limón from the north represent two of the primary trading routes in Central America.

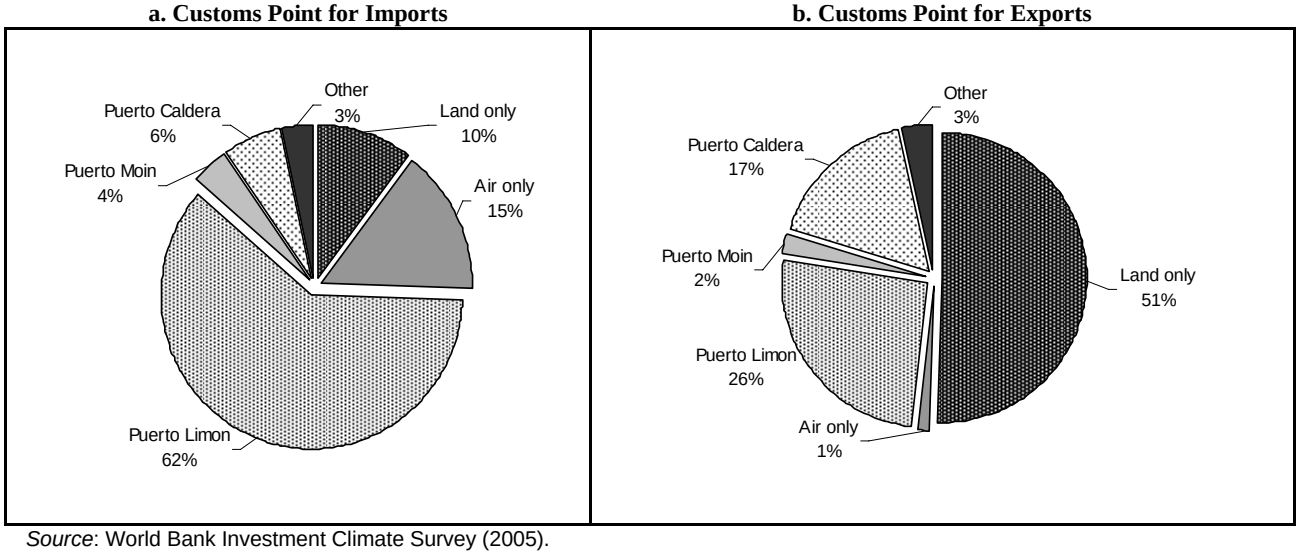
24. **If viewed as independent gateways to trade, each mode--roads, ports and airports—serves as a critical component of Costa Rica's logistics network for reasons that are best illustrated by different types of usage data. There are three ways to view the use of a given transport mode in trade:**

- By numbers of firms, which gives equal weight to small firms moving small quantities as to large firms moving large quantities of product;
- By volume, which indicates the traffic throughput that each mode of transport must handle; and
- By value, which reflects the importance of a given mode in the national trade accounts.

25. **The diagrams below show use of transport mode by number of firms—thus giving equal weight to all firms regardless of how much they ship or the value of their shipments** (Figure 3.4). Firms interviewed in the ICS reported using maritime transportation as their primary mode for imports—with two-thirds of those shipments coming through the Atlantic ports (Figure 3.4 a). For exports, the data are more equitable (Figure 3.4 b). Surface transportation was reported as the most frequently used mode at least to the customs points of the country. This reflects the disproportionate role of small firms in regional trade as well as the growing use of Panama's ports as an export juncture.

Figure 3.4: Diagram: Use of Transport Modes, by Percentage of Firms that Trade

a. Customs Point for Imports **b. Customs Point for Exports**

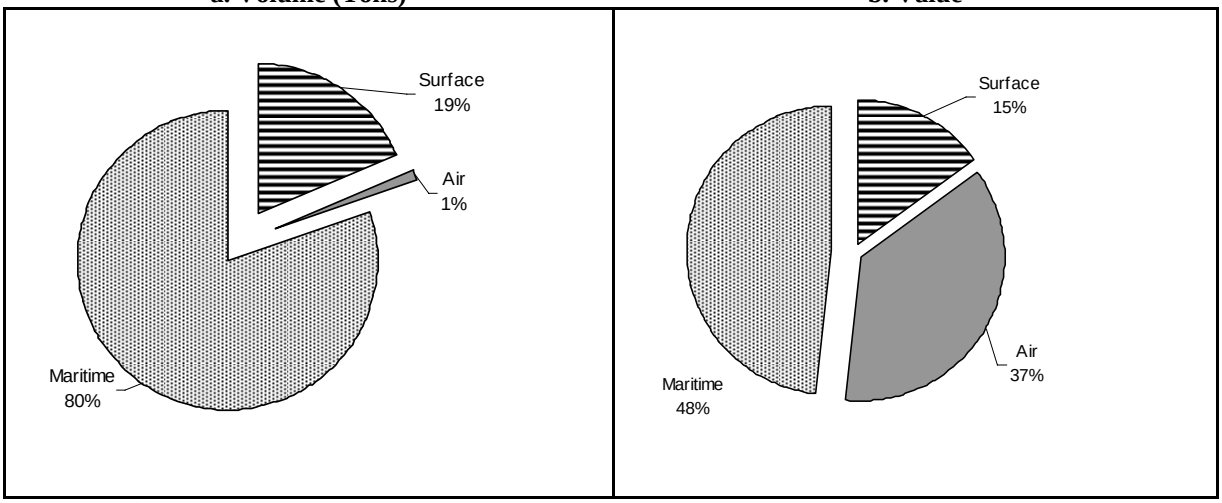


Source: World Bank Investment Climate Survey (2005).

26. **Use of transport mode for export by volume and value offers a different perspective on the relative importance of each mode of transport** (Figure 3.5). Maritime corridors represent 80 percent of exports on a volume basis and about half of exports by value. This difference is the result of the value of time and the resulting use of air shipment for high value, low weight products such as medical equipment, cut flowers or computer chips. In fact, air shipments represent only 1 percent of the volume of exports but 37 percent of the value of exports. Another important characteristic in the different usage data is the small percentage of exports—by volume or value—that use surface transport (roads) as opposed to the large number of firms that report a dependence on roads for expoert. The fact that 50 percent of firms are exporting by land while only 19 percent of exports by volume or 15 percent by value leave Costa Rica by land suggests that smaller firms are more dependent on regional markets, and thus the road network, for their exports.

Figure 3.5: Distribution of Exports by Transportation Mode, Average 2001-2004

a. Volume (Tons) **b. Value**



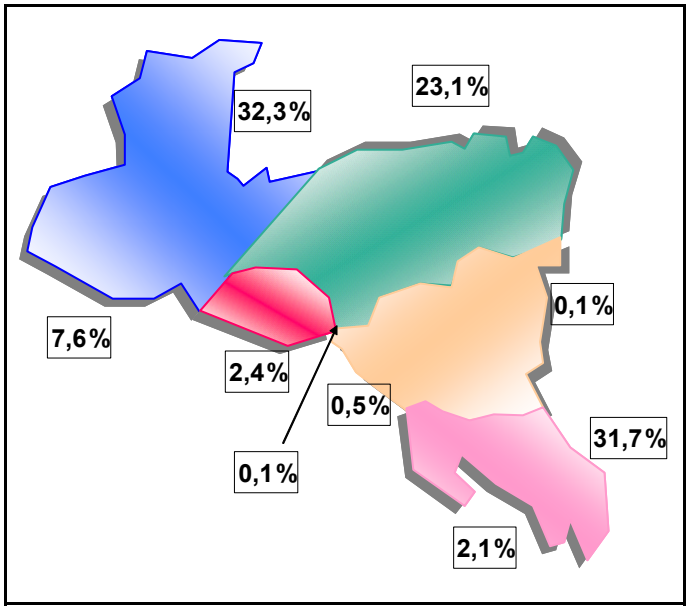
Source: ECAT, MPWT

27. **The data in combination suggest that all three modes are important.** Considered through the lens of these three sets of data, the road network surfaces as the central concern for smaller firms which are trying to export; the ports are vital because they handle the vast majority of Costa Rican cargo movements; and the international airport remains a key asset for its disproportionate role in the shipment of high value goods. A logistics or transport strategy intended to increase the competitiveness of Costa Rica's exports will thus have to pay due respect to all three modes as well as their interconnectivity.

28. **The pull of Limon-Moín is a defining characteristic of Costa Rica's trade.** Given that Costa Rica is the wealthiest country of Central America and its primary trading partners require maritime transit to the East, the Ports of Limon-Moín represent an important channel for the sub-region's commerce (Figure 3.6). As can be seen from the map below, Mo*i*n-Limón handles nearly one-third of all containerized cargo from Central American countries, making it Central America's busiest port area (excluding Panama).[10]

[10] Panama's ports handle about as much container cargo as the rest of Central America combined. These volumes include significant amounts of Europe-US-Asia transshipment cargo passing through the Canal, but they also include most of Central America's Asia-destination and origin container traffic, particularly that of Costa Rica.

Figure 3.6: Distribution of Handled Containers in Central America



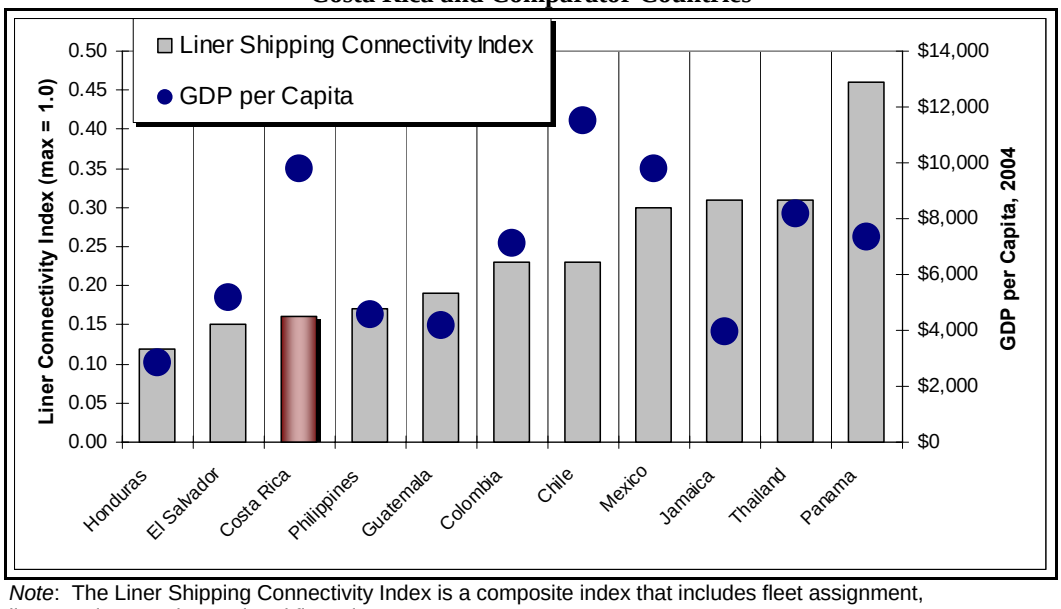
Source: M. Sgut (2005)

29. **Because Costa Rica's trade outside of Central America represents over 80 percent of its total trade, port access and efficiency is a major concern for the country's firms**. Limon is the primary port of the country in terms of both imports and exports, handling nearly 76 percent of the country's freight. Exports at Limon are concentrated (82 percent) in primary sector-related products in which logistics play a central role in their competitiveness. As detailed in the later section on infrastructure quality, the capacity and performance constraints of Limon-Moín combine to make the port expensive and inefficient.

30. **Port infrastructure was heavily criticized by the firms interviewed in the Logistics Survey.** This criticism targets access roads, cranes, container berths and pier depth. Firms identified limitations and outdated technology in the terminals which prevent the provision of better loading and unloading, and embarkation and debarkation and the current constant delays need to be eliminated. For instance, in the Limón case, the access roads are deteriorated and there is only one port crane, which leads to delays in the loading process.

31. **As a result of the capacity constraints and the inefficiencies described later in this chapter, Costa Rica ranks well below the standard set by its level of income in the area of liner connectivity** (Figure 3.7). That is, a single score given to the country based upon the number of containers handled at its ports, the frequency of regular container shipping services, and the size of the vessels that call the nation's ports reveal a national shipping endowment that is typical of much less developed countries.

Figure 3.7: Liner Connectivity Index of Costa Rica and Comparator Countries

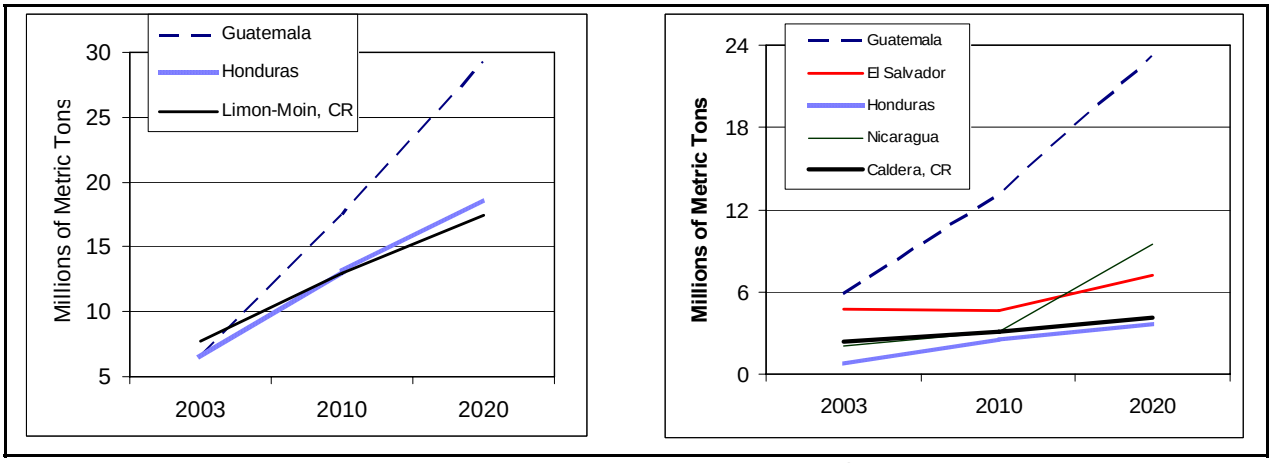


Note: The Liner Shipping Connectivity Index is a composite index that includes fleet assignment, liner services, and vessel and fleet sizes.
Source: UNCTAD (2006)

32. **The implications of inadequate port capacity, inefficient port services and poor liner connectivity on the future of Costa Rica's export competitiveness cannot be overstated**. Forecasts of maritime trade from the ports of Central America undertaken by UNCTAD anticipate Costa Rica's rapid loss of leadership in the area of cargo shipment (Figure 3.8). Indeed, Guatemala is expected to nearly double Costa Rica's East Coast shipping movements by the year 2020 while even Honduras is expected to surpass Costa Rica over the same period. At current performance levels, Caldera will be an even less significant player in Pacific cargo movements within 10 years.[11]

Figure 3.8: Projected Port Throughput by Country and Coast (Volumes in Millions of Metric Tons)

a. Caribbean Ports **b. Pacific Ports**



Note: Pacific ports' forecasts do not include development of the Port of Cutuco at La Unión, El Salvador.
Source: Authors' calculations based on forecasts of UNCTAD (2006)

[11] Imported volumes in Caldera were seven times export volumes in 2003. This suggests that all Asia and most West Coast-bound exports must travel to Panama to find a port of exit.

33. **Where will Costa Rica's cargo go if not through its own ports? There are two parts to the answer to that question.** The most obvious response is that Costa Rica's cargo will move increasingly through Panama's ports (Table 3.3). Indeed, data taken from all four of Panama's primary ports show that, in 2005, over 60,000 containers coming from or going to Costa Rica moved through Panama's ports.

Table 3.3: Costa Rican Container Traffic through Panama Ports in 2005
(Number of Containers)

Ocean	*Panamanian Port*	*Costa Rican Cargo*			
		Imports	**Exports**	**Total**	**Trade Imbalance**
Atlantic	Puerto de Colon	15,209	498	15,707	-14,711
	Puerto de Manzanillo	20,998	22,601	43,599	1,603
Pacific	Puerto Cristobal	69	118	187	49
	Puerto Balboa	2,583	1,335	3,918	-1,248
	Total	38,859	24,552	63,411	-14,307

Source: Autoridad Marítima de Panamá

34. **This represents about 100,000 TEUs or over 15 percent of Costa Rica's container traffic.** Because of the trade imbalance, nearly one-fourth of all trucks are empty (non-revenue) between Costa Rica and Panama doubling the impact on the shipper from cost of operating those trucks. From these figures it is possible to calculate about 80,000 truck movements a year (220 per day) that are moving mostly between Panama's Atlantic ports to and from the Central Valley of Costa Rica—along 800 or so kilometers of road as opposed to the 162 kilometers of road between San Jose and Puerto Limón. When converted into costs, Costa Rican firms are absorbing about $1500 of extra road haulage fees per container to move their cargo through Panama. This totals approximately US$100 million per year in additional road haulage costs to avoid Limon-Moín.

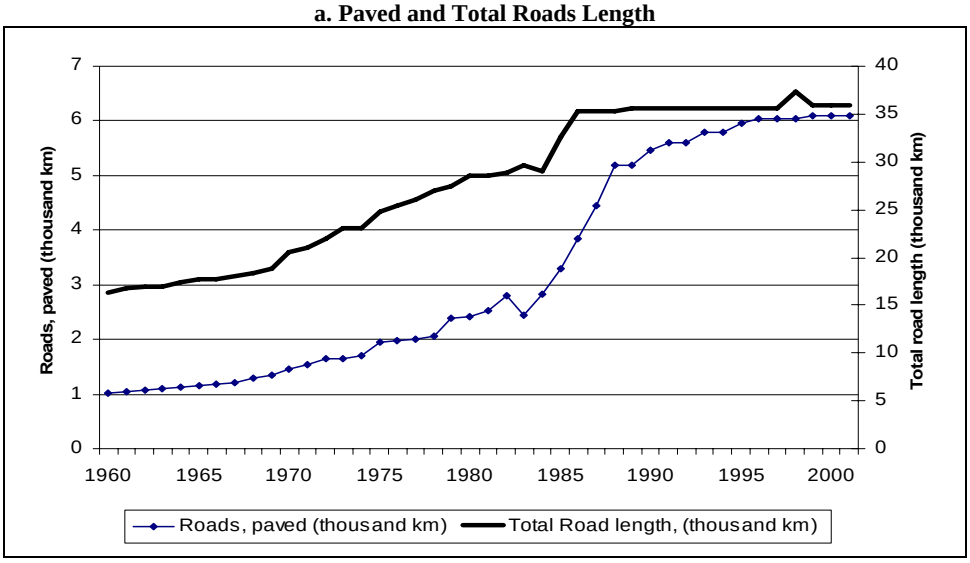
35. **The other part of the answer to the question about what will happen to Costa Rica's cargo in the absence of increased efficiency and capacity at its Atlantic ports is harder to quantify but equally important to consider.** The comparative disadvantages offered by an inefficient and capacity-constrained logistics network will mean fewer firms that will be able to afford to acquire needed inputs from overseas or to compete for export markets. That is, there will be less Costa Rican cargo overall.

The Road Endowment

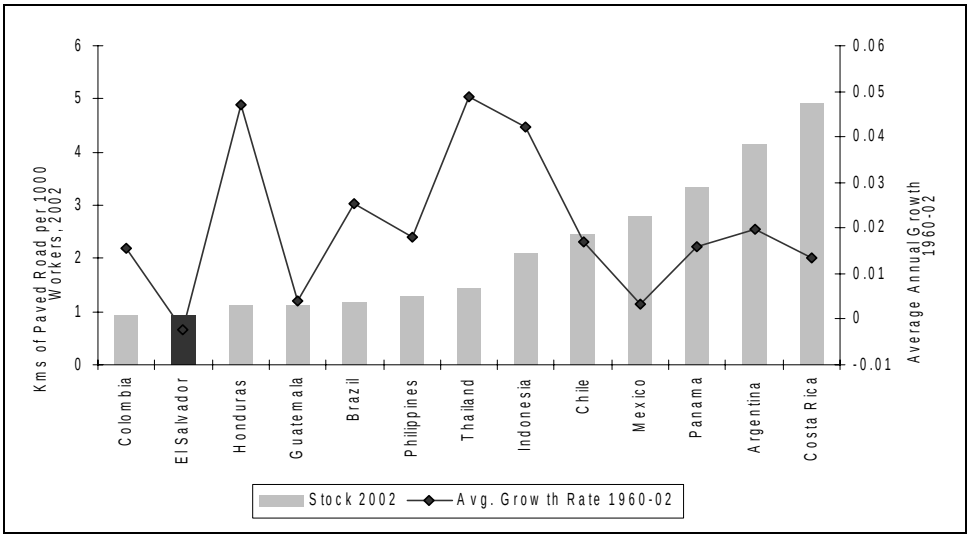
36. **Through the 1970s and 1980s Costa Rica invested heavily in road infrastructure creating the highest paved road density among all Latin American countries, surpassing the runner-up by 30 percent in per worker terms** (Figure 3.9). These investments have substantially contributed to Costa Rica's economic development, making the country an oft-cited benchmark for the entire region (Serven and Calderon, (2004); Fay and Morrison (2005)). However, as can be seen below, the growth in the network has stagnated.

Figure 3.9: Paved and Total Roads Length

a. Paved and Total Roads Length



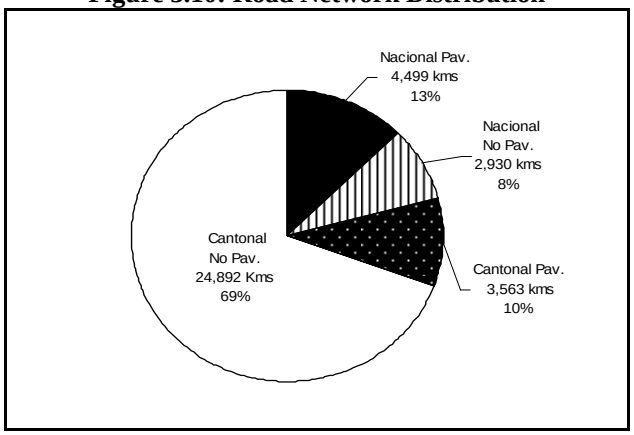
b. Paved Roads and Growth in Paved Roads



Source: WDI, LANAMME; Ministries of Transport; Easterly and Seven 2003)

37. **Costa Rica's total road network had nearly 35,884 kilometers in 2002, only 22 percent of which is paved** (Figure 3.10). There is a direct relationship between that quality gap and the administrative level assigned responsibility for a road corridor. There are two administrative levels for the network: "national" reflecting the main corridors and "cantonal" or municipally owned roads representing nearly 80 percent of the total. Differences among the two administrative levels are substantial in terms of demand levels. The primary network totals about 2000 kilometers and has an average traffic per day of 13 thousand vehicles, while those managed at the sub-national level have less than 500 vehicles per day. Though this makes it easier to define priorities in terms of economic impact, it also shows the burden faced by sub-national authorities in maintaining a large network of roads with relatively low use.

Figure 3.10: Road Network Distribution



Source: Ministry of Transport

38. **Even though most of Costa Rica's exports and imports move by ocean-borne shipping, roads and highways remain an important element to trade. This is due to the following characteristics of Costa Rica's commerce:**

- smaller firms tend to concentrate on Central American markets and thus depend on land transport for most of their trade activities
- most Asia-origin and destination shipments travel through Panama (and hence require long-haul over land);
- an increasing share of Caribbean-bound traffic (mostly to East and Gulf Coast U.S.) is traveling via Panama in order to utilize better ports and shipping services; and
- the primary demand and production center of the country—the Central Valley—is physically removed from Limón-Moín or the Port of Caldera.

39. Because of the importance of the road network to trade, the effects of the decreasing investment in roads and the resulting decline in the quality of the roads is of central concern to Costa Rican firms and policy makers alike. These issues are discussed in more detail in sections 3.4 and 3.5.

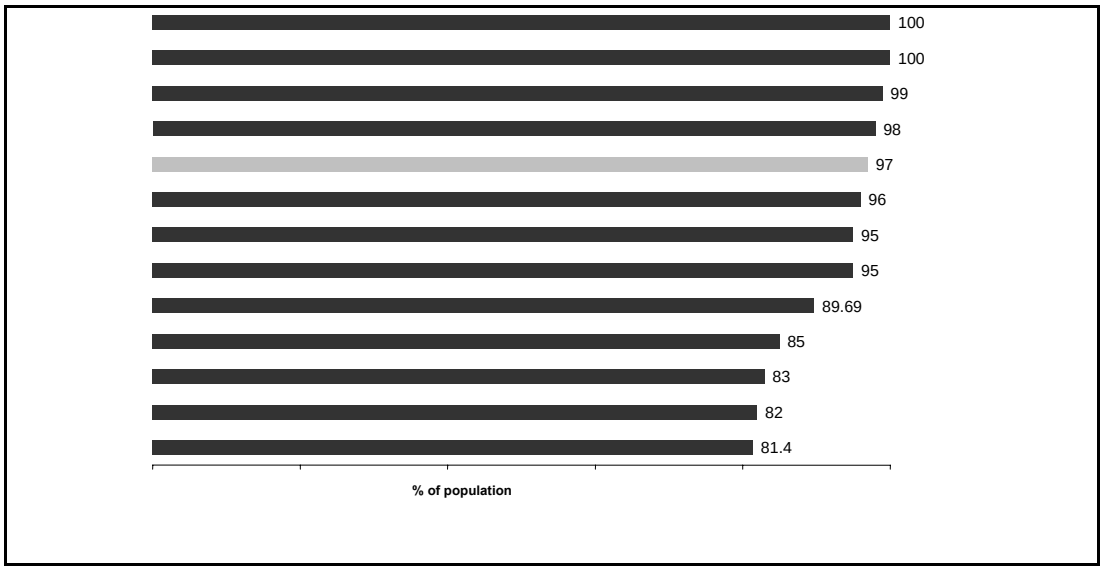
Airport Endowment

40. **Passenger traffic through Costa Rica's primary airport, el Aeropuerto Internacional de Juan Santamaría has grown rapidly—about 10 percent per year—over the last decade**. In parallel, the increasing role of very high value and time-sensitive exports as a total share of exports has placed considerable demand on the Airport's cargo facilities. In order to expand the Airport's passenger and cargo capacity, a concession was signed in 1997. About half of all construction was completed with the cargo area significantly improved until the time at which the concession was halted due to a dispute with the concessionaire. Although the airport remains the highest ranked mode of transport infrastructure in Costa Rica according to business survey respondents, current capacity of the airport during tourism season is insufficient to meet demand.

3.2.2 Electricity Sector Endowment

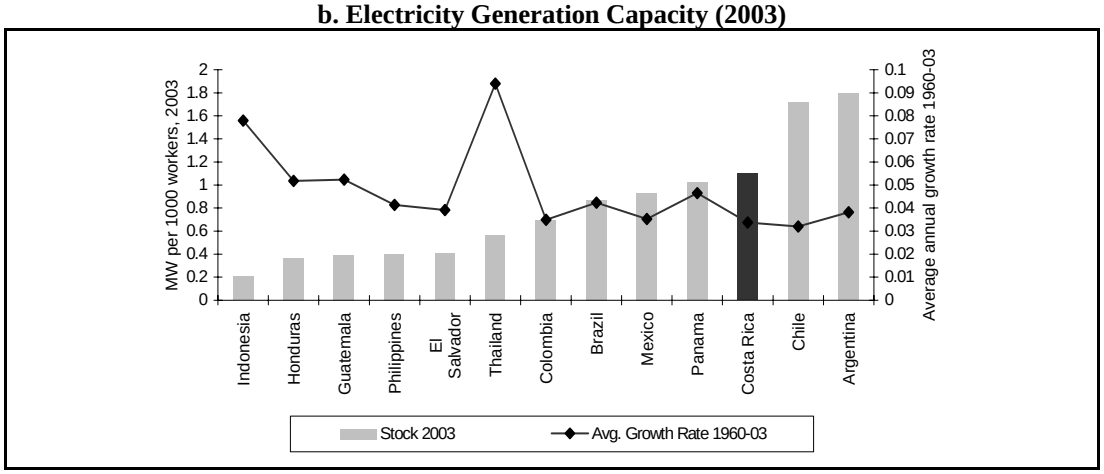
41. **In terms of over-all endowment, Costa Rica performs well in the provision of electricity services compared with its Latin American peers and fast growing economies in East Asia**. Its electrification rate is the second highest in the region and comparable to the best performers in East Asia (Figure 3.11).

Figure 3.11: Benchmarking of Costa Rica's Electricity Supply and Endowment
a. Access to Electricity (2004



Source: ECLA, OLADE, and World Bank (2004)

b. Electricity Generation Capacity (2003)



Source: Organizacion Latinoamerican de Energia, U.S. Energy Information Agency

42. **In terms of generation assets, Costa Rica is characterized by a reliance on renewable energy-based generation.** Of the 1,958 MW installed in 2004, hydro power plants accounted for 67 percent, plants based on other renewable sources such as geothermal and wind represented 13 percent, and thermal plants accounted for the remaining 20 percent[12]. The thermal facilities are primarily used as peak-load plants.

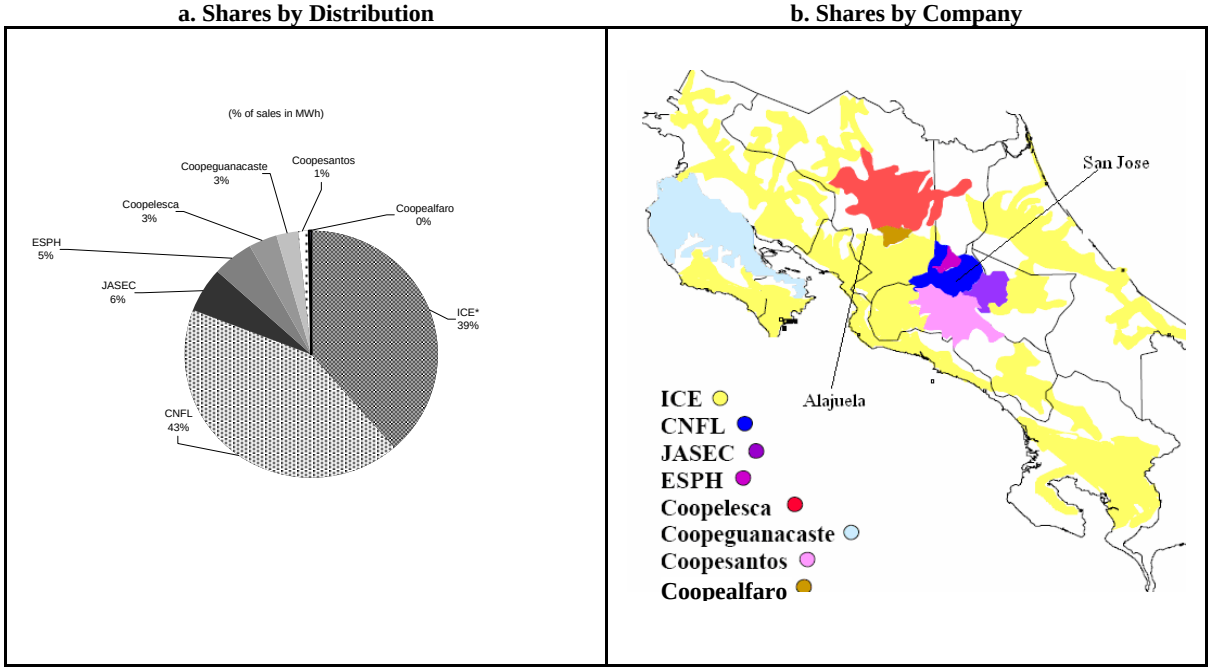
[12] ICE's Relevant data Electricity Sector December 2004.

43. **The electricity sector is dominated by the government-owned "Instituto Costarricense de Electricidad"** (ICE). ICE accounts for 86 percent of the installed capacity in the country, controlling 82 percent directly and the remaining 4 percent through its subsidiary Compañia Nacional de Fuerza y Luz (CNFL). Private independent power producers (IPPs) represent 11 percent, and sell their electricity to ICE through long-term power purchase agreements (PPA). The municipally-owned utility of Cartago (JASEC) and the rural electrification cooperative de San Carlos (Coopelesca) have the remaining 2 percent of installed capacity.

44. **As an integrated utility, ICE dominates directly or indirectly all elements of service provision.** In transmission, ICE owns and controls all assets and is in charge of planning, constructing, operating, and maintaining transport facilities of the interconnected transmission system (SEN). ICE is also its technical operator and the sole entity responsible for international interconnections. In distribution and supply there are eight providers of which CNFL is the largest, serving the capital San Jose. Two municipally-owned utilities, JASEC and ESPH, provide retail electricity service in the cities of Cartago and Heredia, respectively. Four cooperatives serve rural isolated systems. ICE distributes electricity in all other regions (Figure 3.12). ICE also supplies electricity to the other seven electricity distributors. ICE and CNFL jointly account for more than 81 percent of final electricity sales.

Figure 3.12: Share in Electricity Sales in Costa Rica by Distribution Company in 2004

a. Shares by Distribution **b. Shares by Company**



Note: * It does not include electricity sales to other distribution companies.
Source: ARESEP.

45. **In addition to providing electricity services, ICE has the mandate to plan and coordinate the development of Costa Rica's National Electric System (SEN).** ARESEP, the regulator, is primarily responsible for defining tariff reviews, handling consumer complaints, and supervising quality of services. The Ministry of Environment and Energy (MINAE) is responsible for defining the sector policy and overseeing its implementation. In practice, however, ICE determines the sector's development because of its dominant position and the constraints that other agents face to increase their participation.

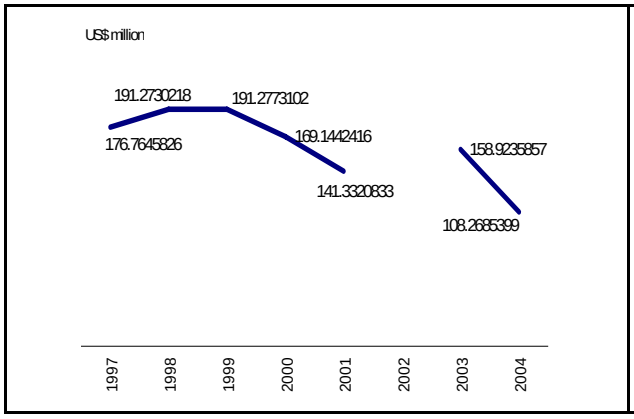
46. **ICE, the dominant company in the sector, has reduced its annual capital expenditure in electricity from US$190 million in 1998-99 to US$108 million in 2004**. Generation appears to be the most affected segment by this decline. The average annual growth rate of installed capacity fell from

more than 7 percent in 1994-2000 to 3.8 percent in 2001-2004. The recent growth rate of generation capacity barely keeps up with the demand growth. The insufficient supply growth appears to have been aggravated in 2005 when the installed capacity did not increase at all. This situation is significantly different from the one experienced in the 1990s when the generation capacity grew much faster than the maximum demand. This decline in investment seems to be the primary cause of recent service quality decline analyzed in the following section.

47. **Expansion of the transmission network has also slowed in recent years.** While the growth of the distribution network has remained strong, the expansion appears to be insufficient to keep up with demand based on the long waiting period for new connections reported in the ICS (Figure 3.13).

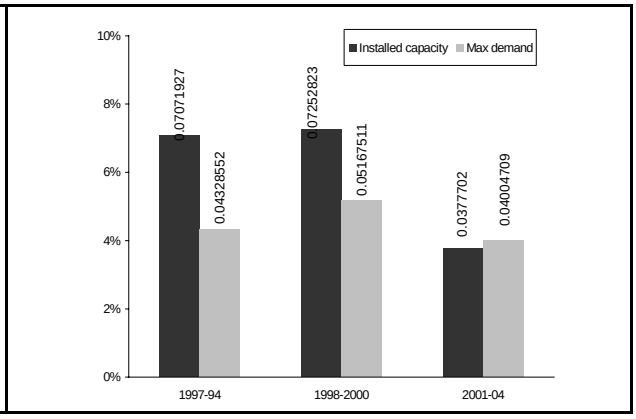
Figure 3.13: Declining Electricity Investment in Costa Rica

a. Capital Expenditure of ICE in Electricity



Source: ICE Financial Statements

b. Growth of Installed Capacity and Maximum Demand

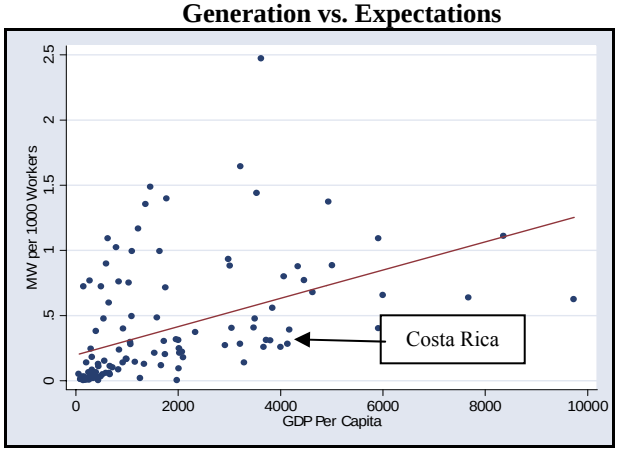


Source: ICE.

48. **As a result of the drop in investment, the reserve margin is expected to decline from 40 percent to 30 percent in 2006-09, while Costa Rica's system requires between 50 percent and 40 percent due to its high reliance on run-of-river hydropower plants.** Consequently, Costa Rica faces a high risk of power shortages in the coming years. To avoid electricity rationing in the coming years, ICE estimates that it needs to add 50 MW of temporary generation in 2006, growing to 95 MW in 2008. ICE expects to get that extra capacity through short term power purchases agreements with local companies that own generation capacity and by leasing thermal power plants.

49. Given Costa Rica's income level, it is grossly underperforming in this area in comparison to other countries. That is, Costa Rica does note meet expectations in generation capacity based on world performance in this area (Figure 3.14).

Figure 3.14: Endowment of Costa Rica's Electricity Generation vs. Expectations



Source: Authors' own calculations; World BankDevelopment Indicators

3.2.3 Telecommunications Endowment

50. **The acceleration of productivity growth in developed countries has been widely attributed to the rapid increase in investment in information and communication technology.** This growth acceleration is to a large extent due to improved productivity growth in the ICT-producing sector, as well as an increasingly productive use of ICT goods and services elsewhere in the economy[13]. ICT adoption in Costa Rica is essential in order to implement strategies to obtain higher sustainable rates of growth and competitiveness in the future.

51. **The state-owned electricity institute (ICE) currently provides both telecommunications and electricity services within Costa Rica on an almost exclusive basis, as only niche segments of the market are open to private participation and competition**. The joint provision of telecommunications and electricity services challenges the future liberalization of the telecommunications sector, and therefore innovative solutions are needed to build a competitive framework. The public monopolistic nature of this market structure is unique within the region (see diagram below).

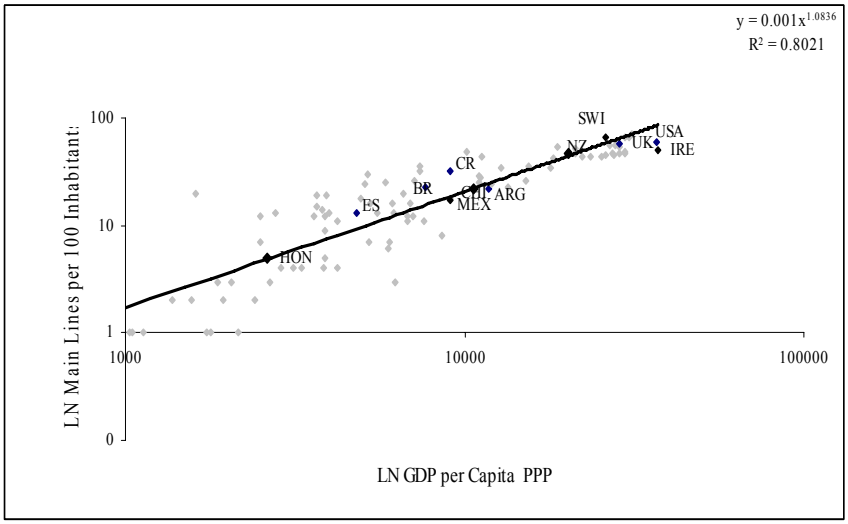
52. **On a global scale, the telecommunications sector in Costa Rica still faces great development challenges when compared to regional counterparts as well as to OECD countries.** According to the World Economic Forum (WEF), on the Network Readiness Index[14] which measures the relative level of ICT development in 104 nations across the World, Costa Rica was ranked 61 in 2004, significantly down from 49 in 2003. Brazil, for example was ranked 46 (vs. 39 in 2003); and Chile 35 (vs. 32 in 2003). Singapore and the US are ranked among the first five.

[13] Van Ark, Bart, Robert Inklar, Robert H. McGuckin, *The Contribution of ICT-Producing and ICT-Using Industries to Productivity Growth: A Comparison of Canada, Europe and the United States,* 2002*,* International Productivity Monitor.

[14] Network Readiness Index: The first pillar captures aspects of the environment of a given nation for ICT development, such as the regulatory regime and the legal framework for ICT, the available infrastructure, and other factors capturing elements of the market for technological development. The second pillar looks at actual levels of networked readiness of the three main stakeholders in the economy: individuals, businesses, and governments. Finally, the actual levels of usage of ICT by these three groups are also brought in as a third pillar.

53. **When assessing Costa Rica's success in deploying fixed telephone service, as measured by number of main lines per 100 inhabitants, the performance of the country is above its regional counterparts**. Costa Rica outperform countries such as Mexico, El Salvador, and Chile in this area and is even comparable in performance to countries such as Ireland, the US and the UK, when adjusting for their higher per capita income, as shown in Figure 3.15 (measured by the trend line).

Figure 3.15: Main Lines and GDP per Capita



Source: ITU database, World Bank Indicators from DDP database, World Bank

54. **However, Costa Rica's overall development of its telecommunications infrastructure has not been as successful as some of its regional counterparts and OECD countries**. While ICE has focused on the development of main lines, having reached an official teledensity of 31.6 main lines per 100 inhabitants, other countries have focused mostly on cellular development, achieving higher total teledensities. The figures below illustrate this difference: Out of 20 comparator countries, Costa Rica ranks 5th in fixed line penetration but 17th in mobile penetration (Figures 3.16 & 3.17).

Comparative Degrees of Telecom Reform in Latin America

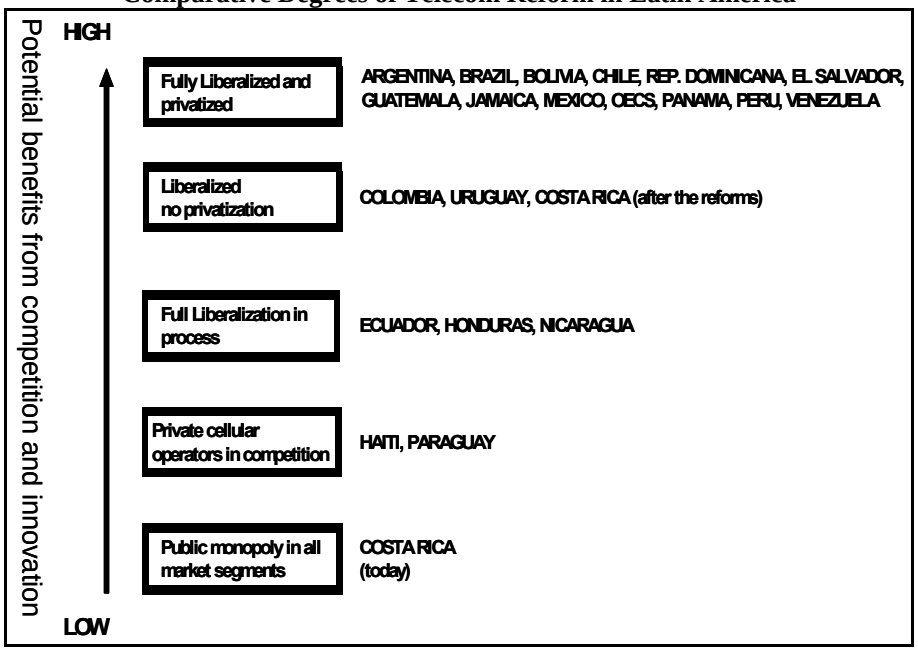
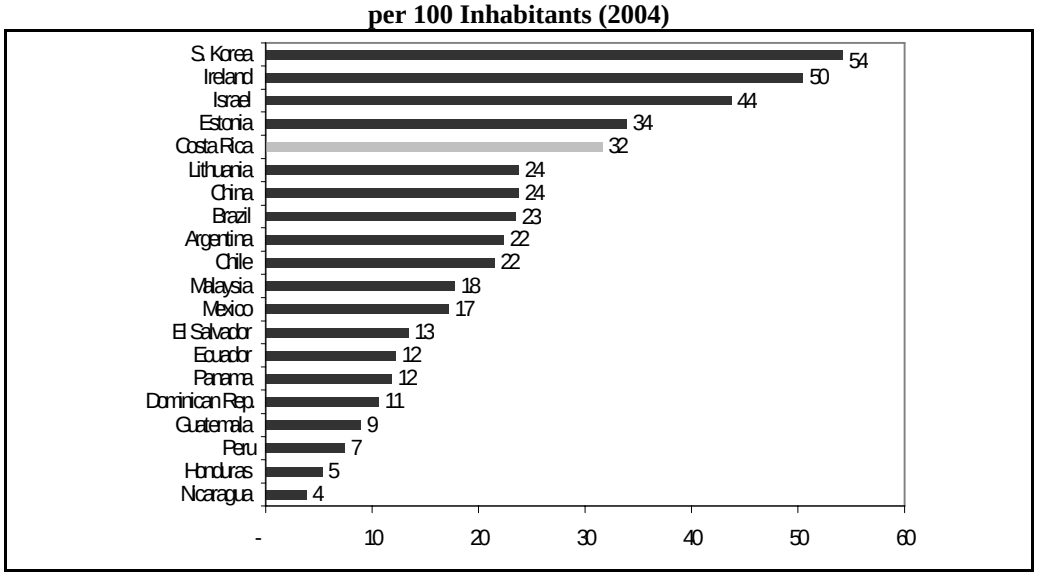
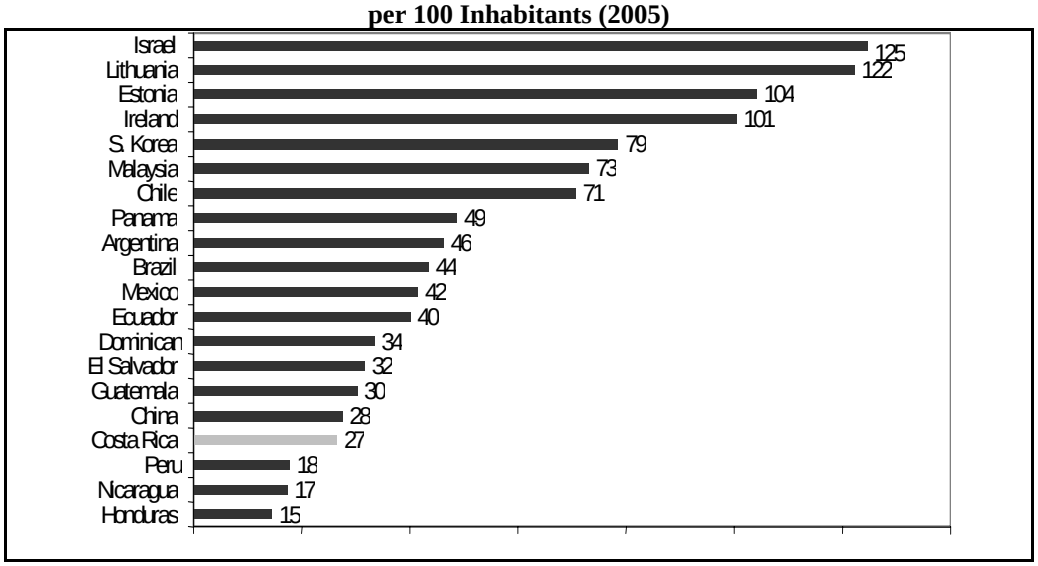


Figure 3.16: Fixed Phone Lines per 100 Inhabitants (2004)



Source: ITU indicators from DDP World Bank Database & EMC Database

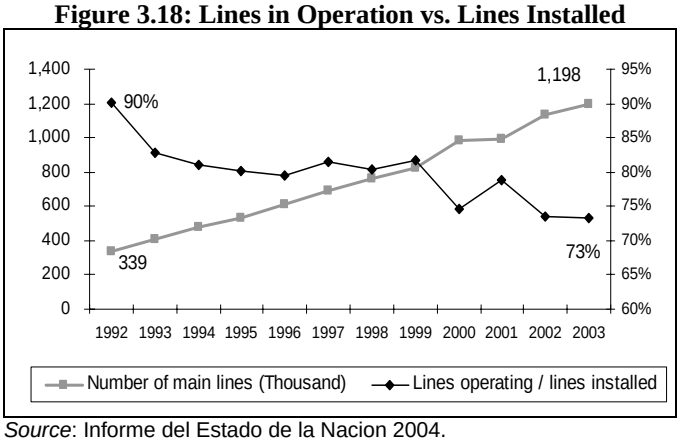
Figure 3.17: Mobile Phone Lines per 100 Inhabitants (2005)



Source: ITU indicators from DDP World Bank Database & EMC Database

55. **The quality of the statistical information on the sector is however not very high, with a large number of inconsistencies.** Almost every source consulted on basic telecommunications indicators for Costa Rica has shown different numbers, even though ICE has been the primary source for that information. For instance, various reports produced by ICE for different purposes quote the number of fixed telephone lines for the year 2004 as either 941,254 or 1,343,193. This gap may be explained if one considers that the lower figure quoted reflects the number of lines actually in operation, whereas the more generous figure reflects the capacity of lines available in the switches. As can be seen from Figure 3.18 below, the ratio of lines in operation to installed capacity has been dropping dramatically, mostly due to the fact that expansion of the line capacity of switches is done with vendor financing, which is a financial vehicle not available for investments in outside plant.

Figure 3.18: Lines in Operation vs. Lines Installed



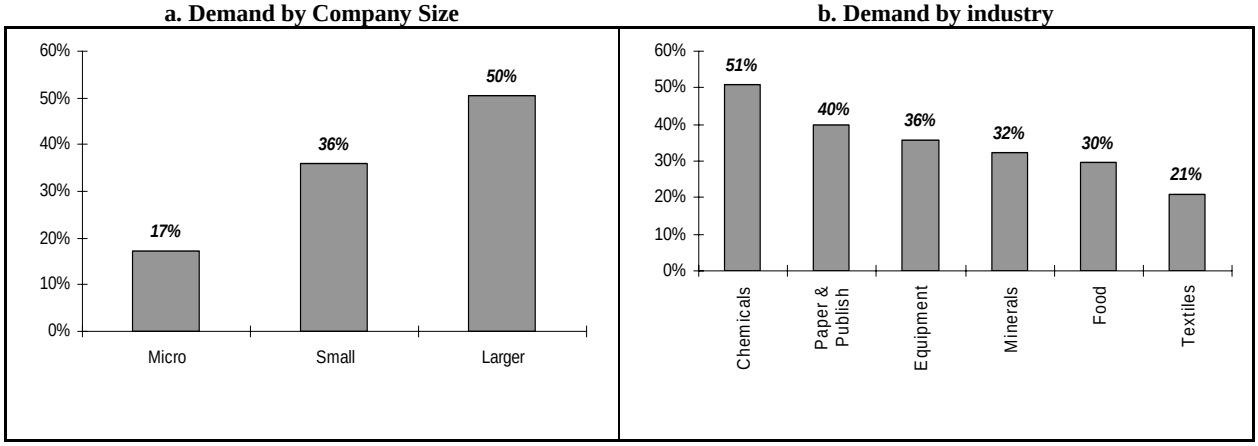
Source: Informe del Estado de la Nacion 2004.

56. **Clearly, Costa Rica's performance in the cellular industry has been poor compared to countries with similar characteristics.** By September 2005, in Costa Rica, there were only 26 cellular lines per 100 inhabitants, as compared to countries like Chile (70), Ireland (100), South Korea (78), and even Panama (49) or Dominican Republic (33). While this relative underperformance can be attributed in part to the high number of main lines in the country, its main cause is more likely to be the lack of efficiency in allocating investments by ICE, due in part to cumbersome procedures related to its status as a government entity.

57. **According to the Investment Climate Survey (ICS)[15], demand for additional connections to fixed line telephony is strong, even among existing users.** Almost one in three of the companies participating in the ICS requested connection to fixed telephony services over the last two years. A breakdown of these data shows that the demand is higher in the segment of medium and large companies, where one in two companies requested additional connections (Figure 3.19). From an industrial perspective, the highest demand appears to be in companies operating within the chemicals, and paper and publishing industries.

Figure 3.19: Demand for New Fixed Lines Among Existing Users

a. Demand by Company Size **b. Demand by industry**



Note: Demand for fixed lines represents the proportion of respondents that requested a new telephone connection over the last two years
Source: World Bank Investment Climate Survey (2005).

[15] The ICS captures information from companies using ICT services as a way to assess their relative importance for the growth of the private sector.

58. A simple regression model was also used to compare Costa Rica's telecommunications infrastructure outcomes to a sample including all developing countries, while accounting for income differences across countries.[16] This model tells us what levels of infrastructure development are "expected" for a country with Costa Rica's per-capita GDP.[17]

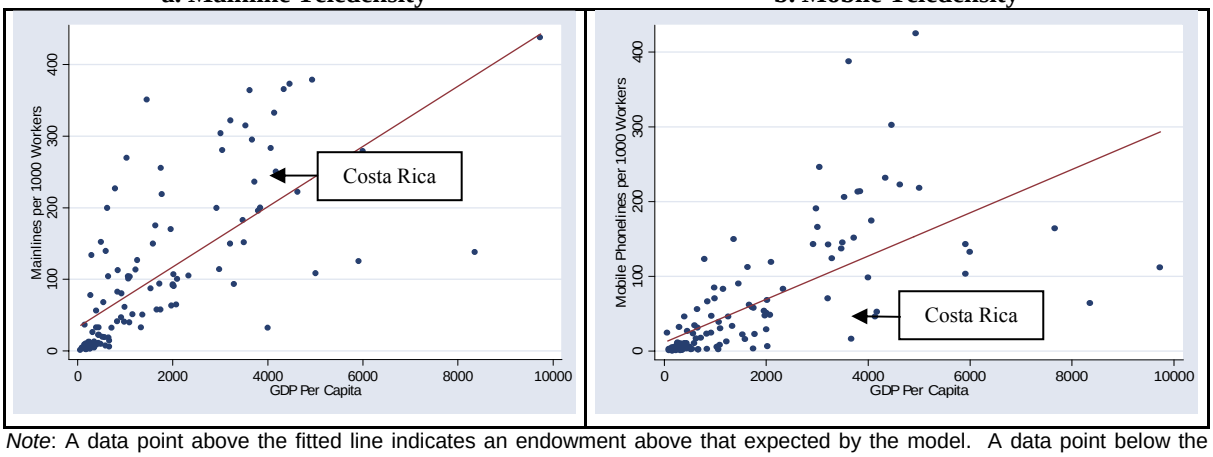
Table 3.4: Percentage Deviations from Expected Values Endowment of Telecommunications Relative to Expectations

	Fixed Teledensity	*Mobile Teledensity*	*Total Teledensity*
Percentage Deviation from Expected Value	19.30%	-60.80%	-11.80%

59. **Table 3.4 above reports percentage deviation between observed and predicted telecom network endowments.** Thus, a positive value indicates that Costa Rica has achieved coverage levels superior to those predicted by the model, while a negative value indicates the opposite. The results, graphed in Figure 3.20 below, show the extent of Costa Rica's fixed telecommunications network as well as its underperformance in mobile telephony given the income levels of the country.

Figure 3.20: Endowment of Costa Rica's Telecommunications Networks vs. Expectations

a. Mainline Teledensity **b. Mobile Teledensity**



Note: A data point above the fitted line indicates an endowment above that expected by the model. A data point below the fitted line indicates an endowment below that expected by the model.

60. **In the expansion of access to information technology, Costa Rica has experienced considerable success, particularly with fixed liner telephony, personal computer density and internet usage**. Costa Rica boasts the highest personal computer density—measured by the number of personal computers per 1,000 people—in its peer group. Similarly, Costa Rica ranks behind only Chile in Internet usage, having overtaken Argentina in 2002. While these figures reflects Costa Rica's role as a technological leader in Central America, they point to the need for a different set of targets for the use of information technology.

[16] Full results of this regression analysis are provided in Appendix 1.

[17] This simple model takes into account only the effect of per-capita GDP on infrastructure outcomes and should not be viewed as inclusive of all variables affecting infrastructure development.

3.3 The Quality and Efficiency of Costa Rica's Infrastructure Services

61. **When one drills down below the level of infrastructure connectivity or the supply of Costa Rica's infrastructure, concerns about Costa Rica's future competitiveness and trade potential arise**. Indeed, the quality of Costa Rica's infrastructure in some areas is below regional standards—including less wealthy neighbors—while even its stronger performing sub-sectors are beginning to see marks of decline. This deterioration has not gone unnoticed by investors and businesses. A recent survey of major industrialists ranked Costa Rica below the regional average in port efficiency and overall transport infrastructure quality. The ICS reveals a higher level of concern among firms in Costa Rica with regard to the quality of roads, electricity and telecommunications than other countries in Latin America.

62. **Why do firms care so much about infrastructure quality and efficiency?** The product cost analysis conducted with data from the Logistics Survey of three core export groups—processed foods; flowers and plants; and medical equipment—show the importance of infrastructure in the cost structure of Costa Rica's export products (Table 3.5). When transport/logistics, energy and telecommunications are combined, they represent between 17 and 36 percent of the total cost of production and delivery (excluding raw material inputs which contain, in and of themselves, even higher component contributions of infrastructure inputs). For the higher value-added products—processed foods and medical supplies—this represents the primary cost components. For plants and flowers, only labor is a more significant cost contributor to the final cost of the goods.

Table 3.5: Cost Structure by Export Product (Excluding Raw Materials)

Sector	*Processed Foods*	*Plants & Flowers*	*Medical Supplies*
Total Infrastructure	36%	17%	35%
Labor	27%	63%	35%
Capital	15%	8%	12%
Financial	10%	7%	9%
Others	12%	5%	9%

Note: Excludes raw material inputs to avoid redundancy as they contain, in and of themselves, even higher component cost contributions of infrastructure inputs

63. **Within infrastructure, the relative importance of transport versus energy versus telecommunications will depend upon the nature of the production process and the value-added elements of the product being considered**. For low value goods shipped in bulk—such as, cement, iron ore, edible oils or grain products—transport costs are always a large portion of delivered costs. For processed bulk products such as fertilizers, energy may also be a large component. For information technology (as well, of course, for service firms), telecommunications costs may be a more significant part of the cost structure. And although it is not analyzed here, water is a primary cost component for such industries as breweries, distilleries and chemical producers.

64. Table 3.6 shows the cost breakdown by sector of infrastructure for the three sectors analyzed in the Logistics Survey. This breakdown illustrates the importance of the three sectors, particularly transport and logistics, in the cost structure of firms and the competitiveness of their outputs.

Table 3.6: Infrastructure Contributions to Cost by Sector and Export Product

Sector	*Processed Foods*	*Plants & Flowers*	*Medical Supplies*
Transport & Logistics	24%	13%	22%
Electricity, gas, and other energy sources	9%	3%	7%
Telecommunications	3%	1%	6%

Note: This breakdown illustrates the importance of the three sectors, particularly transport and logistics, in the cost structure of firms and the competitiveness of their outputs. Reducing infrastructure-related costs by ten percent would provide

3.3.1 Quality of the Transport Network

65. **Despite possessing a larger endowment of roads per worker than its peers as well as the busiest port in Central America (excluding Panamá), Costa Rica ranked poorly in most categories of transport infrastructure in the survey of business executives contained in the World Economic Forum's *Global Competitiveness Report 2004-2005*.** In ports, Costa Rica was tied with Guatemala for the lowest ranking in its peer group (Table 3.7). Air transport was the only category in which Costa Rica's score exceeded the peer group average.

Table 3.7: Comparative Survey on the Quality of Transport Infrastructure

Comparator	*Overall infrastructure quality*	*Port infrastructure quality*	*Air transport infrastructure quality*
Argentina	3.6	3.6	4.1
Brazil	3.5	3.1	5.1
Chile	4.9	4.8	5.7
Colombia	2.9	3	4.4
Costa Rica	**3**	**2.5**	**4.8**
El Salvador	4.4	3.3	5.6
Guatemala	2.7	2.5	3.5
Honduras	3	3.8	3.3
México	3.4	3.3	5
Panama	4	5.7	5.2
Indonesia	4.2	4.4	4.4
Philippines	2.5	2.6	3.9
Thailand	4.6	4.2	5.3
Average	**3.6**	**3.6**	**4.6**

Source: World Economic Forum, Global Competitiveness Report 2004-05
Notes: Survey based subjective evaluation on scale from 1 "poorly developed and inefficient" to 7 "among the best in the world."

66. **The impact of poor transport quality and security on firm competitiveness is multi-tiered; it impacts the cost of production and shipment as we have seen above**. In addition to these direct costs, delays, breakage and theft total cost Costa Rica's exporting firms an average of 12 percent of their sale value. This explains the disproportionately high share of logistics costs associated with delivered price of Costa Rica's exports.

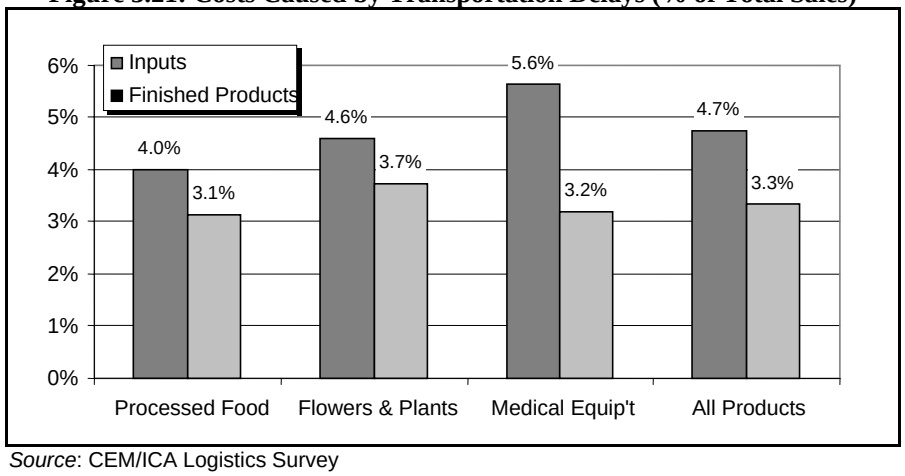
67. **According to the Logistics Survey, logistics services (transportation, warehousing and procedures to comply with regulations) represent as much as 35 percent of the total delivered costs of the three export products analyzed**. When raw materials are included as a single cost input, transportation and logistics alone represent 15 percent of the product. This figure is significantly higher than in Costa Rica's industrialized competitors where the average percentage of logistics costs for all goods rarely surpasses 10 percent. Moreover, the costs for logistics services in Costa Rica appear to be rising, having increased by 1.2 percent just between 2002 and 2004. The primary cause of that increase is shipping transportation costs (2 percent) while other stages of the supply chain and production process have seen a decrease, particularly financial costs which have decreased by 0.7 percent).

68. **The Logistics Survey revealed that, on average, transportation system delays represent an 8 percent loss in total sales for the three products analyzed. These costs compound from:**

- demurrage fees paid to carriers who must wait for the cargo to arrive;
- additional storage and warehousing fees; and
- lost sales from inability to meet a customer's schedule.

69. The diagram below (Figure 3.21) shows these losses for each product for both inputs and finished products.

Figure 3.21: Costs Caused by Transportation Delays (% of Total Sales)



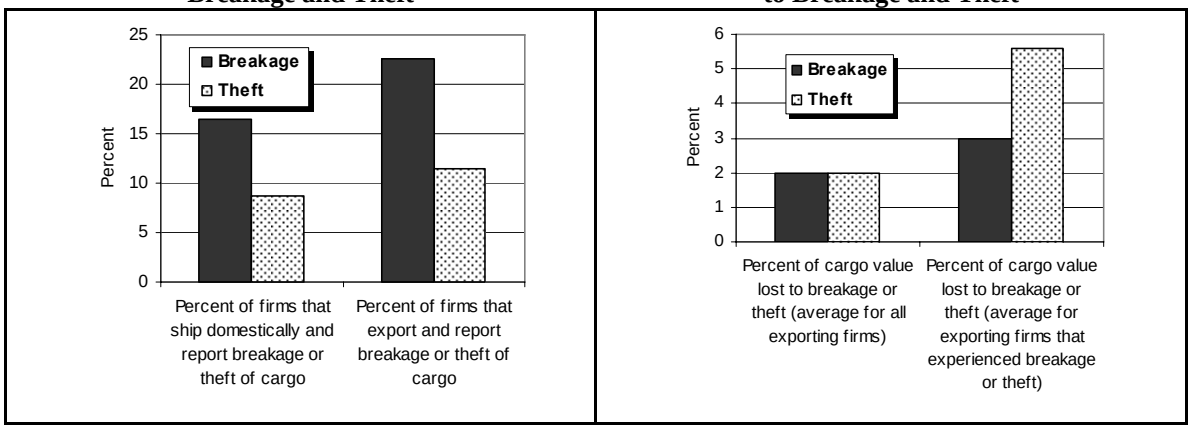
Source: CEM/ICA Logistics Survey

70. **In addition to the calculable costs of delay described above, firms must plan for higher inventories and incur the capital costs associated with that lost productivity**. Still, the poor quality of transport infrastructure affects firms' competitiveness beyond the direct and indirect cost of delays. Goods are often damaged and congestion leads to greater opportunities for theft. These problems are commonplace in Costa Rica.

71. **The ICS found that damage and theft in transit alone cost Costa Rican exporters over 4 percent of their total sales.** For those exporters that reported breakage or theft—22 percent and 12 percent of firms, respectively—losses rose to over 8 percent of sale value (Figure 3.22). The impact was felt greatest for exporting firms, suggesting that port-related activities are a primary area of concern for transport quality as well as the concerns about the quality of the road network that impact all shippers.

Figure 3.22: Impact of Breakage and Theft in Transit on Costa Rican Firms

a. Percent of Firms Reporting Breakage and Theft | **b. Percent of Sales Lost to Breakage and Theft**



Source: World Bank Investment Climate Survey (2005).

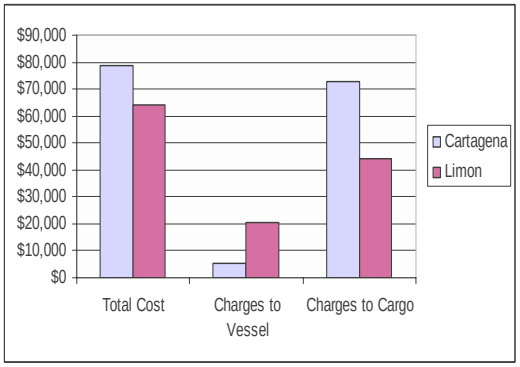
Quality of Port Services

72. **Port inefficiency and lack of capacity is one of the main competitive disadvantages for Costa Rican exporters.** For instance, the Port of Caldera was designed to move a maximum of 600,000 metric tons annually. That amount was surpassed in 1988 and, for 2003, the saturation level (throughput of cargo/maximum tolerated cargo rate) was close to 300 percent. Additionally, important bottlenecks are caused by red tape and logistics in the operation of businesses depending on imported materials. Bontempo, Chávez and Rivera estimated in 1996 that in the case of a company which imported grain through Puerto Caldera it could see an increase in the CIF price, of at least 6 percent just because of warehousing expenses. Although there are no updated studies, it is more than likely that the situation has not changed significantly.

73. **At first glance, the Port of Limon appears to enjoy a cost advantage over other ports in the region.** According to a 2004 study by Kent and Fox, charges per vessel and per container are lower at Port of Limon than at Colombia's Port of Cartagena (Figure 3.23). This comparison seems impressive given that Cartagena has been operated under a concession contract since 1993, operates in a highly competitive environment and is widely considered to be an efficient port.

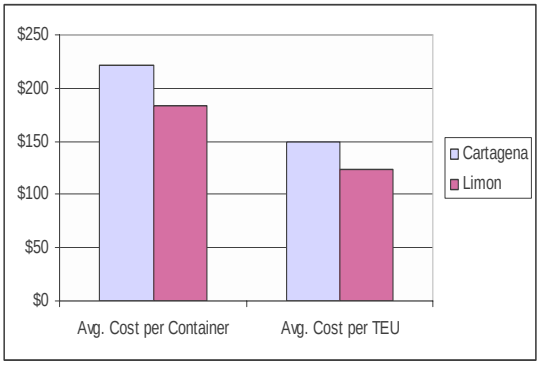
Figure 3.23: Charges at Port of Limon Versus Port of Cartagena

a. Total Charges



Source: Kent and Fox (2004), Figure 4

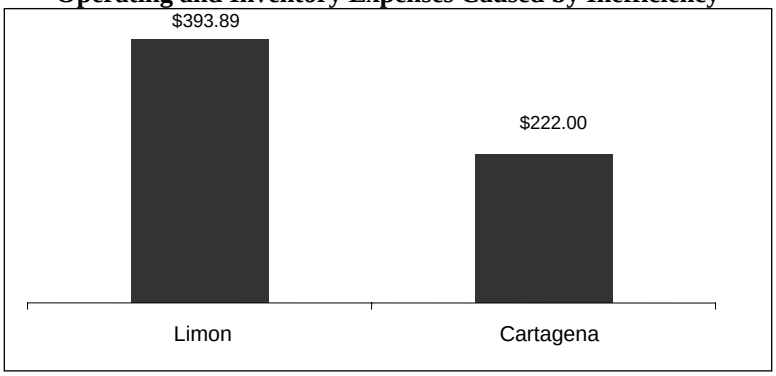
b. Average Costs per Container or TEU



Source: Kent and Fox (2004), Figure 4

74. **However, any cost savings from lower port charges is more than offset by higher operating and inventory expenses due to inefficiency at Limon**. Crane productivity is significantly lower at Limon (38 moves per ship-hour) than at Cartagena (52 moves per ship-hour). Moreover, waiting times to dock are 12 hours longer at Limon than at Cartagena and waiting times at the berth are 1.5 hours longer. These waiting times result in additional expenses associated with idling ships, as well as higher inventory expenses. After taking these expenses into account, Kent and Fox estimate that the total cost per container for a call at Port of Limon exceeds the cost at Port of Cartagena by $171.89 (Figure 3.24).

Figure 3.24: Total Cost per Container, Including Operating and Inventory Expenses Caused by Inefficiency



Source: Kent & Fox (2004) Table 5

Road Quality

75. **While Costa Rica ranks first in its peer group in paved road density per worker, independent studies of the quality of its roadways have found that large percentages of the system are in poor condition**. A 2004 study conducted by the National Laboratory of Materials and Structural Models at the University of Costa Rica (LANAMME-UCR) found that only 32 percent of Costa Rica's paved roads were of "good" quality. A 2002 study by the National Road Advisory (CONAVI) rated 24 percent of Costa Rica's paved roads as being in "good" condition. Moreover, while most countries report only the length of highways in their paved road statistics, Costa Rica also reports urban roads, which leads to an overstatement of its paved road density relative to other countries.

76. **Although the impact of the large endowment of transport infrastructure has historically supported Costa Rica's trade and growth, deterioration in the road network's quality and the ports' efficiency are beginning to hinder firm competitiveness.** In comparison to Investment Climate Surveys conducted throughout the region, a disproportionately large share of Costa Rica's firms view transport as a constraint to doing business. The Logistics Survey of three key export sectors confirmed that roads quality appears in 80 percent of responses as one of the three biggest impediments affecting businesses. Moreover, 40 percent of firms surveyed for the ICS in Costa Rica found that Road Quality was a major or very severe constraint to their business environment. By comparison, only 7 percent found trade regulations to be a constraint.

77. **Despite users' consensus about the low quality of roads infrastructure in Costa Rica, there is some disagreement among entities in charge of the sector about exactly how poor the roads are.** The proportion of the network found in good condition range from 24 percent to 52 percent depending on the source. In 2002, an assessment of the state of the national paved network was performed, for the first time, by the National Laboratory of Structural Materials and Models (LANAMME - *Laboratorio Nacional de Materiales y Modelos Estructurales*) of the University of Costa Rica: 24 percent were in

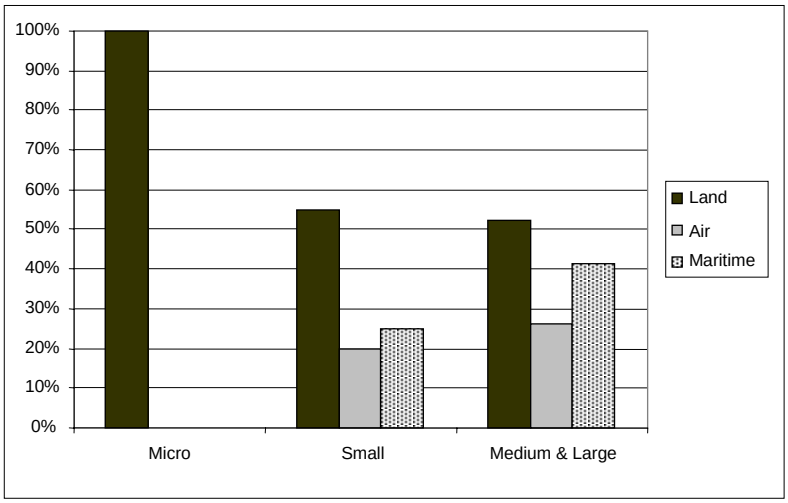
good condition, 38 percent were in average condition and 38 percent were in poor condition (Table 3.8). These results contrast with the official assessment from the Ministry of Transportation, which concluded that 52 percent was in good condition. This significant difference has led to broad discussions among the institutions and the Comptroller's Office.

Table 3.8: Quality of the National Road Network

Condition	*CONAVI-MOPT (2002)*	*LANAMME-UCR (2004)*
Good	52%	32%
Fair	27%	34%
Poor	21%	34%

78. **However the institutions rate the over-all quality of the network, drivers on the highways of Costa Rica widely recognize that the country's main corridors offer insufficient capacity for the level of demand and are poorly maintained**. This explains the World Economic Forum's relative ranking. The poor quality of roads disproportionately impacts smaller companies that depend on them for a larger share of exports, as seen in the section above on infrastructure endowment (Figure 3.25).

Figure 3.25: Mode of Transportation Used for Trade by Size (% firms)

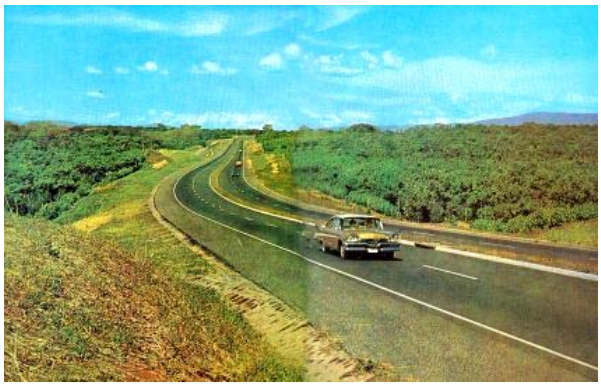


Source: World Bank Investment Climate Survey (2005).

79. **Aside from maintenance concerns, there are also substantial problems of overcrowding and urbanization in specific highways that are central for competitiveness.** A noteworthy example is San José-Juan Santamaría Airport road, which appears in the photos below. It was initially built as a primary service road with rights-of-way and shoulders appropriate for that type of inter-city designation. Today, the road continues to provide primary service while also functioning as an urban road. As a result, its specifications are substantially diminished. The shoulder was used as an expansion lane, increasing the hazardousness of the road (the height of the pavement can reach one meter above the drainage pipes) while local traffic has been added to the congestion with heavy load vehicles competing with daily urban traffic.

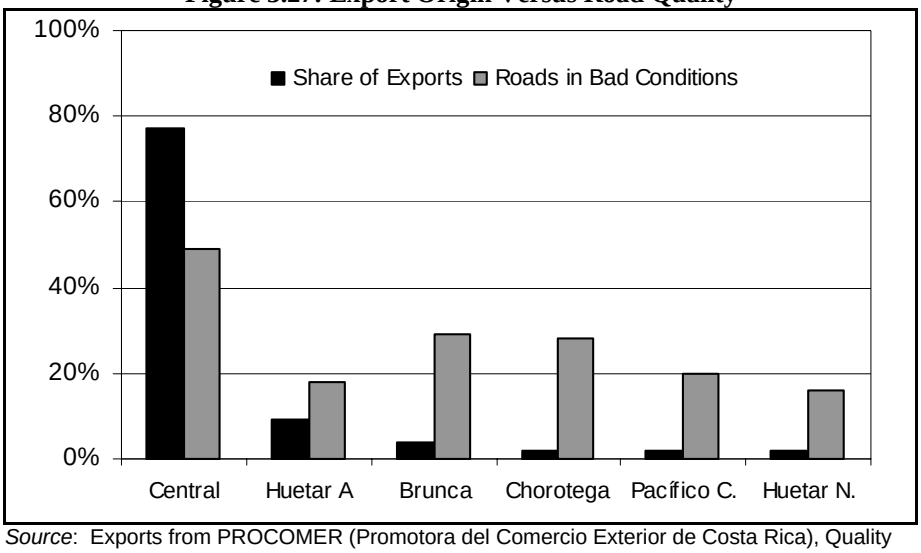
Figure 3.26: General Cañas Roadway Links San Jose with Juan Santamaria Airport

1966 **2005**



80. The worst quality road infrastructure is found in the central region, which produces close to 80 percent of the country's exports (Figure 3.27).

Figure 3.27: Export Origin Versus Road Quality



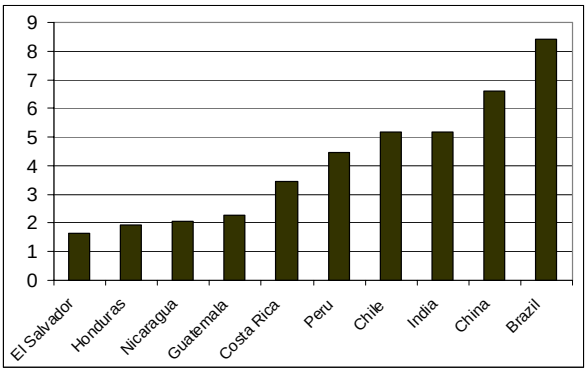
Source: Exports from PROCOMER (Promotora del Comercio Exterior de Costa Rica), Quality from LANAMME (Laboratorio Nacional de Materiales y Modelos Estructurales - Universidad de Costa Rica)

Customs Efficiency

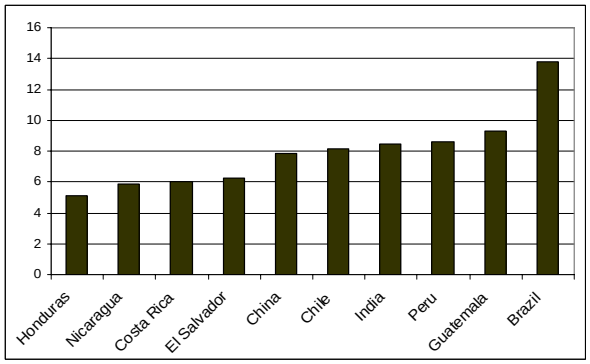
81. **After transportation costs, customs is the second largest barrier to trade identified in the ICS. Costa Rica performs worse than the rest of Central America in exports customs clearance and about average for Latin American surveyed firms in import customs** (Figure 3.28). Still, the 6 day delay for import customs clearance is very high for the types of firms that Costa Rica wishes to attract in investment Costa Rica's sophistication.

Figure 3.28: Average Days to Clear Customs

a. Export clearance



b. Import clearance



Source: ICS

Airport Quality

82. **To the degree that cost is a reflection of efficiency, the low cost of air freight for garment exports to the United States supports Costa Rica's above-average ranking in air transport** (Table 1.5). Air freight charges total 4.7 percent of the free on board (FOB) value of garment exports shipped by air to the United States from Costa Rica (Table 3.9). This charge is lower for Costa Rica than any of its peer countries, with the exception of Colombia.

Table 3.9: Average Charge Air Shipment of Garment Exports to U.S.

	Average charge (% FOB)
Colombia	4.3
Costa Rica	4.7
Mexico	5.6
El Salvador	5.9
Honduras	8

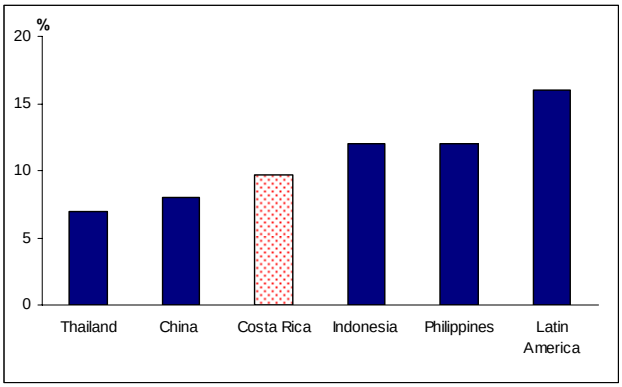
Source: Nathan & Associates in Kent and Fox (2004).

3.3.2 Quality of Electricity Services

83. **There are many ways of considering service quality for electricity. Some indicators of quality reflect efficiency—such as distribution losses or lines per employee**. These do not affect users directly although they may serve as indications of commercial success among providers. Other indicators—frequency of outages, duration of outages, waiting periods for connections—are directly felt by consumers. In the primary commercial indicators of quality--distribution losses--Costa Rica performs well. It is the indicators of quality that affect consumers—particularly small firms—that show weaknesses.

84. **Costa Rican distribution utilities suffer line losses significantly below those in neighboring countries**. Line losses in Costa Rica stood at 9.7 percent of output in 2003 (Table 3.10), the lowest in Central America and similar to competitor countries in other regions (Figure 3.29).

Figure 3.29: Transmission and Distribution Losses Selected Countries, 2003



Source: World Bank (2005a) and ECLA.

Table 3.10: Comparative Distribution Losses in Electricity Distribution, 2003

Country	*Distribution losses, 2003 (% of total output)*
El Salvador	13
Guatemala	17.3
Honduras	21.9
Nicaragua	32.5
Panama	19.4
Average (9 countries)	20.8
Costa Rica	**9.7**

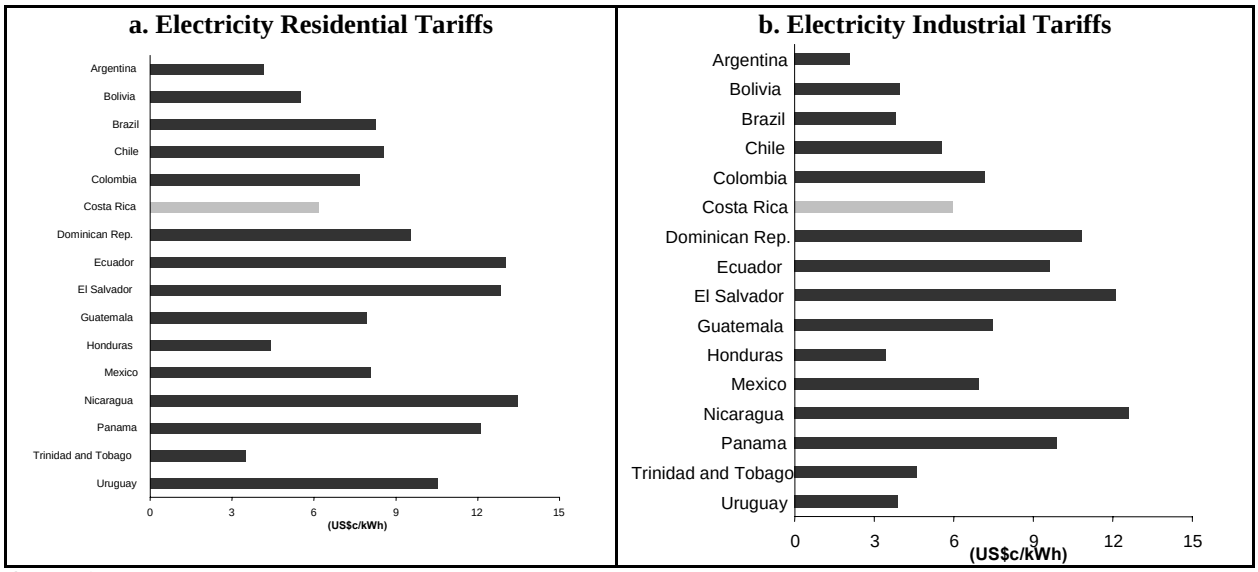
Source: ECLAC in Energy Sector Report

85. **However, the ICS data suggest that while Costa Rica's losses are relatively low, other indicators of service quality—waiting periods for new connections, frequency and duration of outages, and business losses due to outages—are below those of its regional peers**. This is particularly troublesome because of Costa Rica's interest in developing high-tech industries for which highly reliable electricity is essential.

86. **The data also suggest that the impact of service quality varies widely within the country**. Small companies and companies in San Jose are those most affected by long waiting periods for new connections. Companies in San Jose and regions other than Alajuela are the most affected by outages. Micro enterprises and companies in chemicals, metal products, and paper and publishing industries have the highest financial losses due to outages.

87. In tariffs, Costa Rican consumers enjoy one of the lowest rates in the Latin American region, while industrial and commercial users pay tariffs similar to the average (Figure 3.30).

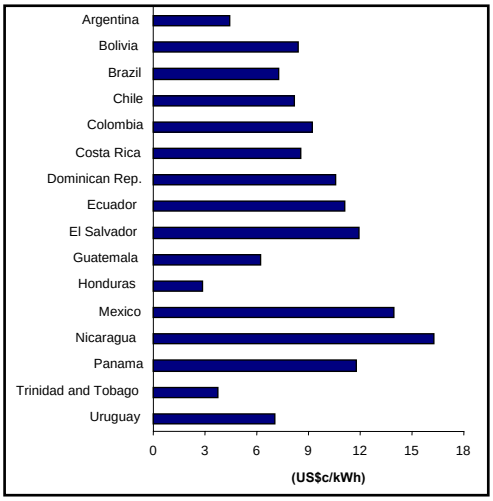
Figure 3.30: Electricity Tariffs in Selected Latin American Countries, 2003



Source: OLADE

88. **The current tariff structure is the result of a gradual reduction of cross-subsidies from industrial and commercial users to residential ones.** The residential tariffs increased, in real terms, 18 percent between 1998 and 2004; while the industrial and commercial ones declined by 14 percent and 10 percent, respectively.[18] The weighted average real tariff remained unchanged at US¢ 7.4 per kWh between 1998 and 2004. Despite these adjustments, the tariff structure still appears to contain important cross-subsidies. The ratios of industrial and commercial to residential tariffs in Costa Rica were 96 percent and 139 percent respectively in 2004. Those ratios are among the highest ones in the selected sample of Latin American countries, which tend to rely significantly in this type of cross-subsidies. In high income countries, where those cross-subsidies tend to be lower, the ratio of industrial to residential tariffs varied from 30 percent in Denmark, France, and Germany to 70 percent in Czech Republic, Italy, and Taiwan.

Figure 3.31: Electricity Commercial Tariffs
Selected Latin American Countries, 2003

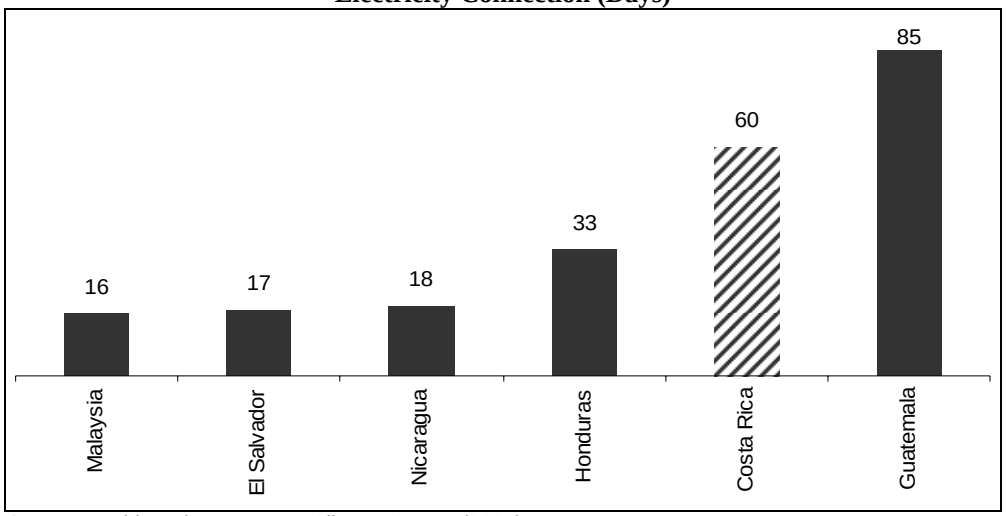


Source: OLADE.

[18] Author's estimates based on the average tariff per type of user reported by ARESEP.

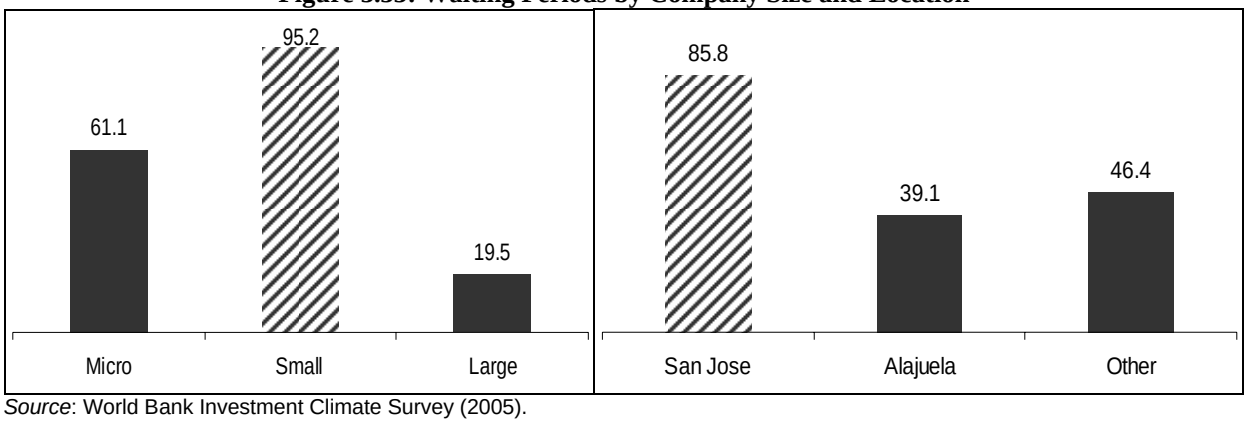
89. **According to the recent Investment Climate Survey (ICS), companies in Costa Rica reported an average waiting period of 60 days for a new electricity connection, which is one of the highest in Central America** (Figure 3.32). This problem appears to be more acute for small companies and for companies in San Jose (Figure 3.33). In contrast, Alajuela province seems to be the better served area with shorter waiting periods. This may be the subtle influence of "yardstick competition"—the ability of consumers, advocates and providers to compare the performance of two distribution companies. Unlike other areas of the country which are served by one provider, this province is served by two, ICE and Coopelesca.

Figure 3.32: Waiting Periods for New Electricity Connection (Days)



Source: World Bank Investment Climate Survey (2005).

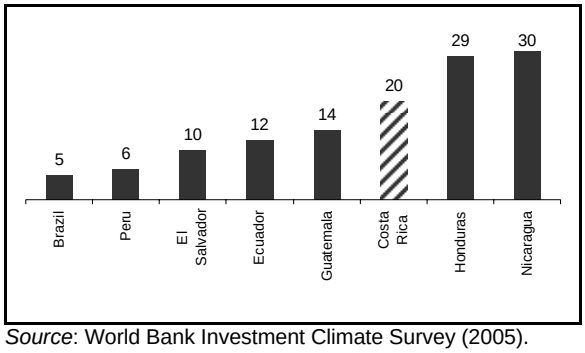
Figure 3.33: Waiting Periods by Company Size and Location



Source: World Bank Investment Climate Survey (2005).

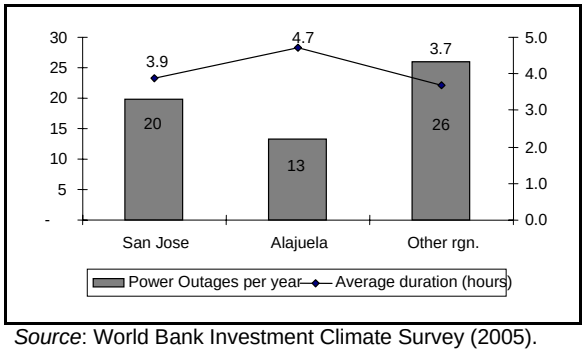
90. **Power outages in Costa Rica also appear to be more frequent than in other Latin American countries** (Figure 3.34). The ICS reported that as much as 84 percent of surveyed companies experienced at least one outage in 2004, which is slightly higher than the Central American average (81 percent). Surveyed companies also reported experiencing, on average, 20 power outages in 2004, the third highest number among the Latin American countries with ICS. The incidence of power outages varies within the country with Alajuela being the less affected province (Figure 3.35).

Figure 3.34: Power Outages in Selected Countries, 2004



Source: World Bank Investment Climate Survey (2005).

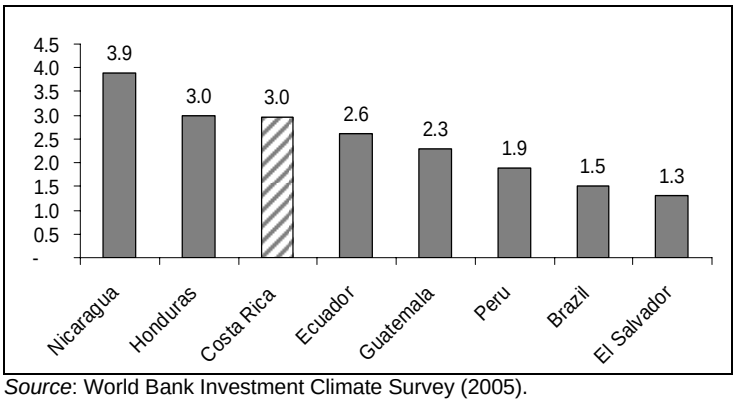
Figure 3.35: Frequency and Duration of Power Outages in Costa Rica



Source: World Bank Investment Climate Survey (2005).

91. **Exacerbating frequency concerns, power outages in Costa Rica cause significant losses to companies: 3 percent of annual sales on average** (Figure 3.36). This ratio is similar to the ones in countries with poorer performing sectors such as Nicaragua and Honduras, and well above the ones in better performers sectors in region. Such losses estimate is consistent with the reported number of annual power outages and their duration, which imply an annual loss of 2 working weeks on average.

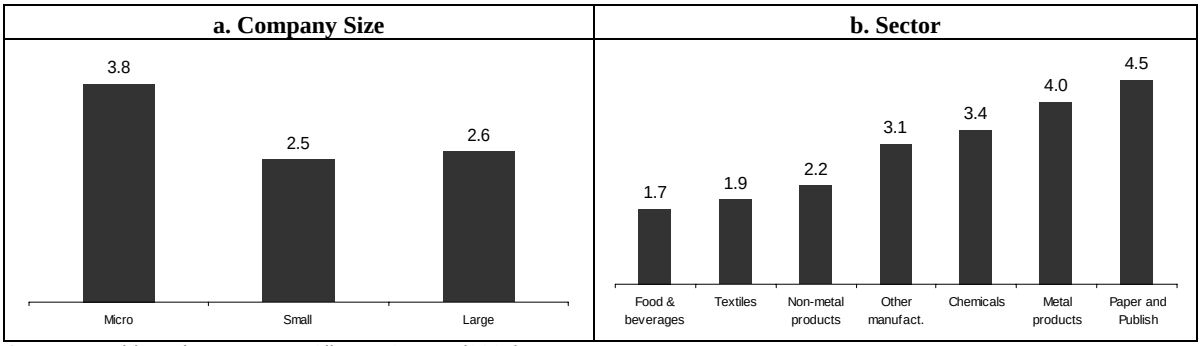
Figure 3.36: Companies' Losses Due to Power Outages (% of Annual Sales)



Source: World Bank Investment Climate Survey (2005).

92. **Micro-enterprises are the most affected financially by power outages**. By sector, power outages also represent a significant cost for many industries such as paper and publishing, metal products and chemicals (Figure 3.37).

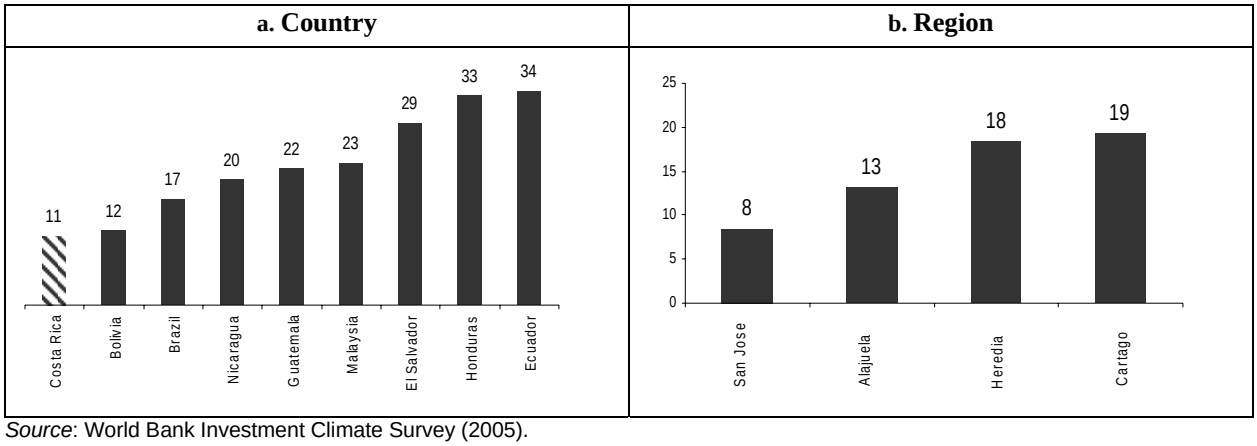
Figure 3.37: Losses Due to Power Outages (% of Annual Sales)



Source: World Bank Investment Climate Survey (2005).

93. **The quality of public electricity supply is particularly important for Costa Rica's competitiveness because most companies rely on public supply to meet their demands**. According to ICS, only 11 percent of Costa Rican companies surveyed own generation facilities, a ratio that is among the lowest in Latin America (Figure 3.38). The reliance on public supply is higher in San Jose than in Heredia and Cartago, suggesting than the quality of electricity services may be lower in these cities.

Figure 3.38: Companies that Own Generators in Costa Rica (%)

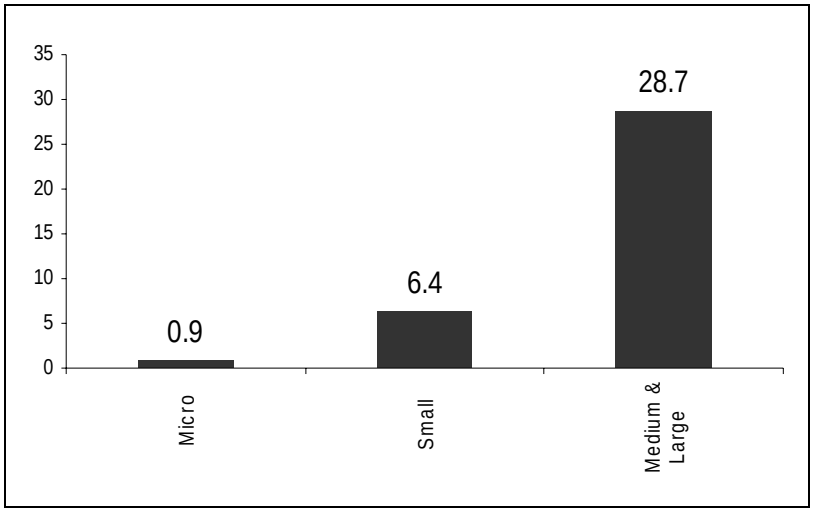


Source: World Bank Investment Climate Survey (2005).

94. **Medium and large firms, however, appear to use alternative sources of supply: more than 28 percent of surveyed companies have their own generators**. Even more, 20 percent of large companies surveyed indicated that their generators were their primary source of electricity, and not just a backup. Given the high electrification rate in Costa Rica, the reliance on own generations appears to be a reflection of an inadequate service quality rather than an access problems as with most of the Latin America region's businesses.

95. **A minor share of small and micro firms own generators**. This appears to reflect the higher costs of generation equipment for those firms rather than better service quality (Figure 3.39). Surveyed small companies reported that generation equipment represented 8.3 percent of their annual sales while it only represented 2.3 percent for medium and large firms.

Figure 3.39: Companies that Own Generators by Size (%)



Source: World Bank Investment Climate Survey (2005).

96. **Companies in technology-related industries (chemicals and electronic equipment) appear to be the ones relying less on public supply.** In these industries, more than 20 percent of surveyed companies own electricity generators, a percentage that is twice the average in other industries. The high share of self-generation in these industries, however, is common as chemical production offesr co-generation opportunities and electronics require high levels of service cooperation.

97. **The ICS's data are based on companies' experience and are difficult to compare with official statistics.** In addition, there is little official data on service quality and the few available statistics show mixed results. Some quality indicators improve significantly. The frequency of interruptions (FPI) and average duration of interruptions (DRIP) declined by more than 50 percent and 20 percent, respectively between 2001 and 2004.[19] Other indicators, however, deteriorated substantially. For instance, average duration of outages to clients increased more than 60 percent in that period.

98. **ICE appears to acknowledge the quality problems and is focusing on improving it albeit on a selective basis.** ICE offers agreements to businesses in which the quantity and quality of electricity supply are clearly indicated. If those agreements stipulate new investments such as additional transport capacity, the benefited company finances those investments and ICE repays them through lower tariffs during an agreed period. The first agreement of this type was signed with US Intel in 1998. These agreements are now becoming more popular, reflecting the growing concerns on the reliability of electricity supply. ICE signed 45 new agreements in December 2005.[20] However, these agreements have a limited capacity to address the supply problems of business clients. At best they could work for large companies connecting to very high voltage networks, or companies which can have multiple connection points for their site such as airports and large industrial parks, or companies whose problems are in the direct connection assets. Those agreements may not be solution for sites with single connections to the electricity network.

3.3.3 Quality of Telecommunications Services

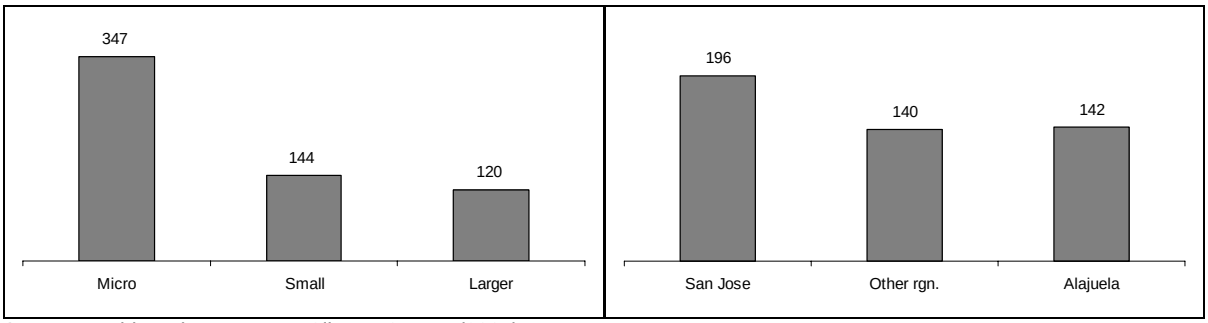
99. **The quality of telecommunications services in Costa Rica appears to be below expectations for a sector which has so successfully built out its mainline services.** According to ITU data, there are close to 65 faults per 100 lines per annum, 79 percent faults cleared within 24 hours (vs. 98 percent in Korea), a 4 month waiting time for the installation of a fixed line and a widening gap between the number of lines installed in the switches and those actually in operation.

100. **Surveyed companies in the Investment Climate Survey reported waiting periods of 168 days (over 5 months) on average for a new telephone connection.** Moreover, this problem appears to be more acute for micro-enterprises, which reportedly have to wait almost one year for a new telephone line. Figure 3.40 is 2.5 times higher than that reported by larger companies, suggesting a differentiated treatment of customers. On a regional basis, the provision of this service also differs, with companies in the area of San Jose waiting 6.5 months on average, while customers in Alajuela experience a waiting period of less than five months on average.

[19] ICE's Relevant data Electricity Sector December 2004.

[20] La Nacion, ICE pide alza de 14.5% en luz, December 09, 2005. (http://www.nacion.com/ln_ee/2005/diciembre/09/pais1.html)

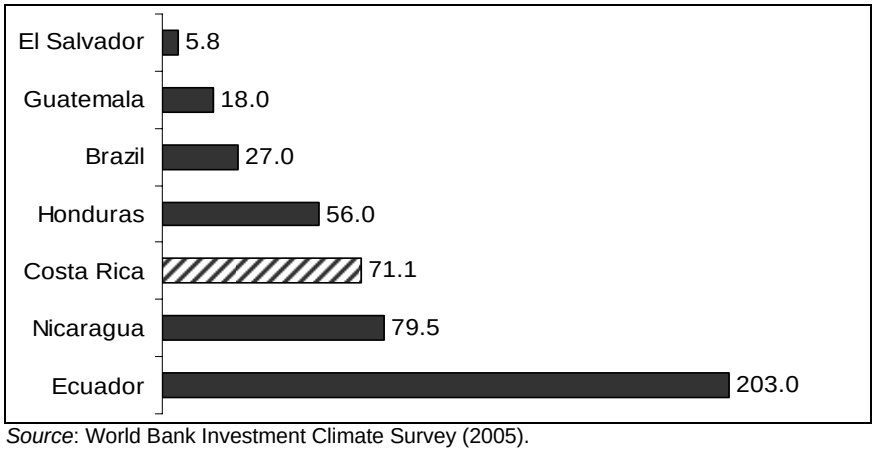
Figure 3.40: Waiting Periods by Size of Company and in Different Regions



Source: World Bank Investment Climate Survey (2005).

101. **The reliability of the telephony service in Costa Rica compares unfavorably to that of regional peers.** Costa Rican companies surveyed reportedly experienced more than four interruptions in the service during the previous year, each one of them lasting more than 16 hours on average. This translates into an aggregated period of telephone shortage of 71 hours per year[21]. In comparison, telephone companies in other Central American countries such as Honduras, Guatemala and El Salvador appear to provide a much more reliable service to customers (figure 3.41).

Figure 3.41: Interruption in Telephone Service (Hours Per Year)[22]



Source: World Bank Investment Climate Survey (2005).

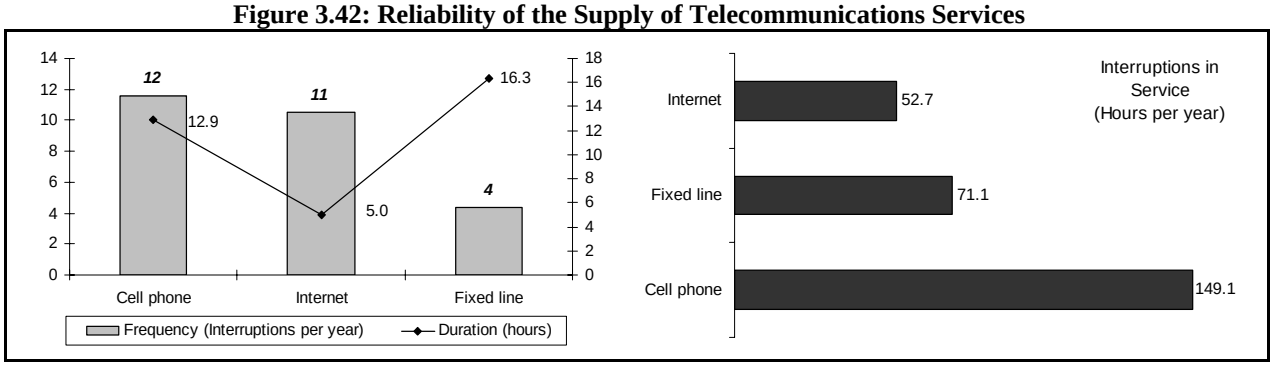
102. **Considering the frequency and duration of interruptions, the Internet appears to be the most reliable service in Costa Rica** (Figure 3.42). Costa Rican cell phone users reportedly experienced more than 12 interruptions in service last year, slightly above the number of interruptions in Internet service in the same period. Figures 3.46 show a significant difference in the reliability of these services as compared to that of fixed-line phones (with four interruptions in the service on average). However, the duration of the service breakdowns in fixed-line telephony was the highest, at more than 16 hours per event (three times higher than interruptions in Internet service, and almost 30 percent higher than interruptions in mobile phone service). Considering both the frequency and duration of the interruptions,

[21] Telephony shortages amounting 71 hours per year imply that the service is available 99.19 percent of the time. The importance of this figure stems from the fact that, in Service Level Agreements, international high tech companies commonly request availability of service on 99.999 percent of the time (i.e. telephone cuts for during less than 1 hour per year).

[22] Aggregate interruption time per year is calculated by multiplying the average number of interruptions reportedly suffered by surveyed companies times the average duration of interruptions.

cellular telephony appeared to be the less reliable service, with almost 150 hours of disruption in the service in 2004[23], while internet was unavailable during 53 hours during the same period.

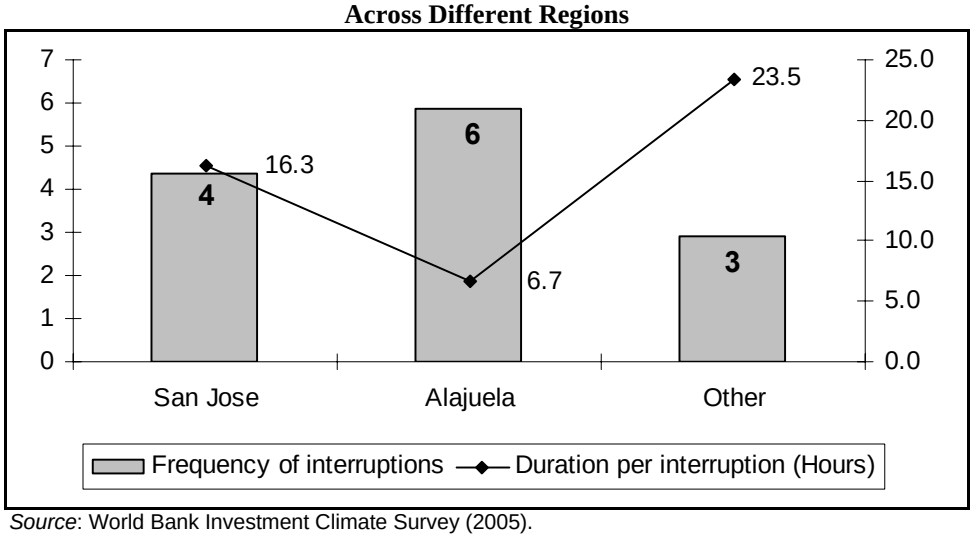
Figure 3.42: Reliability of the Supply of Telecommunications Services



Source: World Bank Investment Climate Survey (2005).

103. **The quality of fixed-line telephony service is variable across different regions of the country**. In terms of reliability of this service, companies based in Alajuela reportedly experience twice as many interruptions as those operating in other regions. However, the duration of each interruption in Alajuela is significantly shorter than that in San Jose and other regions (Figure 3.43). The difference in frequency of service interruptions may point out different degrees of deterioration of existing infrastructure across regions, while the uneven duration of interruptions appear to suggest different levels of efficiency in restoration processes among local teams.

Figure 3.43: Quality of Fixed Line Telephony Across Different Regions



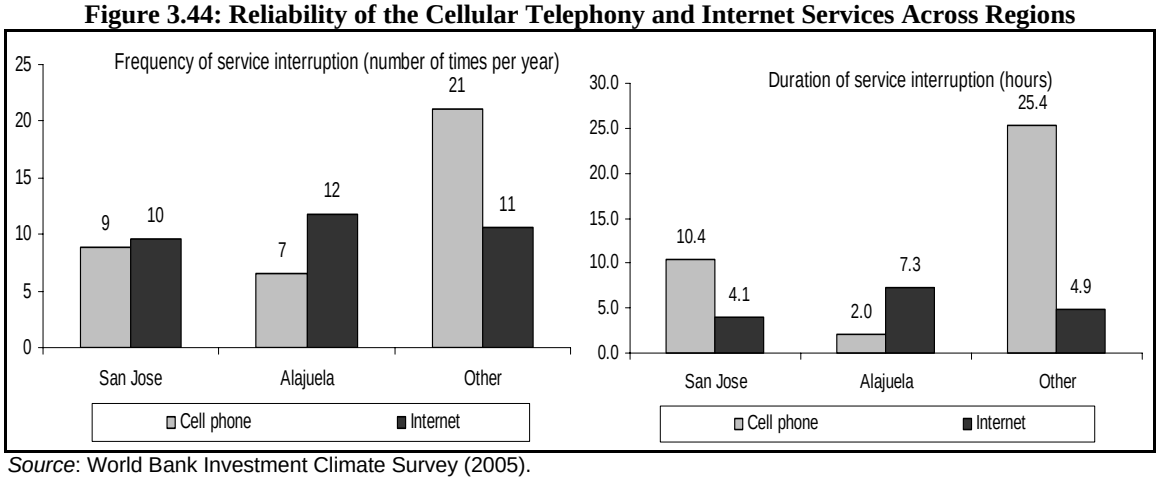
Source: World Bank Investment Climate Survey (2005).

104. **The reliability of cellular telephony also differs across regions, while the provision of Internet service appears more constant**. On cellular telephony, the reliability of the service (as measured by the frequency and duration of interruptions) is significantly higher in the provinces of San Jose and Alajuela than in other regions, where users reportedly face up to 533 hours of service

[23] Calculated as the average number of interruptions in service per year multiplied times the average duration of each event.

interruption per year[24]. As opposed to this, the quality of the provision of internet service appears to be relatively more constant across different regions of the country (Figure 3.44).

Figure 3.44: Reliability of the Cellular Telephony and Internet Services Across Regions

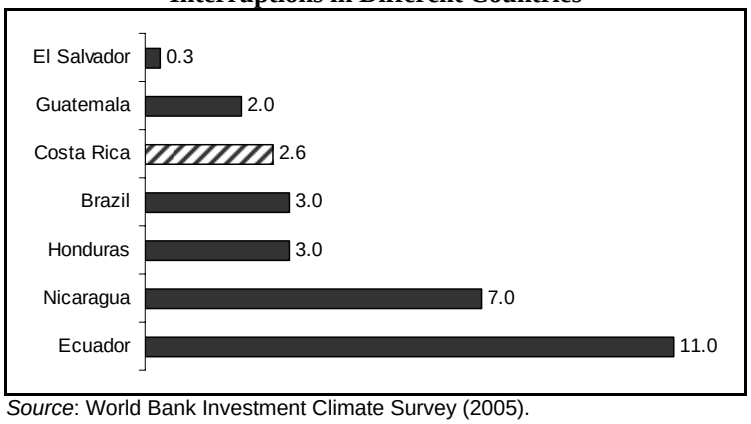


Source: World Bank Investment Climate Survey (2005).

105. **Interruptions in ICT services generate significant losses for Costa Rican companies.** According to the ICS the interruption in telecommunication services translate into significant losses through lost sales and decrease in productivity. To the extent that these losses occur, the competitiveness of companies in Costa Rica is affected, as compared to that of companies based in countries with more reliable services.

106. **Costa Rican companies suffer losses amounting to 2.6 percent of total yearly sales on average as a consequence of interruptions in fixed line telephony service alone**. While this figure is not among the highest in the Latin American countries surveyed (figure 3.45), it is still well above losses reported by companies based in other Central American countries such as Guatemala and El Salvador. This estimation of losses is fairly consistent with the figures reported in terms of the frequency and duration of interruptions in the service in each one of these countries.

Figure 3.45: Losses Due to Telephone Service Interruptions in Different Countries



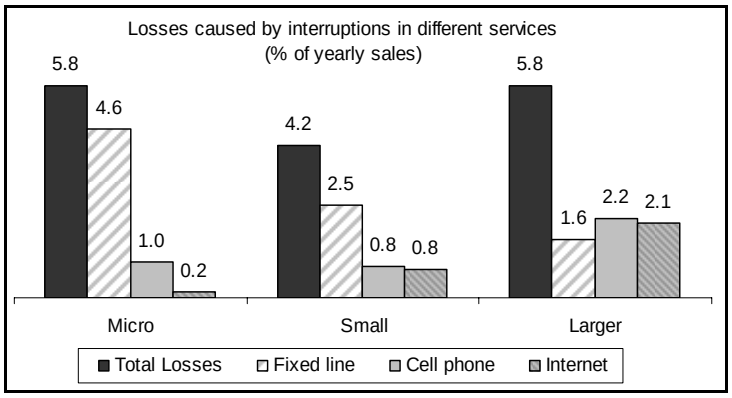
Source: World Bank Investment Climate Survey (2005).

107. **Costa Rican companies reported combined losses above 5 percent of total yearly sales due to faults in telecommunications services.** According to the ICS, the combined losses stemming from

[24] The aggregate time of service interruption per year is calculated as the average frequency of service interruption multiplied times the average duration of the interruption, as reported by companies surveyed.

interruptions in the provision of telecommunications services (including Internet, fixed line and cellular telephony) represented 5.2 percent of their total yearly sales on average. Moreover, service interruptions appeared to have different degrees of impact on companies, based on their underlying characteristics such as size and industry (Figure 3.46). Indeed, the negative impact of interruptions in fixed line telephony appears to decrease with the size of the companies, with losses for micro firms averaging 4.6 percent of yearly sales, almost three times the level of relative losses suffered by larger firms (1.6 percent of sales on average). As opposed to this, interruptions in internet service appear to affect most significantly the segment of larger firms, which reportedly experienced losses of 2.1 percent of yearly sales on average.

Figure 3.46: Losses Due to Telecom Service Interruptions by Size of Firms



Source: World Bank Investment Climate Survey (2005).

Telecommunication Prices

108. **Prices are one critical indicator of successful telecommunications and ICT policies**. As shown in Table 3.11, when comparing Costa Rica with the rest of Central America in local and long distance prices, Costa Rica shows the lowest rates except for international long distance. A local basket price for Costa Rica represents around US$12 for commercial and around US$8 for residential users. These prices are much lower than the rest of Central America where Guatemala has a price basket of US$28 and US$16 for commercial and residential users respectively, and El Salvador US$35 and US$22 for the same categories.

Table 3.11: Prices for Residential and Business Telephone (US$)

	Local		Long Distance	
	Residential (600) min. 2003	Commercial (1000) min. 2003	International (per min.) to the US)	National (per min.) 2005
Guatemala	16.71	28.03	0.25	0.04
El Salvador	22.58	35.28	0.22	0.03
Honduras	10.51	23.72	0.84	0.09
Mexico	n/a	n/a	0.28	0.047
Nicaragua	16.84	41.83	0.35*	0.08
Costa Rica	**8.22**	**12.50**	**0.27**	**0.01**

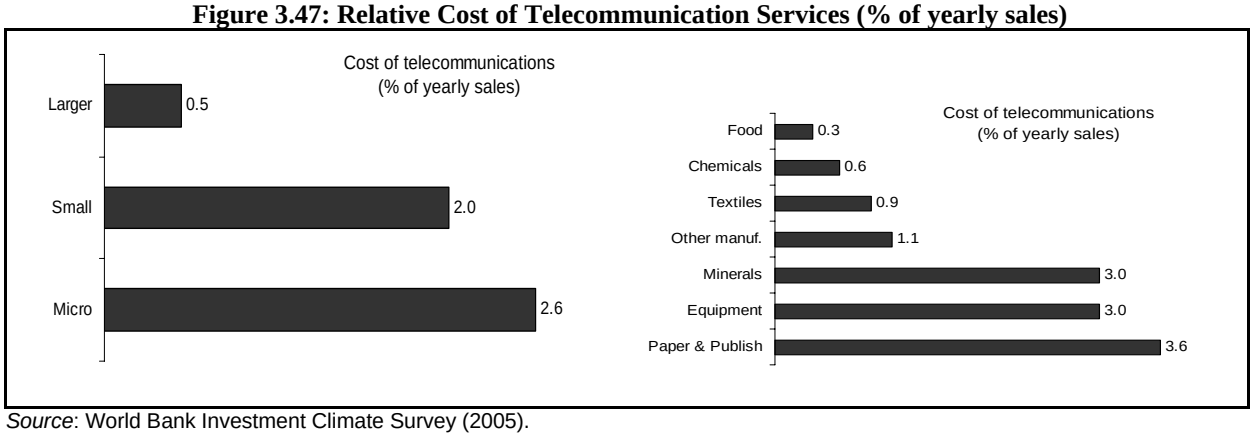
Note: Total Basket = (installation cost/120) * (monthly rate) * (charge p/min call)
* estimated
Source: Regulatory Agencies

109. **The relatively low prices in local and national long-distance calls for Costa Rica can be associated with a cross-subsidy scheme.** One of the key challenges for ICE as it strives to compete in a liberalized sector in the future will be to eliminate cross subsidies in their pricing scheme. In the medium to long term, users should not feel a negative impact as a result of the gradual elimination of cross-subsidies. There is likely to be an increase in the use of international service on the part of firms which will lead to an overall decrease in prices. In addition, a universal service mechanism directed towards users of lower income can help to achieve the same goals as the cross-subsidy scheme with greater allocative efficiency.

110. **Because of the liberalized sector in Guatemala and El Salvador, international long distance rates are lower than in Costa Rica**. Guatemala's international long distance rate represented by a one minute call to the US is US$0.25, and in El Salvador it can be as low as US$0.22, which is lower than Costa Rica's US$ 0.27 rate. Honduras and Nicaragua are in the process of liberalizing their long distance telecommunications sector. Nicaragua in 2005 showed a long distance rate of around US$0.35 for a one-minute call to the US, much lower than the US$0.80 prevalent in 2003 prior to the liberalization of the market.

111. **Overall prices of telecommunication services in Costa Rica are competitive in the context of Latin America**. The ICS survey provides an additional perspective on this issue, by collecting information on how significant is the cost of these services for different segments of companies. As expected, the relative impact of these costs[25] decreases with the size of companies (figure 3.47). However it is noteworthy that the impact of these costs is several times higher for small and micro companies (more than 2 percent of yearly sales) than it is for the segment of larger firms (less than 0.5 percent). A similar discrepancy is observed on an industry basis, with companies operating in Non-metallic Minerals, Equipment Manufacturing and Paper and Publishing spending more than 3 percent of yearly sales on telecommunication services, while firms in other industries spend less than one third of that proportion. It is also noteworthy that most of the industries that reported the highest average costs, also suffered the highest losses due to service failures.

Figure 3.47: Relative Cost of Telecommunication Services (% of yearly sales)



Source: World Bank Investment Climate Survey (2005).

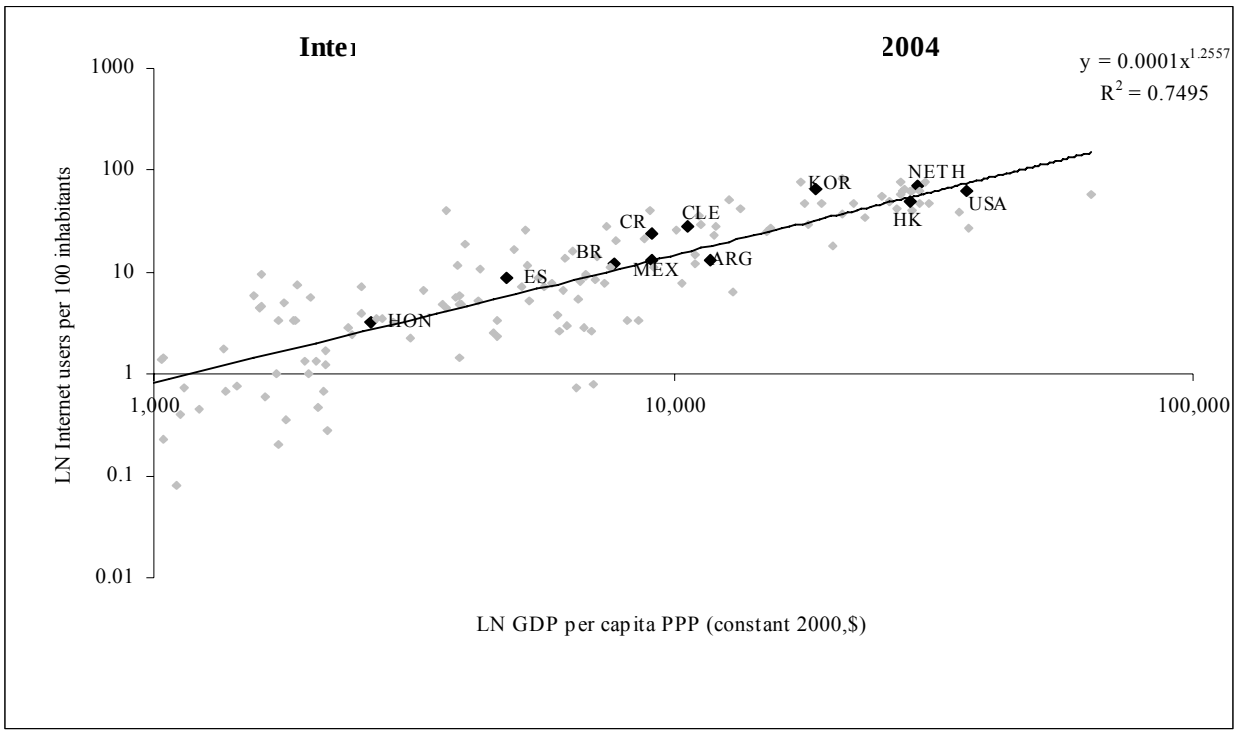
Broader ICT Sector - ICT indicators

112. **Even though the levels of Internet and PC penetration in Costa Rica are relatively high compared to similar countries in the region, Costa Rica has very low levels of broadband penetration.** These low levels of broadband penetration represent a major challenge for the country's competitiveness. Costa Rica has shown a satisfactory performance in Internet penetration (23 percent)

[25] Calculated as the cost of telecommunications as a percentage of yearly sales.

compared to its regional counterparts with penetration that is almost as high Chile (27 percent), and significantly higher than countries such as Mexico (13 percent) or Brazil (12 percent). But still countries such as S. Korea or Estonia have increased their number of Internet users to well over 50 per 100 inhabitants (Figure 3.48).

Figure 3.48: Internet Subscribers and GDP per Capita PPP, 2004



Source: ITU database, DDP World Bank Indicators

113. **The Government has been keen on implementing policies to promote the use of PCs.** These policies have been effective and show how Costa Rica is evidencing a significant lead in the number of PCs per 100 inhabitants as compared to its regional counterparts. However countries like S. Korea or Ireland have a stronger penetration among their citizens with more than 50 PCs per 100 inhabitants.

114. **Despite the positive results in Internet and PC penetration, Costa Rica faces a major challenge in developing its broadband infrastructure**. In 2003, there were only 9 broadband subscribers for every 100,000 Costa Ricans (Table 3.12). This is an extremely low level of broadband penetration, compared to countries such as Chile (22 per 1000 inhabitants); Lithuania (13.7 per 1000 inhabitants); or South Korea, with an impressive rate of 233 subscribers per 1000 inhabitants. Latin American countries like Argentina, Brazil, and Mexico, or even Nicaragua, have substantially higher levels of broadband penetration. This is a clear example of the risk Costa Rica faces of staying behind due to the fast pace of technological innovation, which a public sector institution is incapable of keeping up with. The main cause of the delay in deploying a modern broadband infrastructure, which ICE planned as early as the year 2000, has been the long and cumbersome procurement processes imposed on it. It has taken ICE more than 2 years to select the vendor to supply the first batch of the necessary ADSL cards to be installed in the switches for the provision of broadband services.

Table 3.12: ICT Penetration (2004)

	Internet users per 100 inhabitants	*Broadband subscribers per 1000 inhabitants, (2003)*	*PCs per 100 inhabitants*
Argentina	13	3	8
Brazil	12	4.1	11
Chile	27	22.1	14
China	7	8.2	4
Costa Rica	**24**	**0.1**	**24**
Dominican Rep.	5	0.7	5
El Salvador	9		4
Guatemala		NA	2
	3	NA	2
	27	7.6	
Israel		97.2	73
Lithuania		13.7	15
		4.4	20
Mexico	13	1.7	11
Nicaragua	2	0.4	4
Panama	9	NA	
Peru	12	3	10
S. Korea	66	233.3	55

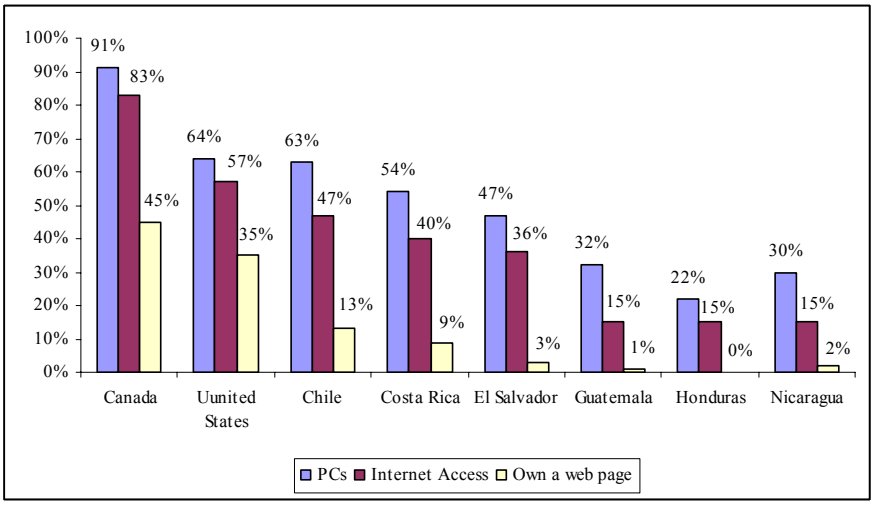
Source: ITU database, DDPWorld Bank; "The Portable Internet", ITU (2004)

115. **Costa Rican SMEs confront an important challenge in the face of globalization and the growth of knowledge-based economies.** The adoption of PCs and Internet applications by these enterprises is relatively low, and there is a digital divide among SMEs within the country, as well as between Costa Rican businesses and those in countries with which the Costa Rican businesses are competing in the international market, such as those in Canada and Chile.[26]

116. Although the levels of Internet penetration in Costa Rica are relatively high compared to its regional counterparts, only 40 percent of the small and medium enterprises (SMEs) in Costa Rica have Internet access and just 9 percent own a web page (figure 3.49).

[26] Monge, Ricardo, "Innovation and Technology adoption in Costa Rica: The Path to the Knowledge – Based Economy", 2005. (paper prepared for the World Bank)

Figure 3.49: ICTs in SMEs, Benchmarking



Source: Monge, Ricardo (2005). "TICs en las PYMES de Centroamérica: Impacto de su adopción sobre el desempeño", Editorial Tecnológica de Costa Rica."

117. **According to Monge[27], there are three main reasons mentioned by Costa Rican SMEs for not making use of ICTs:** (i) the belief that these tools are not necessary for their productive activities; (ii) the belief that their installation and maintenance are very expensive; and (iii) lack of knowledge about how to use these technologies.[28]

118. **Consequently, the use of Internet contents (for B2B, B2C, B2G and electronic banking) in Costa Rica can be summarized as follows:**

- Internet-based transactions with financial intermediaries (e-banking) is still incipient in Costa Rica – the percentage of SMEs that report using e-banking is still very low (about 25 percent).
- E-commerce between enterprises (B2B) is still uncommon in Costa Rica– the percentage of SMEs that order from their providers through the Internet is only 13 percent. In addition, the percentage of SMEs that make payments to their providers through the Internet is only 5 percent.
- E-commerce with individual clients (B2C) is approximately as common as B2B in Costa Rica – 13 percent of Costa Rican SMEs receive orders from their clients through the Internet. Moreover, only 8 percent of Costa Rican SMEs receive payments from clients through the Internet.
- With regard to Internet-based interactions between enterprises and governments (B2G), the lack of participation of Costa Rican SMEs in bidding processes, as well as the lack of use of other Internet services provided by public institutions, may be due to the low access that enterprises have to the Internet (40 percent), as well as to low penetration of electronic government (e-government) activities in this country as will be described below.

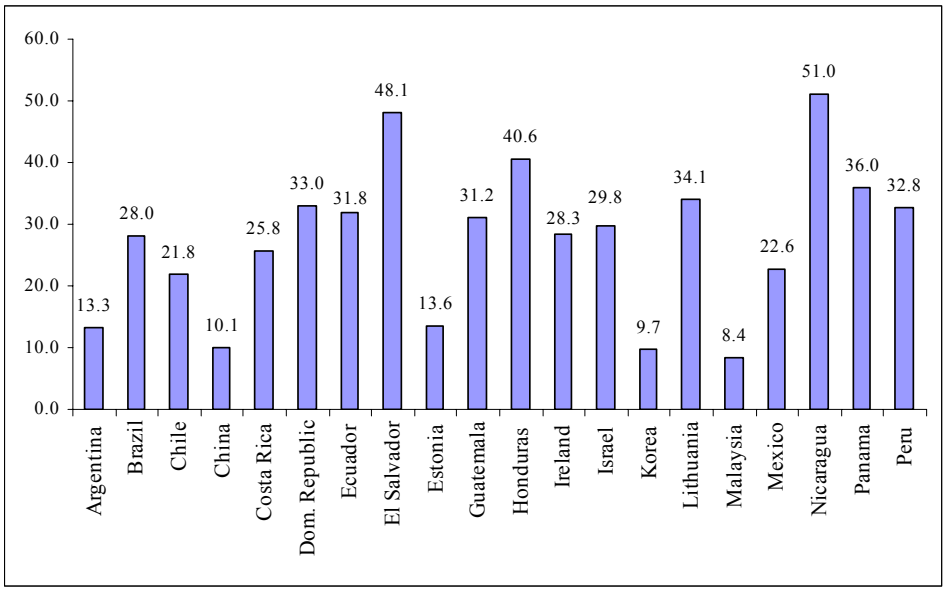
ICT Prices

119. **A fair indicator of ICT performance in a country can be shown by the levels of Internet prices.** Prices for the use of Internet in Costa Rica are low compared to countries like Guatemala and El Salvador (figure 3.50) but are high compared to Argentina, Mexico, Chile, Estonia or S. Korea. High prices for the use of Internet represent less Internet access to lower income households and SMEs.

[27] Ibid

[28] Ibid

Figure 3.50: Internet Total Monthly Price ($ per 20 hour of use), 2004



Source: World Bank Indicators, DDP, World Bank, 2005

ICT Environment and Readiness

120. **During the last decades, the Government has been promoting policies to attract Foreign Direct Investment (FDI)**. Nearly 100 Multinational Companies (MNCs) are currently operating in Costa Rica under the free-zone scheme as a result of these efforts. One-third of these MNCs are high-technology companies, including Intel. These businesses, in particular those in the high-technology sector, have established programs to promote productive linkages with local businesses. In addition, to overcome an important technological gap between MNCs and Costa Rican businesses, the Government along with the academic and private sectors, in 2000 designed and implemented a program called *Programa Costa Rica Provee* to strengthen linkages between MNCs and Costa Rican businesses.[29]

121. **Despite these initiatives, Costa Rica does not have a regulatory framework conducive to encouraging the use of ICTs in the country.** Out of 102 countries ranked in the WEF Political and Regulatory Environment index, Costa Rica is ranked 71 when comparing the laws relating to ICT, (E-commerce, digital signatures, consumer protection) and is ranked 75 when comparing the Government prioritization of ICT.

122. **In addition, the Government's agenda for e-Government does not seem to be sufficiently developed**. According to the WEF Government usage and readiness components, Costa Rica was ranked 61 on Government online presence and 86 on Government online services out of the same 102 countries ranked.

Main Challenges Facing the ICT Sector

123. **Costa Rica's ICT sector has important challenges to address in order to be a competitive player in a global environment**. Many of these challenges have emerged right to the top of the country's development priorities as a result of the CAFTA Treaty, which commits Costa Rica to a gradual and selective opening of the market to competing operators other than ICE. However, the GoCR is convinced that opening the telecommunications market to competition is an imperative for Costa Rica,

[29] Ibid

independently of CAFTA, which will contribute to economic development and competitiveness in the country.

124. **In particular, Costa Rica's telecommunications commitments, as described in Annex 13 to the Treaty, involve opening to non-discriminatory service provision the Internet and private network segments by January 1, 2006 and the wireless mobile services segment by January 1, 2007**. Regarding the latter, it must be noted that it is defined in a footnote in the Annex as covering all types of services (voice, data, broadband) provided by wireless means, including fixed terminals

125. Imminently, the GoCR is expected to submit to Parliament a modernization law for ICE and a modern telecommunications law in line with the main regulatory principles included in the Treaty. These principles, emerging from best international practice, cover issues such as universal service, regulatory independence, transparency, scarce resource management, interconnection, network access, information services, competitive safeguards, access to submarine cables and technological flexibility.

126. The following summarizes the main challenges ahead for the GoCR to be able to develop a modern and dynamic telecommunications sector.

127. **The GoCR recognizes that Costa Rica's legal and regulatory framework for the telecommunications sector is underdeveloped and needs to be modernized to promote competition, growth and the influx of private investment**. In particular, the ICE Modernization Law together with the new general telecommunications law need to be promulgated. The GoCR is convinced that ICE will need to be strengthened and modernized to act as an efficient competitor in a liberalized market and separated from policy decision-making. From the perspective of the Government, the transition of the telecommunications market will be from a monopoly to a mixed model market where the public and private sectors will be able to compete. This poses a complex challenge to the general telecommunications law, as it will have to allow for selective competition, while ensuring transparency and non-discrimination. In addition, the full regulatory framework further developing the provisions of the law will need to be drafted in record time to be ready shortly after the law comes into force.

128. **The GoCR further recognizes that Costa Rica's institutional framework for regulating the telecommunications sector is currently not well adapted to the opening of the market to competition.** It is generally perceived that currently, the regulatory entity (ARESEP) is basically limited to regulating ICE's tariffs annually. While its degree of successful performance, notably in the area of quality of service regulation, may be questionable, the regulatory authority will need to fully reinvent itself to operate in a completely new environment and guarantee fair and transparent regulation of a liberalized sector. Two main alternatives emerge at this juncture, whether to attempt a complete overhaul of ARESEP, or whether to create a new regulatory authority from scratch dedicated to the telecommunications sector. In either case, the GoCR believes that the regulatory authority needs to be independent and impartial focused on guaranteeing a level playing field for the telecommunications sector. In particular, the telecommunications regulatory agency will need to have a fully functioning independent board of directors with staggered terms as far as possible removed from political pressures, be capable of attracting new well-qualified staff to address new areas of regulation, including interconnection and spectrum, and of reorganizing its business processes to facilitate market entry, guarantee fair competition, resolve conflicts, enforce regulation and protect the interests of consumers, among others.

129. **Management of the radio spectrum currently lacks efficiency, as it has been traditionally monopolized for the most part by one single operator**. While this may have been an acceptable situation in an environment of a state-owned telecommunications monopoly, efficient allocation and management of scarce resources and ready access to it by new operators is key to the success of the

reforms in Costa Rica. This may involve the definition of new regulations, the transfer of the spectrum management function to the sector regulator, and the implementation of a migration plan to reclaim unused radio frequencies primarily in mobile telephony bands, so that new entry may be feasible. Also, the licensing of radio frequency for Internet and broadband services in an open and simple registration process is necessary to promote the participation of multiple new operators under equal rules and opportunities. This creates another important challenge for the general telecommunications law and regulatory framework to allow for simpler modes of access to spectrum than are currently available.

130. The **transition to a competitive regime also poses important challenges to the implementation of an effective and efficient universal service financing scheme.** Although Costa Rica does not require an aggressive universal access strategy for basic telephony, given the high level of geographic coverage achieved, in the transition to a competitive environment, it is possible that some of ICE's tariffs may need to be rebalanced, which will require a careful analysis of its impact on the most vulnerable users. A transitory support scheme may be necessary to maintain basic voice telephony service for low income households. In addition, an innovative universal access strategy would need to be defined in terms of Internet access (particularly with regards to broadband services), which may require the creation of a universal service fund. This fund can be financed by contributions from operators and can work as a financing instrument for the deployment of rural telecommunications infrastructure, for both telephony and Internet services in unserved areas. The deployment of telecommunications infrastructure may be focused in the use of new technologies such as broadband, Wimax and Wifi.

131. **Costa Rica has yet to develop a comprehensive digital agenda that takes fully into account the** changes **taking place in the telecommunications sector and positions the country to build an Information Society.** As described above, the broadband penetration in Costa Rica is among the lowest in the region, which means a major competitive disadvantage compared to regional counterparts. The GoCR is aware that the country needs to develop and implement a comprehensive e-strategy to move Costa Rica towards a fully developed technological and innovative environment which may attract investments and contribute to economic development, if the country is to emulate the successes of countries such as Estonia or S. Korea. An aggressive broadband roll-out program could be one of the pillars of this strategy.

132. Finally**, the GoCR is aware that there is no specific regulatory framework oriented to the use of ICTs.** Consequently, there are not enough incentives to attract investments in information technology-enabled services and innovation. Without regulations promoting E-commerce, digital signatures, or consumer protection in the digital world, there is no guarantee for investment attraction related to ICTs because of a lack of confidence and security by private investors. In addition, the service export or outsourcing potential of the country, given its relatively high availability of qualified professionals, remains largely unrealized due this lack of confidence in the investment climate for ICTs.

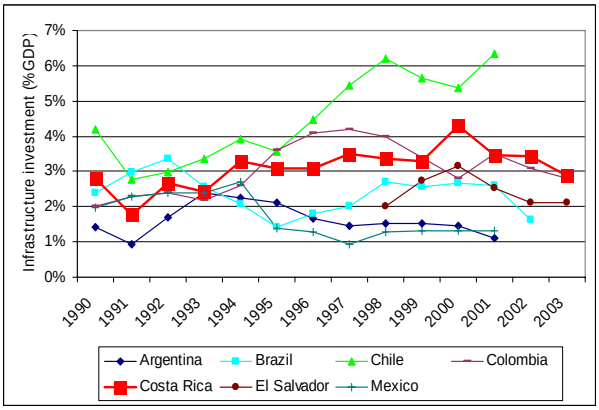
3.4 Infrastructure Financing

133. **While Costa Rica traditionally invested a larger percentage of its GDP in infrastructure than most Latin American countries, investment levels have begun to slip in recent years**. With the exception of the early 1990s, investment in infrastructure has accounted for 3 to 4 percent of GDP. Investment levels are also comparable to several East Asian countries. Costa Rica's infrastructure investment has been roughly equivalent to that of Thailand and Indonesia over the past 10 years. Financing levels prior to 2000 also tended to be much more stable in Costa Rica than in its East Asian peers. Only the Philippines maintained levels of investment that were generally higher than Costa Rica.

134. Infrastructure investment jumped to over 4 percent of GDP in 2000 with the concession contract for investment in Juan Santamaría International Airport, but has fallen sharply in the past years. Investment in infrastructure accounted for less than 2.9 percent of GDP in 2003 (Figure 3.51).

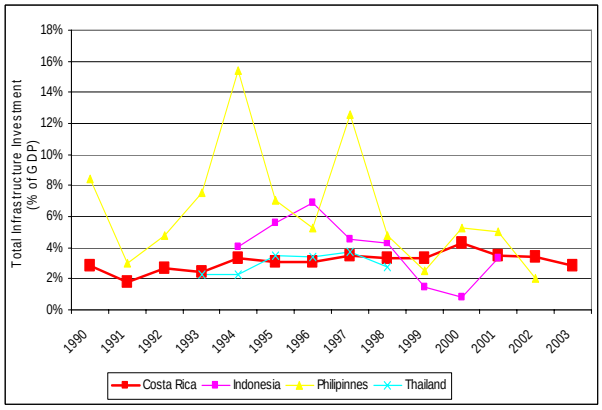
Figure 3.51: Overall Financing for Infrastructure Investment

(a) Against Latin American Peer Group



Source: MIDEPLAN; Easterly and Serven (2003); El Salvador Ministry of Public Finance

b. Against East Asian Peer Group



Source: MIDEPLAN, EAP Infrastructure Flagship (2004)

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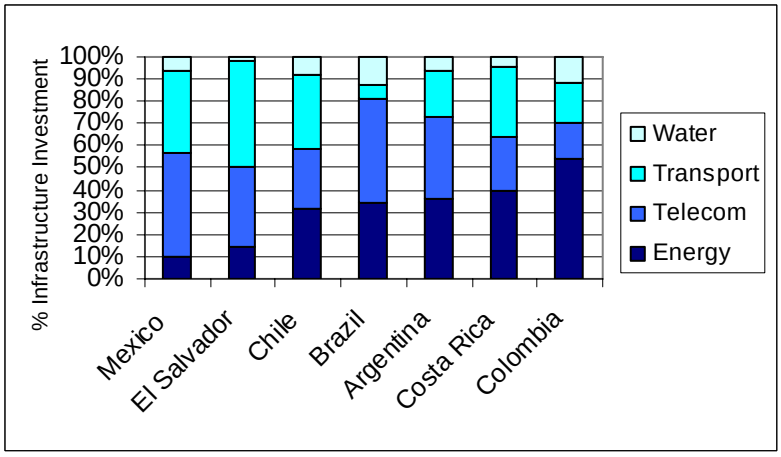
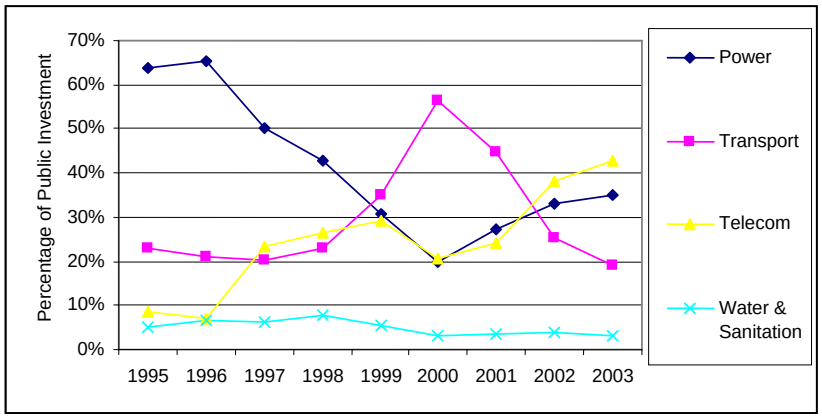
Figure 3.52: Composition of Infrastructure Investment, 1993 - 2003



Source: MIDEPLAN; Easterly and Serven (2003); Colombia REDI

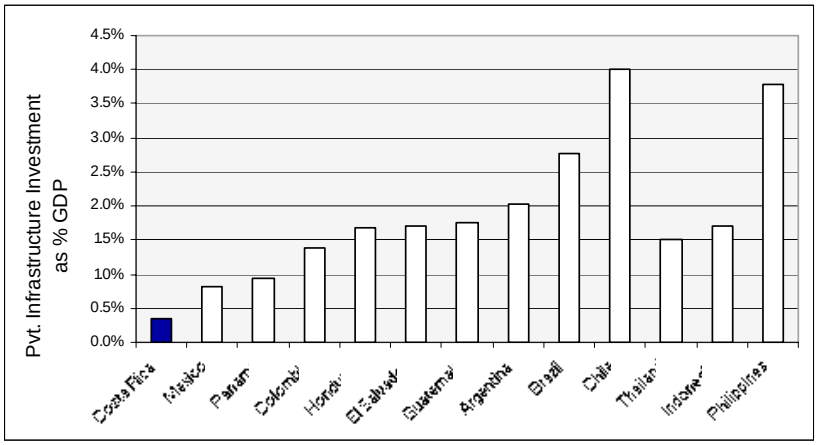
135. **Costa Rica's strong levels of total investment have been driven primarily by public investment.** Public investment accounted for more than 75 percent of total investment in Costa Rica from 1993 to 2003, and Costa Rica has a higher rate of public infrastructure investment than any of its Latin American peers. In contrast, only 40 percent of infrastructure investment came from public sources in other upper middle-income countries such as Mexico, Chile and Argentina. Relatively stable levels of total public investment mask significant fluctuations in the sector composition of public investment from year to year (Figure 3.53).

Figure 3.53: Composition of Public Investment



136. **In contrast to public investment, private financing of infrastructure in Costa Rica accounts for a low percentage of GDP relative to its peers in Latin America and East Asia**. The share of private infrastructure investment in Costa Rica's GDP was lower than in any of its Latin American and East Asian peers from 1995 to 2003 (Figure 3.54). In fact, there were several years during this period in which there was no private investment in infrastructure whatsoever.

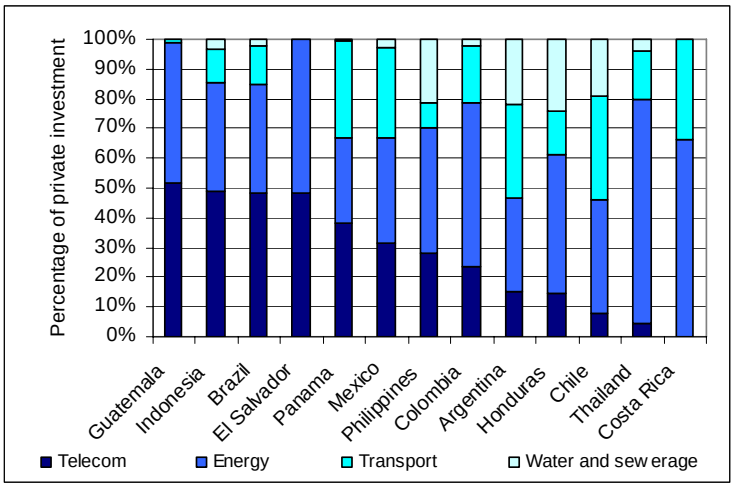
Figure 3.54: Private Investment in Infrastructure (1995-2003)



Source: World Bank, PPI Database

137. **In addition, the composition of private investment in Costa Rica differs markedly from its peers.** Most notably, Costa Rica was the only country within its peer group to have no private investment in the telecommunications sector. This lack of private involvement in telecommunications is especially noteworthy when compared to countries such as Guatemala, Indonesia, Brazil and El Salvador, which had telecom investment shares of around 50 percent (Figure 3.55). Costa Rica's modest levels of private investment have been directed to the Energy (66.1 percent) and Transportation (33.9 percent) sectors.

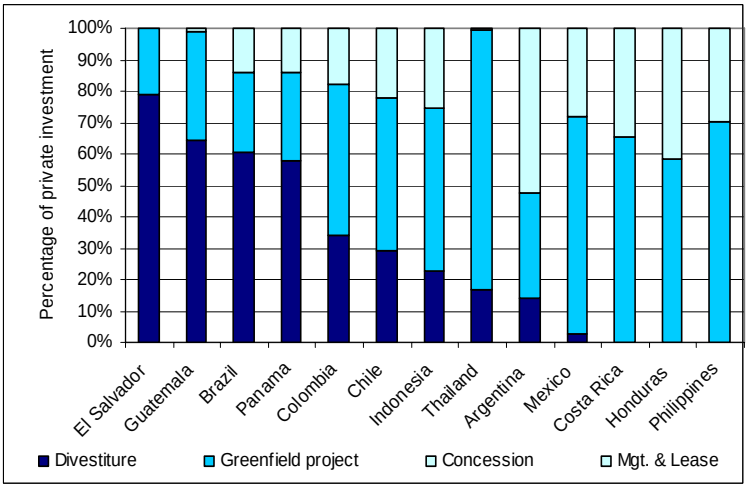
Figure 3.55: Composition of Private Investment, by Sector, 1993-03



Source: World Bank, PPI Database

138. **Costa Rica also stands out among its Latin American peers in terms of the channels used for private investment in infrastructure.** There has been no asset divestiture in Costa Rica in the past ten years and private participation has taken place solely through greenfield projects and concessions. Whereas some Latin American countries, such as El Salvador, Guatemala, Brazil and Panama received over half of their private capital flows in the form of revenues from asset sales, Costa Rica had no asset divestiture from 1993 to 2003 Figure 3.56). Rather, private capital flows went exclusively toward greenfield projects (65.2 percent, primarily IPPs for electricity generation) and concession contracts (34.8 percent, namely the international airport and the grain terminal in Caldera). In this sense, Costa Rica's private capital flows tended to be most similar to countries such as Mexico, Honduras and the Philippines, which also had little or no asset divestiture from 1993 to 2003. In that there has been effectively no private provision of retail services (electricity distribution or supply; water supply; or telecommunications services) Costa Rica stands out as by far the most publicly financed and provisioned country in terms of infrastructure services of its peer group.

Figure 3.56: Composition of Private Investment by type of Investment, 1993-03



Source: World Bank, PPI Database

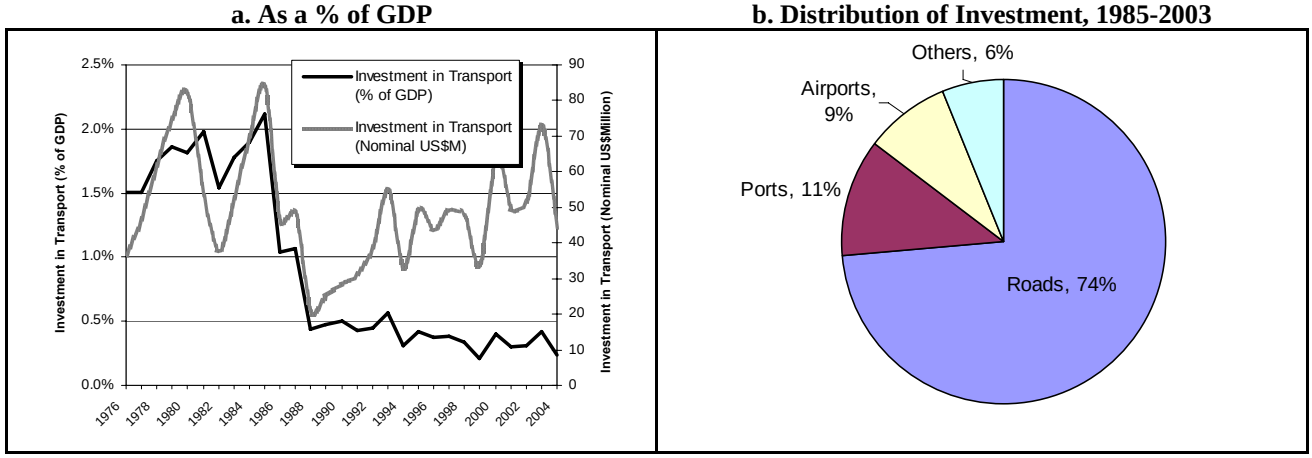
3.4.1 Financing of the Transport Sector

139. **Public Financing: The average investment in roads undertaken by Costa Rica over the past five years is US$75 million.** These funds have been channeled mainly to the maintenance of existing roads. This expenditure level is insufficient to meet the requirements of expansion and rehabilitation. Costa Rica will require approximately US$105 million annually just to create a standard cycle of routine and periodic maintenance, according to the average unitary costs in Latin America. Thus, the estimate of the financial resources needed to maintain the road network must be added to the resources needed to repair the network since between 50 and 70 percent of the network is in poor or average condition and the resources for modernization (geometry-related issues and a need for bridges have been identified) must also be included.[30]

140. **The large resource requirements for maintenance have resulted in the lack of ability for the Ministry to maintain a road modernization program.** Public investment in transportation infrastructure over the last three decades has been highly variable and declining as a percentage of GDP (Figure 3.57). This decline is despite the fact that, from 1985 to 2003, most public investment went towards transportation, with an average participation of 71 percent on roads, 13 percent on ports and 8 percent on airports. Moreover, these public expenditure figures remain below the levels of the 1980s. These represent low levels of investment also in comparison to other Latin American countries, some of which have invested at levels consistently greater than 2 percent of GDP (for instance, Chile and Colombia). The comparison is even more of a disadvantage compared to countries such as Indonesia, the Philippines and Thailand, which have posted investment levels greater than 2 percent since the mid-1990s. Since the mid-1980's, Costa Rica's transport expenditures as a percent of GDP have declined precipitously from a range of 1.5 to 2.1 percent to less than 0.5 percent. Roads and ports have been biggest

Figure 3.57: Investment in Transport

a. As a % of GDP **b. Distribution of Investment, 1985-2003**

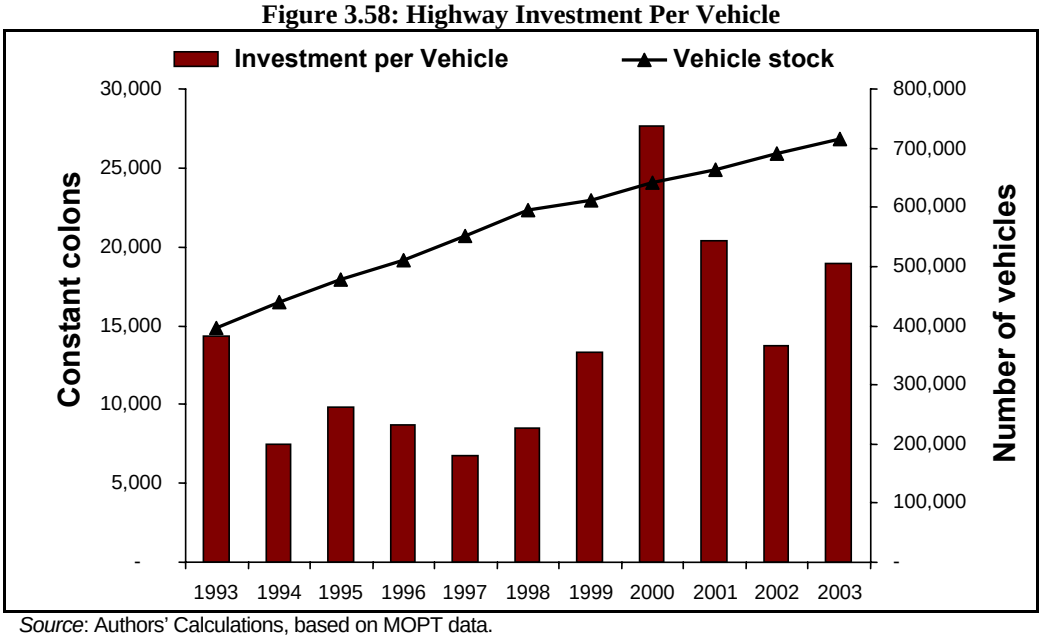


Source: Based on MOPT and the BCCR

[30] 50% according to the National Road Council (*Consejo Nacional de Vialidad*) and 70% according to LANAMME from the University of Costa Rica.

141. In contrast to infrastructure investment, Costa Rican vehicle stock has progressively increased over the past decade while road investments made per vehicle have not grown at the same pace (Figure 3.58).

Figure 3.58: Highway Investment Per Vehicle



Source: Authors' Calculations, based on MOPT data.

142. **Total required investment calculations, in static conditions, have been estimated by the ACCCR at US$3.720 billion, equal to 20 percent of one year's GDP.** The financing of this program will have to be prioritized carefully to ensure maximum impact on competitiveness and economic growth with minimal impact on the fiscal accounts. For a summary of approved and planned projects, see Annex 2.

Private Financing

143. **Although there are several major projects waiting to be executed through concession arrangements, to date, no road concessions have been initiated.** Table 3.13 summarizes the projects which are underway. The San José-Caldera project is probably the one which has advanced the most.

Table 3.13: Status of Road Projects under Concession, 2004

	Condition	*Length in km.*	*Costs*
Anillo Periférico (Beltway)	Feasibility study concluded	24	Total: US$203.5 million Expropriations: US$98.4 million Construction: US$104.1 million
Radial Heredia *Circunvalación Norte*	Project review which includes updating the demand study	15	US$110million
San José-Caldera	The previous period of conditions is currently suspended	78	US$140 million
San José- San Ramón	On October 1, 2004, the concession contract was signed. It was countersigned by the General Comptrollership of the Republic. Then, the order to commence was issued.	65.8	US$170 million
San José-Limón	The CONALVIAS S.A. company, in alliance with three other partners, filed its bid before the National Concessions Council	156	It depends on which alternative is chosen
San José-Cartago	Surveying studies are being conducted in order to establish the required right of way and other related aspects	20.5	US$74.5 million US$20 million in expropriations

Source: The National Concessions Council (Consejo Nacional de Concesiones)

3.4.2 Electricity Finance

144. **The electricity sector's greatest financial challenges are reflected through ICE's constraints to access financial resources and to increase its debt, the difficulties for tariffs to absorb higher service costs, lack of public resources to finance additional investments, and unnecessary delays in project implementation due to inadequate project management**. On the last issue, some important generation projects are suffering from inadequate planning, contracting and public discourse. The 120 MW Garabito thermal plant was planned to start commercial operations in 2006, but is not expected to begin before 2008 because of disputes over its tender process and a pending suit. The 128 MW Pirris hydro power plant, which secured finance in 1996 and was expected to start commercial operations in 2009, may not be developed at all due to population concerns of its negative environmental impact.

145. **Two financial ratios indicate that ICE's ability to generate resources to finance its investments has declined significantly in recent years.** First, the gross margin of ICE in electricity has declined substantially since the 1990s, leaving fewer resources to pay labor, administrative and financial costs and to fund investments (Figure 3.59). Second, the return on assets has also fallen significantly in recent years. ICE's return on assets fluctuated between 0.5 percent and 3 percent in 2002-04, while it was 5.2 percent in 1997 (Figure 3.60). ICE estimates that a return on assets between 6 percent and 8 percent is necessary to finance the investments required for meeting the expected annual demand growth of 5.3 percent in the next decade. The deterioration of ICE's financial ratios could be explained in part by

insufficient tariff adjustments. ICE estimated that its 2005 average tariff were 15 percent lower than its real tariff in 1995, year in which the company was comfortably able to finance its investment needs.

Figure 3.59: Gross Margin of ICE by Line of Business

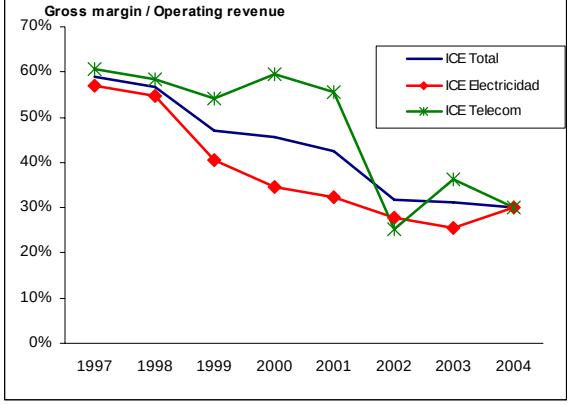
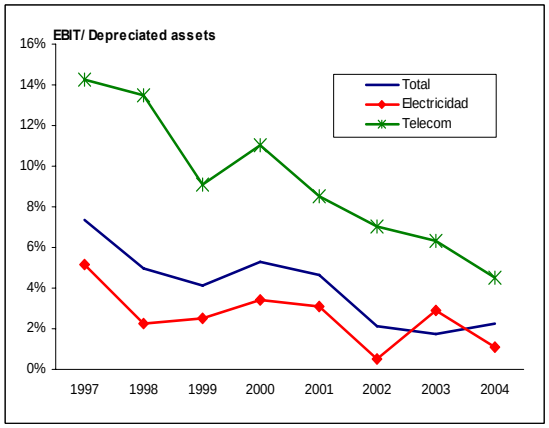


Figure 3.60: ICE's Return on Assets Ratio by Business Line



Source: ICE's consolidated financial Statements.

146. The limited ability of ICE to finance sector expansion has not been compensated by private investment because this is seriously constrained by the legal and institutional framework.

Private Participation in the Electricity Sector

147. **Private participation in the sector is limited to generation and is regulated by the Law of Auto or Parallel Electricity Generation**.[31] The law allows ICE to buy electricity from other agents through two types of contracts. One contract type is for power plants of 20 MW or smaller. Power purchase agreements (PPAs) are directly negotiated between ICE and the plant's owners, although they have to be approved by the sector regulator, ARESEP. The second type of contract is for BOT power plants up to 50MW. The BOT contracts jointly with their PPAs have to be awarded through competitive processes. For both type of contracts, power plants have to use renewable energy sources such as hydro, geothermal or wind. PPAs can not exceed 20 years. In addition, capacity under all PPA contracts can not exceed 15 percent of the installed capacity in the national electric system (SEN).

148. **Under the first type of contract, 20MW plants or smaller, ICE signed around 30 PPAs in the 1990s.** The power plants under those PPA account for 10 percent of the country's installed capacity and represent the primary form of private participation in the sector. Under the BOT scheme, there are only two contracts: Miravalles III, a 29 MW geothermal plant that started its commercial operations in 2000; and La Joya, a 50 MW biomass power plant that is expected to begin commercial operations in 2006. Most of ICE's PPAs are 15-year contracts.

149. **None of these contracts includes explicit government payment guarantees, beyond the purchase agreements from ICE.** The tender processes of these contracts explicitly stated that the winning bidder should renounce the right to request such forms of guarantee. Given the apparent financial soundness of ICE, there is little in the way of contingent liabilities that these contracts represent for the Government.

[31], Law 7200 (Generación eléctrica autónoma o paralela) was enacted in April 1990 and its modification, law 7508, was enacted in April 1995.

Legal and Regulatory Framework[32]

150. **Costa Rica lacks a coherent and clear legal framework that governs the electricity sector. The Constitution and at least twelve laws enacted over the last six decades plus their modifications regulate the sector.** In addition, the Central American regional electricity market treaty with its regulations also imposes rules upon the sector. As a result the legal framework is fragmented, outdated and dispersed, making difficult its interpretation. Current legal proposals aim at maintaining the status-quo because they focus on consolidating the position of specific agents such as the proposal to financially and institutionally strengthen ICE.

151. **In addition, the current legal framework hinders sector investments by making the entry and contribution of agents with current or potential participation in the sector difficult. The main obstacles for a greater participation of new investors or sub-national entities include:**

- Lack of clarity on legal rights for independent generators;
- Gaps and preferential treatments in the legal system related to the allocation of rights for the use of hydro resources;
- The uncertain future of PPA contracts after their expiration are

The Lack of Clarity on Legal Rights to Be a Generator

152. **The legal permits to enter in the generation business are set in different regimes and vary substantially according to:** (i) the type of entity (public, cooperative, municipal or private), (ii) source of generation (conventional, no conventional, or hydraulic), and (iii) size of generation facility with special regimens for plants of 20WM or smaller and for plants of 60 MW or larger. This legal framework creates in an intricate and dispersed regimen of generation permits, which are granted by different authorities. Although it is not unusual to have different rights and obligations of generation permits depending energy source and generator size, the Costa Rican regime has resulted in a very limited and atomized participation of most agents, which revolves around the dominant state-owned enterprise.

Gaps and Preferential Treatments in the Legal System to Allocate Rights for the Use of Hydro Resources

153. **Except for the special regime for cooperatives and municipal operators, there are not clear and explicit regulations which norm concessions of water's hydraulic power despite those concessions are mandated by the Constitution**. Such gaps affect both private and public agents, which lack of a clear regimen for the usage rights over hydro resources for electricity generation.

154. **The legal framework also establishes preferential and discriminatory treatments which further limit the participation of new agents.** The legal framework allows ICE to build hydro power plants without the need to obtain concessions or being subject to regulations governing those concessions. In addition, a special law grants to ICE a preferential access to the country's electricity reserve zone in Arenal and Cote Lakes and Arenal River. There is also a special regime that grants water concessions for up to 60 MW to cooperatives and municipal utilities. Private sector hydro power plants are limited to 20 MW.

[32] This section and the following one rely on Aresep (2005)

Uncertain Future of PPA after Their Expiration

155. **Most of ICE's PPAs expire in the next five years. Hence, there is a need to define the future of the power plants after the expiration of their contracts with ICE.** Although the current legal framework allows independent power producers to sell their electricity only to ICE, there are several options for the future of these power plants. Those include extending current contracts, renegotiating those contracts, negotiating new ones, selling the power plants to the ICE or to other qualified agent such as municipal utilities and cooperatives. Contract extensions, however, would be difficult because of disagreements over amortization and investment repayment period and the controversies in which those contracts have been involved. The agreed rates in PPA contracts have been considered too high and publicly questioned. The agreed rates in those contracts vary between US$0.06 y US$0.07 kWh while the average ICE costs is around US$0.03 kWh.

156. **The conclusion of the PPA contracts creates an opportunity to open the generation business in a controlled manner.** For instance, new and future independent power producers could be allowed to commercialize its electricity output through energy traders. If such measure is taken as part of a well-designed sectoral development strategy, it could create incentives for private investment and, thus, contribute to attain an adequate electricity supply.

Integration to Central America Electricity Market and CAFTA

157. **Costa Rica signed the Central American electricity market treaty (Tratado Marco del Mercado Eléctrico de America Central, TMMEAC) in 1996 and ratified it in 1998**. Costa Rica has also acquired foreign debt to finance its participation in regional interconnection network (SIEPAC), which is expected to enter in operations in 2008.

158. **Despite this progress, Costa Rica has yet to define how it will participate in the regional electricity market which has been operating since 2002 under transitional regulations and whose final regulations are in the process of being approved**. So far Costa Rica has limited to delegate all country's rights and responsibilities under the treaty to ICE. The current legislation, Law 7848, designates ICE as the single agent in the Costa Rican electricity market able to participate in the regional electricity market. The law also delegates all of the government's functions in the regional market to ICE.

159. **Based on the commitments acquired under this treaty, however, such legislation only represents an initial situation that has gradually evolved to another more competitive one.** Costa Rica and Honduras are the only two signing States members which have not yet reformed their electricity sectors. Because of this, the treaty established the regime of "limited initial situation", which should gradually evolve into a situation of greater openness and competition. Therefore, Costa Rica's model of market integration will requires the definition of the characteristics of its "limited initial situation" typified by the presence of a "single agent". It also requires defining common conditions of reciprocity and symmetry to which Costa Rica committed to "evolve gradually." Among the common conditions of reciprocity and symmetry are competition in generation, vertical disintegration at least at an accounting level, open access to third parties to transmission networks in non-discriminatory basis, and the free flow of electricity in territories of states members. Finally, Costa Rica's integration model requires identifying the existing legal and regulatory barriers to comply with both the "limited initial situation" and the common conditions of reciprocity and symmetry.

160. **The market integration model will also be shaped by the ruling of Court IV (Sala IV) regarding an injunction claiming the unconstitutionality of article 2 of Law 7848**. This article is the one granting to ICE all of government functions under the treaty. According to the injunction, this article

is unconstitutional because it modifies the treaty. The Legislative Assembly can only approve or reject international treaties, not modify them. A ruling by Court IV in favor of this injunction would give a clear mandate to the government to define a model to open the electricity market.

161. **Unlike the TMMEAC, CAFTA will not have a direct impact on the sector because it does not include commitments regarding the electricity sector.** On the contrary, the electricity sector is included in Annex I which lists the sectors exempted from the commitments on eliminating restrictions to foreign investment and market access.

162. **A successful integration to the Central American electricity market could create important investment opportunities to export electricity for Costa Rica**. The country has the most competitive electricity prices (Figure 3.61 and 3.62) and, after Guatemala, the largest hydropower potential in the region. Currently Costa Rica uses 1,300 MW of its estimated 6,220 MW hydropower potential.

Figure 3.61: Industrial Electricity Prices in Central America

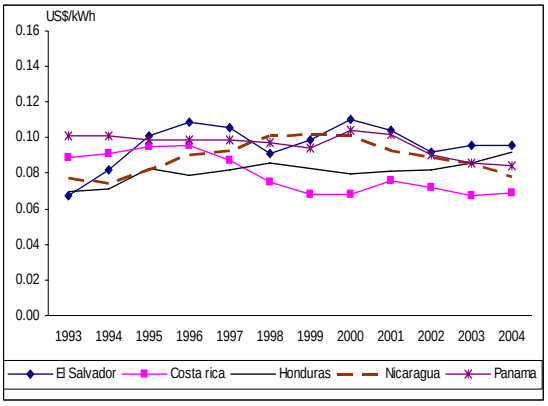
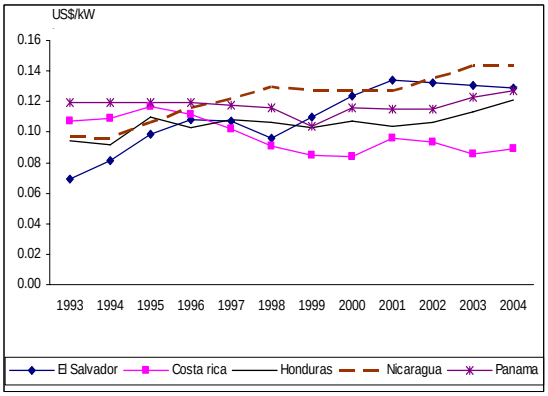


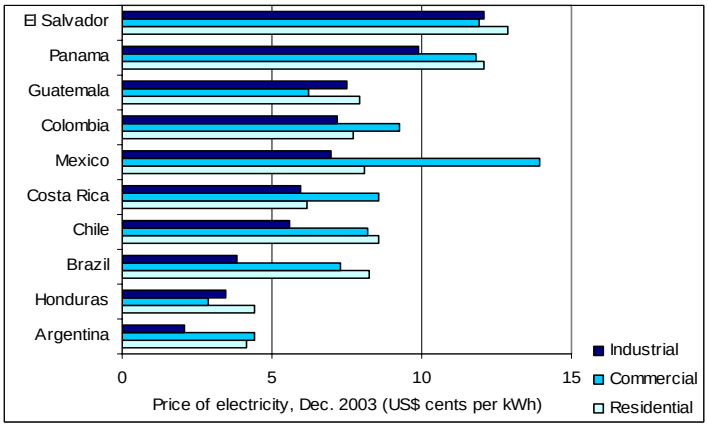
Figure 3.62: Commercial Electricity Prices in Central America



Source: ECLAC**.**

163. **Electricity prices in Costa Rica are near the Latin American average.** The price of residential electricity in Costa Rica is US$0.062 per kWh, 23 percent below the regional average of US$0.082 per kWh (Figure 3.63). Prices for industrial users (US$0.06 per kWh) and commercial users (US$0.086 per kWh) are near the regional average.

Figure 3.63 Electricity Prices (Dec. 2003)



Source: OLADE

3.5 Recommendations for Policy Action Related to Infrastructure Trade and Growth

164. **While Costa Rica retains one of the region's most extensive networks of infrastructure services, it is starting to lose its competitive edge.** The past achievements attained through considerable investment are in jeopardy from eroding quality. Over the past several years, public expenditure levels have become uneven by sector—particularly in transport and electricity generation—while some of the public service providers—most notably in mobile telephony, and ports—have been unable to keep up with sectoral innovation. The private sector has not been allowed to play a compensatory role. The result has been a noticeable decay in the quality of services across sectors--even as connectivity remains high. That quality slippage is beginning to affect Costa Rica's competitiveness, particularly for its small and medium-sized firms.

165. **Policy options for improving the performance of Costa Rica's infrastructure include two key elements**: (1) a recognition of the real source of the fiscal constraints related to infrastructure; and (2) a series of sector-specific initiatives that require the involvement of senior fiscal authorities as well as the technical agencies that implement each service.

Investment Decisions

166. It is important to consider the options for meeting its infrastructure investment requirements in the context of the country's growing fiscal constraints. **How should the infrastructure investment needs of Costa Rica be financed and how will this differ from the country's traditional investment patterns?**

167. **Historically, Costa Rica's investment levels in infrastructure have mapped closely to its growth levels—to the benefit of the country's economy.** That is, at between 3 and 4 percent of GDP, investments in infrastructure have traditionally been the second highest in Latin America--after Chile (4 to 6 percent)--as have Costa Rica's growth levels. Perhaps because the rate of infrastructure investment as percent of GDP continues to remain higher than most Latin American countries or perhaps because Costa Rica's levels of access to basic services (electricity, roads, fixed line telephones and water and sanitation) are among the highest in the region, infrastructure investment trends have not attracted much attention.

168. **It has only been recent reports of quality problems arising from Costa Rican investors, shippers and businesses that have focused a clearer light on the state of infrastructure investment in the country.** Indeed, signs of quality problems in Costa Rica's infrastructure service provision are at odds with the traditional view of Costa Rica as a regional leader in the provision of infrastructure services.[33] An understanding of the cause of the quality problems that have arisen across the productive infrastructure services is revealed by the sector-level analyses presented in Section 3.4.

169. **Investment levels by sector (telecommunications, electricity and transport)—reveals a pattern of expenditure which is different from other middle and upper income countries throughout the world.** Nearly all comparator and competitor countries use public funds for those infrastructure investments that contain a large social or merit good characteristic—such as urban and rural roads. Those same countries rely on the private sector to finance infrastructure services which are more readily paid for by user charges—such as telecommunications, electricity and other types of energy supply. By contrast, the lion's share of Costa Rica's public expenditures in infrastructure is increasingly going toward telephony and electricity generation while public investments in other areas of infrastructure are falling.

[33] See the World Economic Forum's Global Competitiveness Report and in the Investment Climate and Logistics Surveys conducted for this Report

170. **In terms of Government accounts, ICE's growing investments in telecommunications and energy obscure the massive decline in Costa Rica's public investment in transport which declined from about 2.0 percent of GDP between 1976 and 1984 to about 0.3 percent of GDP between 1996 and 2004.** As a result of the public nature of all the service providers, a chain reaction of fiscal constraints has emerged:

- The federal budget has reached its current state based upon a tradition of investment in infrastructure that appeared high (because of the independent revenue sources of ICE from telecommunications and electricity tariffs), but which is, in fact, woefully low;

- The underinvestment in transport stock has resulted in a poor quality road network, dilapidated bridges and poor port access. This deferment of investment routine maintenance has driven up the per unit cost of maintenance and rehabilitation exponentially;

- ICE's autonomy and the logic of auto-sufficiency in ICE's two sectors does not allow for transfer of investment among sub-sectors (e.g., from telecommunications to roads);

- Even if transferring of funds were possible through a system of cross-subsidies or bond financing on the back of ICE, it would not be desirable. ICE will have enough difficulty in the years ahead to finance the backlog of investment needs in energy supply; and address the growing quality concerns in electricity distribution and fixed line telephony. This will have to be done in the face of greater competition (and, possibly, lower revenues) in mobile telephony.

171. **In short, additional sources of funds will be required to rehabilitate the transport network of Costa Rica.** Currently, the Government is moving forward with: concession contracts for the few highways with sufficient traffic to self-finance through tolls; and concessioning of the ports. The Government is also looking at ways to increase the fuel tax to cover road maintenance and rehabilitation for lower density roads.

172. These initiatives are vitally important. However, unless the Government is able to construct a large, separate account for road financing out of fuel taxes, these measures are unlikely to finance the investment, rehabilitation and deferred maintenance gap that the sector currently faces. As discussed below, the Government may have to consider even more creative approaches to accessing capital and leveraging the private sector in the provision of roads. In addition, some sectoral reforms that challenge the traditional "in-house" public solutions may be necessary. These initiatives are described below, broken out by sector:

3.5.1 Transportation Recommendations

173. **Costa Rica's commitment to transport infrastructure has declined precipitously in recent years.** Likewise, the lack of maintenance of Costa Rica's accelerated deterioration of its assets. Moreover, significant delay in the implementation of the private participation contracts has further paralyzed the modernization of key transport infrastructures throughout the country.

174. ***A definition of a trunk network associated to the current location of economic activities must be adopted.*** Although there are regions with great development potential, Costa Rica must ensure that the sectors which are already inserted into the global economy continue to be successful.

175. ***Focus public efforts on expanding, rehabilitating and maintaining key trade corridors:*** Public investment will have to focus on strengthening the most important logistics corridors and improving the commitment to road maintenance—particularly in the central region. Fiscal constraints imply that public

investment should respond to clear prioritization based on traffic demand and trade corridors. The adoption of logistics corridors is necessary.

- The San José–Limón axis generates 32 percent of Central American trade. Road improvements must go along with a better organizing of the entrance to the greater metropolitan area, and the development of areas of logistics provision and modal integration with the Atlantic train in the port access. In this system, the operational modernization process of the port is necessary.
- The concession for the The San José – Caldera corridor should be completed
- The northern component of the Trans-American Corridor should be completed so that it can facilitate exports to the rest of Central America and open up access to the northern areas for greater tourism development

176. ***Enact at least one significant road concession in the short-term to prove the seriousness of intent of the Government*:** Concessions as an approach to leveraging private sector finance, operational and management skills suffer infamously lengthy delays in Costa Rica. Strategically, the most advanced concessions--for instance the San José-Caldera toll road--must be implemented in the short-term, so as to break the procedural impasse and demonstrate to investors that Costa Rica is serious about private participation in its infrastructure services.

177. ***Where highway rehabilitation and expansion are necessary but tolling is unlikely to cover the entire cost, the lumpy fiscal burdens might be "levelized" or spread out over many years through the use of credit enhancements.*** Credit enhancements such as minimum traffic or revenue guarantees backstopping partial tolling commitments would shift the initial financing costs to a consortium of construction, maintenance and operating firms. While the contingent liabilities associated with such guarantees would need to be valued openly and fairly in the public accounts, they would, at least, help to spread out lumpy investments and to shift maintenance and operating responsibility to the private sector. For roads and bridges where traffic volumes are too low to cover large rehabilitation or expansion projects, toll-financed contracting might still be considered to cover the costs of routine maintenance. A detailed analysis of per unit costs associated with current maintenance contracting should be undertaken to determine whether longer term and performance-based rehabilitation contracts would yield greater returns for the scarce resources being spent on the road network. Finally, the bundling of road and port investment obligations with land development opportunities (e.g., property leasing, tourism site or industrial park development) could be considered to entice consortia into providing infrastructure as part of more complex investments.

178. ***Reform and modernize the main container ports, preferably through public-private partnerships such as concessions*:** Costa Rican container ports, especially on the Atlantic, must be modernized. As maritime transportation is the mode most widely used for exports, and the ports have been identified by firms as a key bottleneck to trade, port reform should be addressed as a matter of urgency as should improvements in road access to the ports.

179. ***Further the customs reform initiatives already underway*:** Despite the efforts undertaken by Costa Rica in the past few years to modernize its customs offices, firms still find that bureaucratic procedures are taxing and service hours must be extended (Table 3.14). This will require greater coordination among trade regulation entities, such as the Ministry of Agriculture and Livestock (MAG) and the Ministry of the Environment and Energy (MINAE)

Table 3.14: Summary of Transport Recommendations

Recommendations	*Priority*	*Term*	*Responsible Party*	*Difficulty/Cost*
Expand, rehabilitate and maintain key trade corridors, beginning with road from San Jose to Puerto Limon	High	Short-term	MOPT, CNC, ARECEP, Contraloria	Medium to High
Implement at least one major road concession program over course of 2006-2007 to show government's commitment to financing infrastructure through public-private partnernships	High	Short-term	MOPT, CNC, ARECEP, Hacienda, Contraloria	Medium
Redefine the port model in general, and Limon in particular to make the ports more efficient. This will involve investment in Atlantic container ports, logistics plan, rationalization of operations at Limon and Moin and serious institutional reform	High	Medium	MOPT, JAPDEVA, HACIENDA, Ministry of Trade	High
Expand customs reform and modernization initiatives by increasing interaction between regulatory agencies	Medium	Medium	MAG, MINAE and ARECEP	Medium

3.5.2 Electricity Sector Recommendations:

180. Two related challenges stand out in the evolution of Costa Rica's electricity sector:

- How to increase and maintain sector investments to levels that ensure electricity supply that supports and facilitates Costa Rica's growth; and
- How to successfully integrate Costa Rica to the Central American electricity market so that the country can seize the opportunities offered by this market

181. **The Costa Rican electricity sector has been developed around ICE, a dominant and vertically integrated state-owned company.** Although this sector structure has allowed the Costa Rican sector to become one of the best performers in the region, its ability to meet the demand growth has substantially declined in the last few years. ICE's insufficient investments have taken place in a context of a fragmented, outdated and disperse legal framework that severely restricts the participation of other agents in the sector. Consequently, other current or potential agents have not been able to compensate for ICE's insufficient investments, which have put the country at a risk of electricity rationing in the coming years. On the other hand, the new Central American electricity market creates opportunities to enhance Costa Rica's electricity system reliability and increase its electricity exports.

182. **This context creates a window of opportunity to rethink Costa Rica's electricity sector policy.** A new long-term sector strategy that aims at guaranteeing an adequate supply and addressing the quality issues that Costa Rican businesses are confronting would have to be defined with the active participation of main stakeholders in the sector (Table 3.15). That sector strategy should include the long-term vision of sector structure, institutional arrangements including regulatory independnece, market rules both internally and for trading internationally, and phases of the transition toward the new sector structure. Shorter term investment decisions, such as those related to the size or type of generation projects to be pursued by the Government, will be impacted by the long-term vision of the energy sector. Large projects—particularly in hydro-electric generation—will fortify the integrated nature of ICE. Conversely, the pressures for fair or "level field" purchasing arrangements that come from IPP's may facilitate ICE's move toward a more competitive or unbundled structure.

183. Once the sector long-term strategy has been agreed upon, Costa Rica should develop an action plan to move towards the new sector development strategy. These recommendations as well as other short-term ones are listed in the table below.

Table 3.15: Summary of Recommendations for Costa Rica's Electricity Sector

Recommendations	*Priority*	*Term*	*Responsible Party*	*Difficulty/Cost*
Ensure that tariff adjustments provide ICE with the financial resources needed to fund investments required to adequately meet electricity demand in the next three years	High	Short-term	ARESEP	Medium
Define future of PPAs after expiration and mechanism for trading existing contracts in a more competitive market	High	Short-term	ICE	High
Define public agency responsible for granting concession on hydraulic power at least temporarily	High	Short-term	Legislative Assembly	High
Define Costa Rica's model for participating in the Central American electricity market	High	Short-term	MINAE and Presidency	Medium
Improve ICE project management processes primarily on environmental management and tender processes	Medium	Short-term	ICE	Low
Define new long-term sector development strategy	Medium	Medium term	MINAE and Presidency	Medium
Establish accounting vertical disaggregation of incumbent	Medium	Medium term	ICE and ARESEP	Medium
Establish third party access rights and use of network charges	Medium	Medium term	MINAE, Legislative Assembly and ARESEP	High

3.5.3 Telecommunications Sector Recommendations

184. **Although the basic indicators for the telecommunications sector reveal high penetration, other important issues such as the low quality of service (both landline and mobile), the low penetration of high speed internet, the lack or delay in technological innovation, the slow pace of investment in the sector, and the uncertainty in the efficient allocation of scarce resources, notably spectrum, reveal the need for a shift in the current regulatory environment towards a more competitive one**. With the signing of the CAFTA Costa Rica has taken an important step in the right direction and is now actively executing the necessary subsequent measures to ensure timely implementation of the commitments, which will be the first step in the implementation of the new country's digital agenda and a strong contributor to the creation of a more competitive and faster growing economy attractive to investment and employment.

185. **Based on the analysis of the situation and the challenges identified above, the GoCR is conscious of the need to undertake a number of actions, under the overall umbrella of what can emerge as the country's comprehensive "e-Costa Rica" strategy or digital agenda, structured along three main themes:** (i) telecommunications sector reform and connectivity agenda, (ii) an integrated e-Government strategy, and (iii) a strategy to promote the development of the IT industry and attract investment through IT-enabled services. Given the more urgent character of the first one, it is dealt with in more detail in the following paragraphs:

186. ***Finalize the legal framework*:** The ICE modernization law, which was recently submitted to Parliament, has received some criticism as being somewhat contrary to the principles of the CAFTA. Prior to its approval by Parliament, the GoCR is revising the draft. In addition, the currently well advanced draft of the General Telecommunications Law is currently being finalized, after discussion within government and with key stakeholders. It is expected that both laws will be discussed in Parliament shortly after the new administration takes office.

187. ***Draft and enact subsidiary legislation***: In order to swiftly implement the provisions of the General Telecommunications Law, key pieces of the regulatory framework are also currently being drafted. Notably, licensing and interconnection regulations in order to allow for new entrants to participate in the market segments as they are being opened up to competition.

188. ***Restructure the regulatory agency or create a separate telecommunications regulator*** to allow it to regulate the whole industry and ensure fair competition. In particular, according to the draft General Telecommunications Law the regulatory authority will be able to enforce its regulations on all players equally, including ICE, in order to mitigate the risk perception of potential private investors. This may involve requiring strict account separation between services provided by ICE in competitive and non-competitive segments of the market. In addition, the draft law foresees that the regulatory authority will have a higher degree of independence and an enlarged scope of regulation, to include issues such as interconnection and spectrum, among others.

189. ***Create the telecommunications policy function*** within government, most likely assigned in the forthcoming Telecommunications Law to the renamed Ministry of Environment, Energy and Telecommunications. It is expected that there will be strict separation between ICE and the new policy-maker, to ensure that ICE becomes a pure operator and does not interfere with governance of the sector.

190. ***Improve information generation*:** Every source consulted on basic telecommunications indicators for Costa Rica has shown different numbers, even though ICE has been the primary source for that information. The Ministry and the regulatory agency are aware of this issue and the reforms

undertaken will allow them to be capable of collecting verifiable information from all the operators and conduct audits on all players in the industry, including the incumbent.

191. ***Implement a market opening plan*:** In order to quickly take advantage of the benefits of reform to the overall economy and competitiveness of the country, and in line with its CAFTA commitments, the GoCR has undertaken the preparation of an effective sector liberalization plan, through accelerated licensing of new operators. In particular, tenders for the licensing of new mobile operators are expected to be prepared and conducted shortly after the approval of the law. In addition, as a way to promote competition in Internet services, rules for the use of the spectrum bands internationally allocated to unregulated use will be drafted.

192. ***Simplify access to spectrum*:** Most new entrants will probably choose the provision of services via wireless technologies. Therefore, the GoCR is aware that the current process that requires individual concessions ratified by the Parliament could constitute a tremendous entry barrier and needs to be simplified, taking into account the precedent of paging services. The General Telecommunications Law contains provisions for delegating in the appropriate government agency the concessioning of radio frequencies in order to allow for competition in wireless services.

193. ***Improve efficiency of spectrum use:*** this involves a spectrum reallocation plan, currently under execution, to reclaim unused bands and provide an incentive to operators to improve the efficiency in the use of the bands already allocated.

194. ***Increase the capacity to manage and monitor the radio spectrum*:** the office currently in charge of spectrum management, under the Ministry of Interior, is expected to be moved to the regulatory authority. In addition, the agency will be strengthened with proper capacity, both human and technical, in order to manage this scarce national resource.

195. ***Define a detailed universal service/access strategy*:** As a measure to ensure that the benefits of competition reach beyond the main urban areas, the GoCR wishes to identify a suitable universal service/access strategy and funding approach. The draft law foresees the creation of a universal service fund, and detailed studies will be conducted subsequently to identify the needs and adequate targets for eventual subsidies. Based on the outcome of these studies, the appropriate institutional arrangements and regulatory mechanisms will be put in place.

196. ***Conduct tenders for subsidies from the universal service fund*:** In order to ensure fair treatment of all operators, it is expected that universal service/access projects will be tendered.

Box 3.1: Results of Regression Analysis

Productive Infrastructure

Simple Model

	Electricity Generation Capacity	Total Telephone Lines	Telephone Mainlines	Mobile Subscribers	Paved Roads
GDP	0.00	0.07	0.04	0.03	0.00
	(5.60)***	(12.08)***	(11.16)***	(9.50)***	(6.62)***
Constant	0.19	45.33	32.90	11.46	-0.03
	(3.73)***	(2.99)***	(3.41)***	(1.46)	(0.45)
Observations	118	116	118	116	108
R-squared	0.21	0.56	0.52	0.44	0.29

Table 3.16: Summary of Recommendations for Costa Rica's Telecommunications Sector

Recommendations	*Priority*	*Term*	*Responsible Party*	*Difficulty/Cost*
Develop a comprehensive "e-Costa Rica" strategy or digital agenda to define: i) telecommunications sector reform and connectivity agenda, (ii) an integrated e-Government strategy, and (iii) a strategy to promote the development of the IT industry and attract investment through IT-enabled services.	High	Short	Presidency	Low
Finalize the legal framework and draft and enact subsidiary legislation. Restructure the regulatory agency or create a separate telecommunications regulator; create the telecommunications policy function; and improve information generation.	High	Short	Presidency and Ministry of Science and Technology or successor	High
Implement an effective sector liberalization plan through accelerated licensing of new operators.	High	Short	Presidency and Ministry of Science and Technology or successor	High
Radio spectrum optimization: Simplify access to spectrum; improve efficiency of spectrum use; and increase the capacity to manage and monitor the radio spectrum.	High	Short	Ministry of Science and Technology or successor	Medium
Universal service and universal access: Define a detailed universal service/access strategy and conduct tenders for subsidies from the universal service fund.	Medium	Short	Ministry of Science and Technology or successor	Medium
Implement an integrated e-Government strategy that would improve efficiency, quality and transparency of government services, and would be structured around horizontal actions (infrastructure, standards, legislation, capacity building) as well as vertical (financial management, customs and taxation, registries, social security, education, health, etc.).	Medium	Medium	Presidency/ Vice-Presidency	Low
Implement a strategy to promote the development of the IT industry and attract investment through IT-enabled services aimed at capitalizing on Costa Rica's achievements in the high-tech industries, and promote the development of a domestic IT-enabled services industry.	Medium	Long	Ministry of Economy, Industry and Trade	

Chapter 4 The Role of Innovation in Costa Rican Development: An International Comparative Perspective[1]

4.1 Introduction

1. **Innovation is a key ingredient to pursue a *new* growth agenda in Costa Rica.** As mentioned in Chapter 1, Costa Rica has enjoyed a successful record of long-term growth with respect to other Latin American and Caribbean countries, but is currently facing challenges related to fiscal policies and debt sustainability, while at the same time recent events have cast doubts on the quality of public governance. In this context it is worth asking whether innovation policies can and should be placed at the top of a new growth agenda. This chapter addresses this issue and the evidence suggests that indeed Costa Rica should seek to at least double its national investment in research and development (R&D) by protecting the public resources already dedicated to stimulating private-sector investments in innovation. Furthermore, if fiscal concerns prevent increasing public funding of private-sector innovation, then at the very least some existing programs should be protected and improved. In a nutshell, innovation policies are a key ingredient in the country's *new* long-term growth agenda.

2. **When compared to middle income "star" performers outside the Latin American and Caribbean region Costa Rica still lags behind, especially in terms of total factor productivity (TFP).** While countries such as Taiwan, South Korea, Singapore, and more recently Ireland and China, grew at 7 to 8 percent per annum in recent years, Costa Rica underperformed by almost half (figure 4.1 below). In this backdrop, the challenge going forward is not only to return to the country's relatively good growth levels by Latin America standards during the 1990s, but also to catch up to some of the world's booming economies. Still, this will be no easy task. A recent study by Sauma and Sanchez (2003) attempted to quantify this effort and estimated that for Costa Rica to attain similar growth as that experienced by East Asian countries, Ireland and China, the country needed to aim for a 20 to 30 percent increase in TFP, which entails raising its recent TFP growth rate of 2 percent per year to over 2.4 percent. Although TFP estimates are notoriously imperfect as indicators of innovation or technical progress, partly because they are subject to a variety of technical pitfalls, the real question remains how to maintain or accelerate economic growth for the long term.

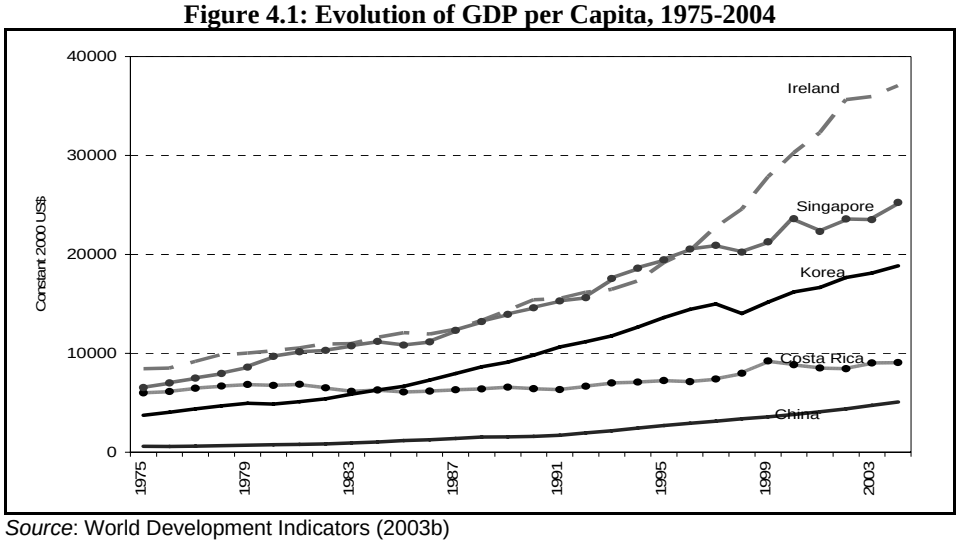
3. **Numerous studies recognize the link between productivity growth and investments in innovation.** Some studies even point out that much of the widening gap between rich and poor countries is due, not to differences in capital investment, but in technological progress.[2] Also, in the context of a DR-CAFTA agreement, understanding these factors is of utmost importance for Costa Rica. DR-CAFTA offers a great opportunity to make further progress in fostering trade-led growth–a crucial ingredient in Costa Rica's recent success story. Yet the ability to take advantage of the opportunities offered by this agreement will largely depend on the degree to which the country changes its production and employment patterns and adopts foreign technologies.[3]

[1] This chapter was prepared by Daniel Lederman (LCRCE) and Camila Rodríguez (LCSFP), with invaluable contributions from Daniel Chodos (consultant).

[2] Hall and Jones (1999), Dollar and Wolf (1997), Easterly and Levine (2003), and Maloney (2005)

[3] World Bank (2005)

Figure 4.1: Evolution of GDP per Capita, 1975-2004



Source: World Development Indicators (2003b)

4. **The role of private-sector innovations that are not protected by patents in the process of development is less well understood.** Despite a long literature on the importance of patents and science and technology policy on innovation, a distinction between adoption and invention in developing countries should lead us to explore other types of innovation where market failures can hamper private-sector performance. These non-patentable types of innovation have generally received less attention in the innovation agenda, but merit scrutiny especially in the context of developing countries such as Costa Rica.[4] Moreover, the relation between investments in research and development (R&D) and non-patentable innovations also remains murky.

5. **This chapter provides an international perspective of the enormous potential that innovation policies have to accelerate Costa Rica's development.** To this end, this chapter combines macroeconomic and microeconomic analyses concerning the relationship between innovation outputs and inputs, as well as their potential effects for economic growth and firm performance. The empirical analyses are complemented with a qualitative assessment of relevant government policies since policy makers are interested in understanding the factors that promote or impede innovation and in undertaking initiatives and policy actions that benefit the general society by targeting innovation-related market failures.

6. **Innovation might seem to be of secondary importance in the current Costa Rican context characterized by challenges in the fiscal and governance areas; the evidence discussed in this chapter strongly suggests otherwise**. The main findings are: *First*, the characteristics of the Costa Rican economy in terms of its level of development, educational level, and even institutional quality, imply that smart policies to promote private-sector innovation can have tremendous payoffs. In fact, some evidence suggests that the payoffs can be even larger than improving the quality of governance. *Second,* both R&D and licensing payments to secure the legal use of foreign technologies are significant correlates of common types of innovation in a large sample of firms operating in developing countries, including Costa Rica. Thus these innovation inputs, which are commonly believed to be important only for very sophisticated innovation in developed countries, seem to be part and parcel of the process of innovation and economic diversification in poor countries. Costa Rica is ready to reap the benefits from policies that solve key market failures that inhibit innovation in developing countries. *Third*, Costa Rica's current subsidy program aimed at promoting innovation through a matching grants system, as well as its efforts to promote exports through the activities of PROCOMER are well justified by the empirical evidence

[4] Maloney (2005); Hausmann and Rodrik (2003).

presented herein. The country also faces challenges regarding its policies towards Export Promotion Zones (EPZs, *Zonas Francas* in Spanish), which provide tax incentives for companies that assemble products for export. A detailed analysis of the costs and benefits of alternative reforms to these programs is well beyond the scope of this report, it is worth highlighting that EPZs tax exemptions linked to export performance will need to be reformed in the coming years due to World Trade Organization norms, which nonetheless allow the use of such incentives to promote private R&D. Moreover, the matching grants program, however close it is to global best practices, can be improved while at the same time it can be rigorously evaluated to enhance its future performance.

7. **The focus of Section 4.2 is on the role played by the private sector, the public sector, and how these efforts interact in the context of public policies that help or hinder private innovation**. In this context the business environment plays a crucial role. It then explains the role of government policy in response to market failures that hinder innovation by the private sector. Section 4.3 provides descriptive statistics on the status of innovation in Costa Rica by analyzing aggregate and firm-level data and comparing this country's performance in recent years with those of countries at similar levels of development. Section 4.4 discusses new macroeconomic evidence linking innovation and economic growth on the one hand, and the role of market failures in hampering innovation on the other hand. Section 4.5 describes the roadmap followed to empirically pinpoint the main correlates of firm-level innovation in Costa Rica and elsewhere in the developing world and presents the corresponding econometric results. The final section 4.6 describes innovation policies and programs currently in place in Costa Rica and assesses their recent performance through a qualitative analysis. It also discusses challenges that must be met to evaluate and monitor the performance of such public subsidy programs. Lastly, Section 4.7 summarizes our conclusions and main policy recommendations.

4.2 Innovation Framework

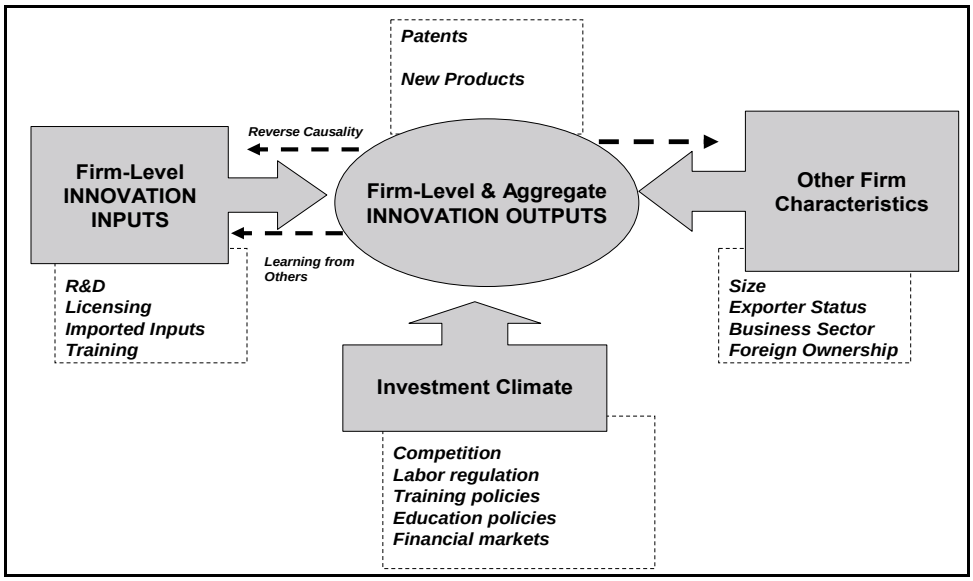
8. **Figure 4.2 illustrates the innovation framework linking firm-level innovation "inputs" with firm-level innovation "outputs."** This naïve view relies on simple logic: the level of innovation by a firm will be a result of its own innovative efforts. In turn, the sum of all firms' innovation outputs yields the economy-wide level of innovation. In this simple framework firm-level innovation is a result of firm investments in innovation inputs, but firm decisions regarding expenditures or other business decisions that determine a firm's ability to learn, adapt, and change, are themselves shaped by the business environment. Without a proper participation of the public sector in promoting firm investments in innovation, it is likely that the private sector alone will make sub-optimal levels of investments in innovation.

9. **Firms' propensity to invest in innovation inputs, namely, R&D, licensing, imported inputs and worker training, and to learn from other firms is directly and indirectly determined by the investment climate and public policies**. Firm characteristics such as size, exporter status, business sector, and foreign ownership also affect firms' levels of innovation outputs, either because such characteristics "cause" innovation or because the most innovative firms tend to have those characteristics. Other factors in the investment climate, including the costs of financing risky investments in innovation, corruption, or the coverage and quality of domestic infrastructure may affect the private sector's propensity to innovate. These *direct* effects of the business environment are illustrated by block arrows in Figure 4.2 below indicating the direction of influence. However, these variables may also affect innovation indirectly (not shown in Figure 4.2) by affecting the characteristics of firms that in turn affect private-sector innovation, such as limiting the size of firms and thus preventing the private sector from achieving economies of scale necessary to finance risky innovative activities. In addition, innovation inputs and firm characteristics may actually be determined by the innovation outcomes *per se*, leading to a process of technological upgrading that takes place endogenously at the firm-level. This process is labeled "reverse causality" in our framework to highlight the fact that observed correlations between firm

innovation inputs and outputs can be due to innovation (e.g., producing a new product) creating a need to increase the inputs (e.g., training the workforce to produce the new product).

10. **The incentives to invest in innovation inputs are affected by the example and ideas developed by other firms, which produces market failures that justify government interventions to promote private sector investment**. The bold dashed arrow feeding back to firm-level innovation inputs depicts this effect here. When firms can imitate the commercial ideas of their competitors, be it in the form of the commercialization of scientific ideas or in the form of producing products that already exist elsewhere or even just improving the quality of existing products, the incentives to make such investments are low. This "appropriability problem" is the principal market failure that justifies the use of government subsidies or other instruments to stimulate private investments in innovation inputs, but there are others discussed in the remaining sections of this chapter. Subsequent econometric exercises attempt to provide quantitative estimates of the relationships highlighted in Figure 4.2, but we were unable to uncover underlying causal relationships between firm-level innovation inputs and outputs, for example, although we do uncover potential causal effects concerning the existence of market failures by using macroeconomic data in Section 4. We now turn our attention to the market failures that presumably justify government interventions to promote innovation.

Figure 4.2: Innovation Framework



Source: World Bank (2002)

4.2.1 Market Failures in the Creation and Diffusion of Innovation

11. **The market failures that shape private-sector investments in innovation have been widely discussed in the specialized literature (Kortum 1997; De Ferranti et al. 2003; Maloney 2005; Jones and Williams 1999; Hausmann and Rodrik 2003, among others).** Innovation often requires lumpy and complementary investments (sunk costs), and once an innovator undertakes this activity, others may be inclined to follow suit and imitate or appropriate the incumbent's new idea. Such market failures or implicit "taxes" on innovation undercut the creation of new ideas and depress private investment in innovation inputs. Overcoming these shortcomings requires an understanding of the forces that create these market failures and a pro-active strategic policy stance to guide a country's innovation agenda.

12. **One of the most commonly discussed "taxes" on innovation is related to the appropriability of rents and the low cost and barriers to imitation.** The process of innovation requires entrepreneurs to investment in experimenting and discovering new products or processes. However, once this entrepreneur discovers an innovation that pays off, others will be inclined to imitate and drive down the entrepreneur's profit. This can occur through a reduction of the new product's sales price if it is a non-tradable good. It can also occur through increases in the costs of non-tradable factors of production, such as labor and land. The result is that firms will under-invest in R&D and other innovation inputs, because of the risk that other firms will appropriate such benefits. In this case, a market failure arises because private returns to innovation will inherently be lower than the social returns, thus justifying a role for public intervention.

13. **If innovation can be perfectly protected through intellectual property rights (IPRs), then additional incentives might not be required to promote private-sector innovation, but this would come at the expense of higher costs for users of those innovations.** Furthermore, it is possible that many innovations in developing countries cannot be protected by IPRs. The advantage of rigorously enforcing IPRs regulations is that it brings the additional benefit of knowledge diffusion through the informational content provided in the patent applications. Hence in most contexts the optimal policy mix for advancing innovation will entail a mix of IPRs, their enforcement, and public support to private-sector investments in innovation inputs.

14. **Another "tax" on innovation–and one extremely relevant for developing countries—is associated with the sunk costs that come with the activity of innovating and the economies of scale that are ultimately necessary to spread these costs and make a profit**. Technological changes and expenditures on R&D are for the most part sunk costs, and in developing countries most firms do not have the scale for these investments to make economic sense. Not only does the innovator face the threat of being undercut by imitators once he makes a discovery, but he also needs to consider how he will recover his initial investment. When firm size and market scope are limited, there is an inherent barrier that discourages innovation from taking place. This situation is exacerbated by the lack of all other downstream investment (i.e. transport, logistics, marketing, distribution, etc) associated with the launch of a new product or service. In this context, government intervention makes sense either by providing sweeteners to initial investors so that sunk costs can be recovered, or by promoting sector associations or industrialists' groups that can coordinate these upstream and downstream activities and spread the costs among a number of firms.

15. **Lastly, another issue to be considered in the innovation agenda and one that further stunts the growth of the marketplace for new ideas is credit market imperfections**. Access to credit and financing in developing countries usually takes the form of bank lending. The underdevelopment of capital markets in these places means that most firms tap into bank loans as a main source of financing. This not only exacerbates the cost of accessing capital but also limits the availability of funds for riskier projects, since bank lending is necessarily low risk as it involves intermediating deposits. In the absence of riskier forms of financing, the creation and diffusion of innovation is limited, and in turn, the possibility that it will act as a growth catalyst diminishes. The empirical analyses presented section 4 in this chapter evaluate the potential magnitudes of some of these market failures, but we first describe Costa Rica's macro- and micro-economic position in terms of innovation outcomes and inputs.

4.3 How Much Does Costa Rica "Innovate"?

16. **Growth in per capita income and improvement in the standard of living of Costa Rica's population driven by productivity growth and private-sector investment are the fundamental measures of innovation success**. A standard growth accounting exercise for Costa Rica sheds light on the contribution to growth that can be attributed to the accumulation of physical capital, the increase in the labor force and the increase in total factor productivity (TFP). As evidenced by Table 4.1, the

economy has shown relatively modest rates of productivity growth – an average of 1.97 percent over the 1985 to 2001 period.

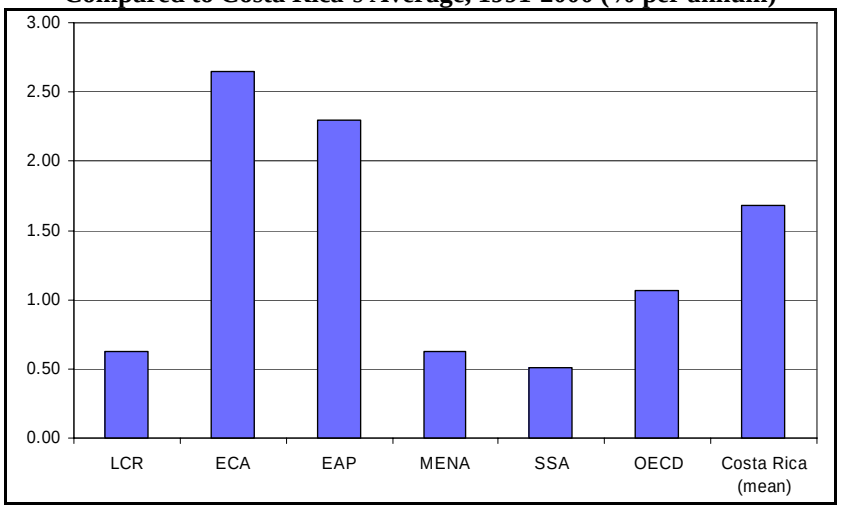
Table 4.1: Costa Rica: Growth Accounting Exercise, 1985-2001

Period	*GDP Growth*	*Contribution from Capital*	*Contribution from Labor*	*Contribution from TFP*
1985 – 1990	5.9	2.6	1.8	1.6
1990 – 1995	5.8	1.8	1.3	2.7
1995 – 2001	4.4	1.6	1.1	1.6
1985 –2001	5.37	2	1.4	1.97

Source: Robles-Cordero and Rodriguez-Clare (2002)

17. **Other studies also suggest that Costa Rica's productivity growth has lagged behind star performers**. Loayza et al. (2005), for example, report a TFP growth rate of 1.98 percent per year for Costa Rica during 1991-2000. Their estimates that control for human capital accumulation as well as capacity utilization are lower at around 1.2 percent per year. Figure 4.3 shows additional back-of-the envelope estimates of TFP growth for the typical developing country belonging to the various geographic areas, including LAC. Although Costa Rica fared well with respect to the typical LAC country, it did not fare well with respect to the typical East Asian and Pacific (EAP) country.[5] Based on these results, it is clear that Costa Rica will inevitably have to increase its TFP to pursue the higher and sustained rates of growth that are necessary to catch up to more stellar performers.

Figure 4.3: Median TFP Growth Rates by Regions Compared to Costa Rica's Average, 1991-2000 (% per annum)



Source: Authors calculations, assuming a capital share of GDP of 40% for all countries and years, and based on data provided by Loayza, Fajnzylber and Calderón (2005).

4.3.1 Aggregate Innovation Outputs and Inputs

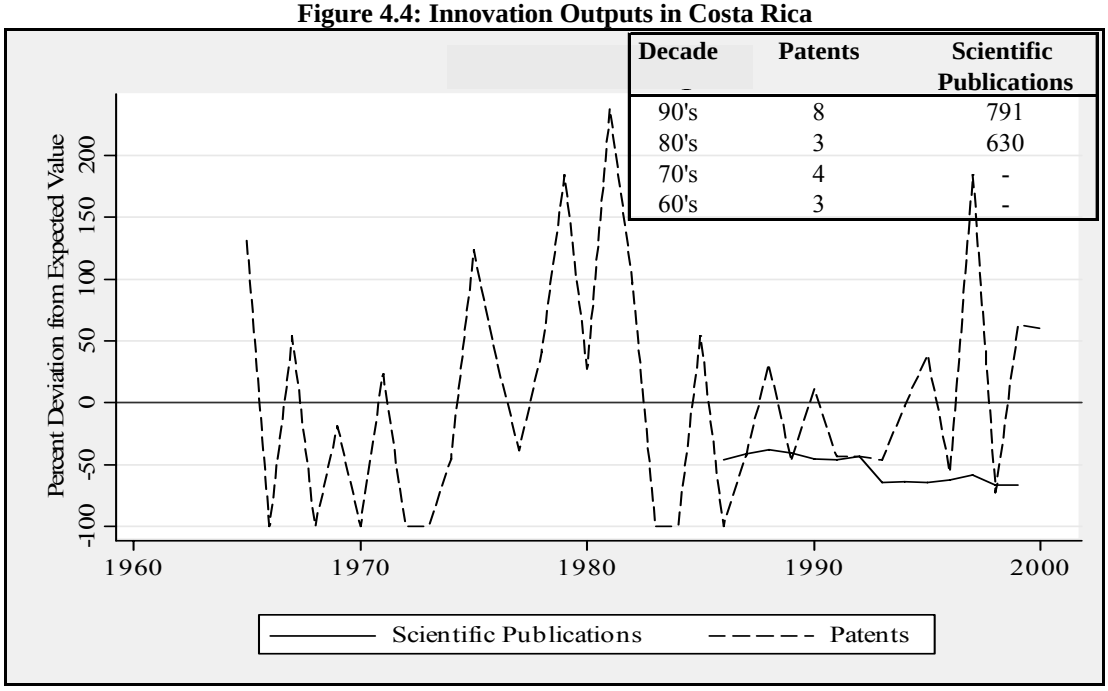
18. **In the current Costa Rican context of a slowdown in the pace of economic growth combined with a modest productivity record, innovation and private-sector investment in innovation take center stage**. As shown through regression analysis later in this chapter, it is likely that innovation, as measured by the accumulation of patents, is positively correlated with the level of development across

[5] Underperformance with respect to the typical country of Europe and Central Asia (ECA) was to some extent due to the radical restructuring that occurred in those economies during the 1990s, which entailed drastic reductions in employment and investment during the transition.

countries in "causal" sense. Figure 4.4 benchmarks Costa Rica's performance in accumulating patents granted by the United State Patent and Trademark Office (USPTO) and the number of scientific publications (an alternative indicator of innovation output) with respect to its economic size and level of development, which are captured by each country's GDP, labor force, and value of exports to U.S. market in the case of USPTO patents.[6]

19. **Given Costa Rica's economic size, there is no clear evidence that it is under-performing in terms of patents registered in the United States, but it seems to be falling behind in scientific publications**. The evidence in Figure 4.4 shows how far Costa Rica is from the average of similar economies (the zero line) while the embedded table reports Costa Rica's average absolute levels by decades. A negative number on the vertical axis is evidence of under performance. Because the predicted number of patents are relatively small (1 or 2) the performance of Costa Rica in terms of patents appears to be erratic. However one could say that Costa Rica does not seem to systematically under perform. In contrast, the outcome of scientific publications is around 50 percent below the expected number.

Figure 4.4: Innovation Outputs in Costa Rica



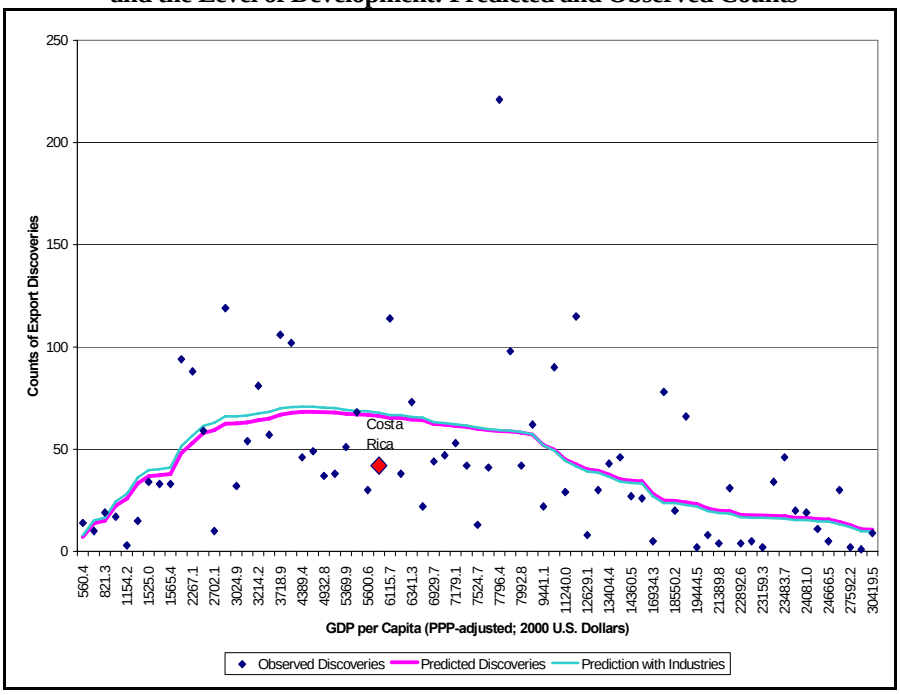
Source: World Bank (2003)

20. **In terms of the introduction of new export products, a form of non-patentable innovation, Costa Rica does seem to be underperforming**. Another indicator of innovation outcomes is the appearance of new products in a country's export basket. Recent evidence suggests that there is a linkage between the appearance of new export products and economic growth. For instance, Khan (2004) finds that the introduction of new products does indeed affect economic growth by stimulating productive investment, and econometric evidence provided by Klinger and Lederman (2004; 2006) suggests that market failures may reduce the frequency with which new export products are introduced by developing countries. Figure 4.5 shows the predicted and the observed number of export discoveries during 1994-

[6] Controlling for the value of U.S, exports is essential for benchmarking countries' performance in terms of patents granted by the USPTO, because the incentive to apply for patents in the U.S. is proportional to the economic value of exports. That is, entrepreneurs who wish to protect their commercial ideas have an incentive to apply for patents, thus absorbing the costs of the application process, only if their products have economic value in the target market.

2003, as a function of the level of development (GDP per capita) in a sample of 73 countries.[7] The graph shows two different predictions. One is derived from a Negative Binomial estimation that controls only for GDP per capita and its squared terms, while the other also controls for sector-specific effects, where Leamer's (1984) commodity groups encompass the corresponding sectors. This latter adjustment could have been important if the introduction of new export products in developing countries is the result of structural transformation, whereby growing economies change their patterns of production. Since both curves seem very similar, the data suggest that structural transformation is not an important part of the story. Either way, Costa Rica is an underachiever in this realm.[8]

Figure 4.5: Export Discoveries during 1994-2003 and the Level of Development: Predicted and Observed Counts



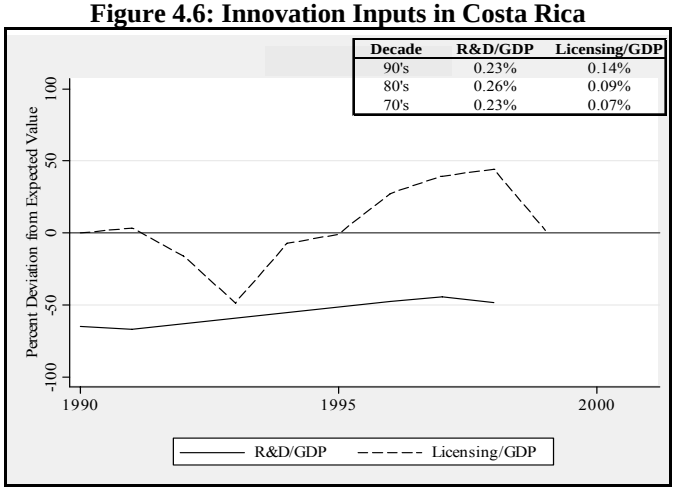
Source: Klinger and Lederman (2006)

21. **Recent evidence also suggests that Costa Rica is underperforming in terms of its investment in R&D.** Similar benchmarking can be done with innovation inputs at the aggregate level, namely expenditures in R&D and payments for licensing of foreign technologies. The results of these exercises are depicted in Figure 4.6. The data suggest that Costa Rica's R&D effort has been weak compared to countries of similar size (0-line). On the other hand, the share of GDP Costa Rica devotes to licensing does not show deficits in investment. These low rates of investment in R&D are not due to low returns, as will be discussed further below in section 4.2.

[7] A discovery is defined as a good if it was not exported during 1994-1996, but exported for more than US$ 10,000 in 2002 and 2003, based on disaggregated export data at the 6-digit level of the Harmonized System. See Klinger and Lederman (2006).

[8] This new evidence contradicts the evidence reported by World Bank (2005), which showed a similar graph where Costa Rica appeared to be an overachiever. This previous finding was due to recording errors in the export data affecting numerous countries including Costa Rica. For a methodological discussion concerning recording errors and the measurement of export discoveries, see Klinger and Lederman (2006).

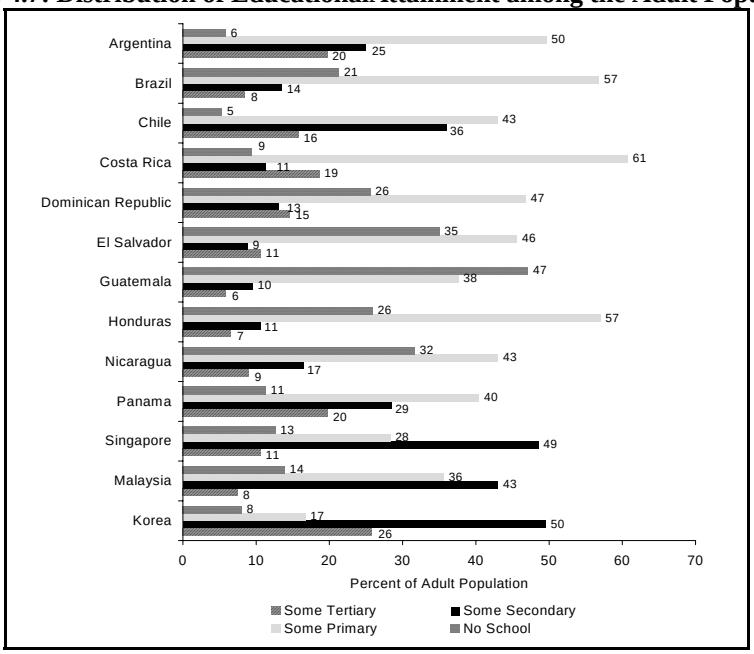
Figure 4.6: Innovation Inputs in Costa Rica



Source: World Bank (2003)

22. **A strong education base is a prerequisite for innovation and technological change**. Bosch, Lederman, and Maloney (2005), for example, find that educational attainment of the labor force is an important determinant of the efficiency of R&D investments. Costa Rica's educational attainment is among the highest in Latin America, but there is still room for improvement, especially when one compares this performance to other countries with similar income level (Figure 4.7). The country has made remarkable efforts in reaching the goal of universal primary education of its population. Today, more than 60 percent of the adult population has some primary schooling, and enrollment rates for those in the appropriate age cohort are almost 100 percent.[9] Despite this, Costa Rica's overall educational performance is still not ready to propel the country into a virtuous growth cycle. Average years of educational attainment are still somewhat lower than other Latin American countries with similar income per capita, and far from innovating countries such as Israel and Ireland.

Figure 4.7: Distribution of EducationalAttainment among the Adult Population



Source: De Ferranti et al (2003) based on Barro and Lee (2002)

[9] World Development Indicators (2003b)

23. **To some extent, Costa Rica's educational attainment is being hampered by a "secondary education gap".** The country has gone through an *unbalanced* educational transition characterized by excellent coverage for primary education, rising enrollment in tertiary, but dwindling enrollment and high dropout rates at the secondary level. In fact, Costa Rica has one of the highest coverage rates at the primary level among its adult population, but also has a greater proportion of the population with university degrees than with secondary schooling.[10] The declining proportions of secondary school graduates also evidence this phenomenon and increases in the number of secondary school drop outs in the work force.[11] The problem is that this deficit in secondary school enrollment impinges on the country's long-term prospects for increasing overall educational attainment of its work force and thus its ability to upgrade its economic structure through technological upgrading. This is evident when one compares Costa Rica's situation with the educational transition followed by most East Asian countries, which followed a pattern of skills upgrading from the bottom-up. That is, they started increasing the fraction of adults with secondary education while enrollment in tertiary education was almost left unchanged. In countries like Korea, Hong Kong and Singapore, the fraction of adults with primary education or less fell by more than 30 percentage points between 1960 and 2000, while the fraction with secondary schooling increased by more than 25 percentage points over the same period.[12]

24. **In sum, from an international comparative perspective, Costa Rica shows some strengths and weaknesses in terms of its innovation outputs and inputs**. Regarding outputs, it is difficult to conclude that Costa Rica is falling behind in international patenting, given that it is a relatively small economy, but it does seem to be lagging behind in terms of scientific output and with respect to the frequency of emergence of new export products. On the side of the inputs, Costa Rica's clearly underperforms in terms of R&D effort, but seems to be outperforming similar countries in terms of licensing payments. Without additional empirical work, it is difficult to derive strong policy conclusions based on these benchmarking exercises, because in the presence of market failures the average or typical performer for a given level of development might reflect the "mediocre" case, rather than best practices. Moreover, falling behind in one indicator might be less harmful than falling behind in another since the social rates of return might be different across the different types of innovation inputs, which in turn can vary depending on the institutional context and investment climate in which firms operate. We now turn our attention to the characteristics of Costa Rican manufacturing firms in terms of their apparent innovative capacity and effort, based on new international survey data.

4.3.2 Firm-level Innovation Outputs and Inputs

25. **New data on firm-level innovation can be used to assess Costa Rica's performance relative to other developing economies.** The new survey data was collected under the auspices of the World Bank's Investment Climate Assessment (ICA) program. A sample of over 300 Costa Rican manufacturing firms was surveyed in 2005. To place this country's microeconomic innovation performance in comparative perspective, we also use comparable data from sixteen other developing countries. Since developing country firms tend to innovate more frequently through the introduction of new products or changing existing production processes, the survey data is relatively strong in terms of measuring accurately these types of innovation outcomes.

26. **The surveys also collect data on various innovation inputs, such as R&D expenditures and licensing, as well as on other firm characteristics that could be correlated with both innovation outputs and inputs**. The following paragraphs assess international comparisons of manufacturing firms along these dimensions, by relying on all available data from the World Bank's ICA surveys of the

[10] De Ferranti *et al* (2003)

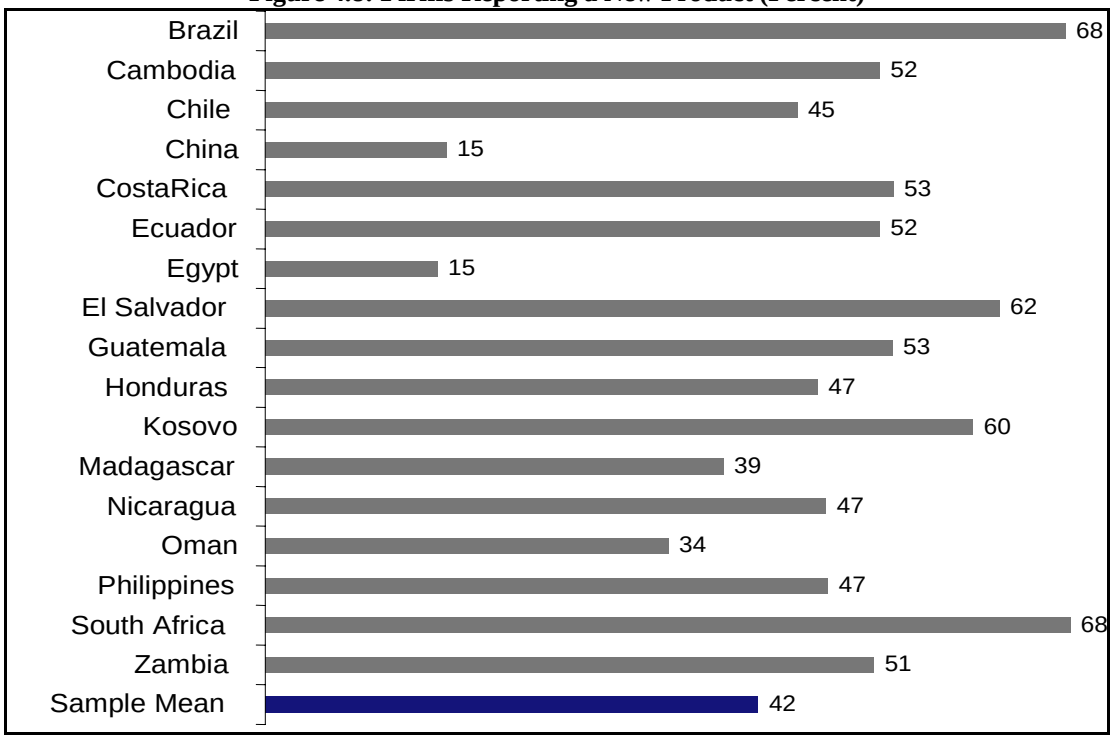
[11] Gindling (2005). Labor Market Study for the Costa Rica Poverty Assessment.

[12] De Ferranti *et al* (2003).

countries that are part of the sample used in the regression analyses discussed in section 5 below. Overall we cover seventeen countries, including Costa Rica, although the firm samples used in the regressions is smaller than the sample of over 10,000 firms (for some of the indicators) that were used to calculate the descriptive statistics used in the following paragraphs.[13] Furthermore, readers should be cautious and not derive strong policy conclusions based purely on this descriptive statistics that follow, because the average firm-level characteristics by types of firms tells us nothing about the direction of causality nor about the magnitude of the any measurement errors afflicting the data.[14]

27. ***New product.*** **In Costa Rica, 53 percent of surveyed firms reported introducing a new product during the previous 2 years, which is above the sample mean (47 percent) but in line with results from other countries in the region, namely Chile (45 percent), Guatemala (53 percent), Honduras (47 percent), and Nicaragua (47 percent).** However, other countries in our sample, such as Brazil, South Africa, and even El Salvador, have more than 60 percent of surveyed firms engaged in new product development (Figure 4.8), and thus these data do not contradict the macroeconomic evidence on export discoveries discussed above.

Figure 4.8: Firms Reporting a New Product (Percent)



Source: World Bank Investment Climate Survey (2005)

[13] The sample of firms used in the regressions presented in Section 5 below is smaller than the sample used for the descriptive statistics by country because the regressions require that every firm in the sample have data on all dependent and explanatory variables, whereas the descriptive statistics only require that firms report answers on each question of pairs of questions.

[14] If measurement errors are "classical" in the sense that the magnitudes of the errors for each variable are not systematically correlated with the other variables under investigation, then group averages can approximate true averages. But causality cannot be inferred even from well measured data based purely on a comparison of averages across groups of firms, such as comparisons between innovative and non-innovative firms, as done in the following text. Furthermore, even classical measurement errors in the data can have profound effects in regression analysis that attempts to estimate partial correlations among variables. Our subsequent econometric estimations of section 5 attempt to deal with some types of measurement errors in order to uncover true partial correlations between firm-level innovation outcomes and inputs. Nevertheless, the problem of endogeneity and causality are not resolved in our econometric exercises, which limit the policy conclusions that can be derived even from multivariate regressions.

28. **There is a close association between firm's investments in innovation inputs and outputs in Costa Rica and elsewhere**. In Costa Rica the percentage of firms that introduced *new products* also report offering training to employees, being exporters and foreign owned, licensing new technology, and investing in R&D to a notably greater extent than non-innovative firms, as shown in Table 4.2 below. With the only notable exception of worker training, the same pattern is broadly confirmed in the sample from the seventeen countries studied in the regression analyses reported later in this chapter. Another piece of evidence that stands out is the fact that in Costa Rica almost 71 percent of firms that introduced new products also claimed being exporters, while only 15 percent of firms reported exporting but not engaging in this type of innovation. This is the highest frequency among benchmarked countries and substantially above the sample mean. Other countries, like China that is usually associated with high trading volumes, actually reports that only slightly more than 11 percent of firms that introduce new products engage in exports.

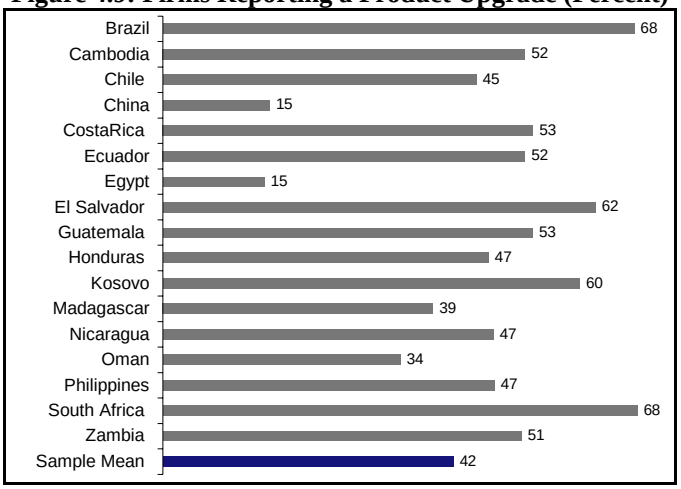
Table 4.2: New Product versus Non-Innovative Firms: % Firms with Key Characteristics

Country	*Offered Formal Training*		*Exported previous year*		*Foreign Ownership*		*Paid for Licensed Technology from Foreign Firms*		*Use Imported Inputs*		*Made R&D Expenditures*	
	Firms w/ New Product	*Other Firms*	*Firms w/ New Product*	*Other Firms*	*Firms w/ New Product*	*Other Firms*	*Firms w/ New Product*	*Other Firms*	*Firms w/ New Product*	*Other Firms*	*Firms w/ New Product*	*Other Firms*
Brazil	70	59	68	19	76	4	76	5	74	7	76	33
Cambodia	53	22	63	34	62	31	57	16	63	38	82	3
Chile	53	57	55	25	51	14	56	14	53	15	65	11
China	0	31	11	27	11	24	0	6	14	7	22	38
Costa Rica	63	37	71	15	67	6	65	24	65	24	69	7
Ecuador	60	58	60	71	50	13	51	24	55	39	60	33
Egypt	33	8	35	15	26	3	37	7	26	16	35	6
El Salvador	70	29	65	35	68	7	69	11	66	31	78	10
Guatemala	59	36	58	29	48	11	60	17	58	29	64	27
Honduras	56	34	48	33	45	16	62	11	49	33	69	7
Kosovo	82	10	63	10	100	0	61	23	64	52	81	10
Madagascar	43	40	43	30	43	36	50	7	42	49	39	17
Nicaragua	61	19	47	22	42	11	56	7	50	34	64	9
Oman	37	18	56	17	42	11	64	6	43	41	33	6
Philippines	67	11	46	36	57	19	63	11	51	31	61	15
South Africa	70	58	70	42	65	21	75	18	68	20	81	30
Zambia	50	28	52	30	56	25	53	8	54	46	57	15
Sample Mean	*47*	*47*	*46*	*26*	*39*	*16*	*55*	*9*	*51*	*18*	*53*	*24*

Source: World Bank Investment Climate Survey (2005)

29. ***Product upgrade***. **Costa Rica ranks fifth among benchmarked countries in terms of firms reporting a product upgrade (Figure 4.9)**. Indeed, 83 percent of firms report having done a product upgrade, which translates as the main source of innovation for firms surveyed in the country. In this category the sample mean is 66 percent, and interestingly enough Brazil is one of the countries that most engages in this type of innovation, while China, Oman and Egypt lie at the bottom of the scale among benchmarked countries. Still, the fact that over sixty percent of all firms in this sample of countries report product upgrades suggests that this type of innovation is commonplace in developing countries, and that there might be little justification for the public sector to provide subsidies or other incentives to stimulate this type of innovation, because public action is justified in the presence of market failures that presumably limit the private sector's ability to innovate without some sort of public intervention. It is unlikely that this is the case when the vast majority of firms report product upgrades and many cases over 80 percent of firms report this outcome.

Figure 4.9: Firms Reporting a Product Upgrade (Percent)



Source: World Bank Investment Climate Survey (2005).

30. **Nonetheless, Table 4.3 shows that in the case of Costa Rica, firms that do some sort of product upgrading also report offering training, being exporters and foreign owned, licensing technology from abroad and investing in R&D.** Note that in most cases almost 90 percent of firms that innovate also report these set of characteristics. In fact, most firms that engage in product upgrading also have these traits. Although the sample averages are slightly below the Costa Rican average, it is clear that there is a strong positive correlation between this innovation outcome and the corresponding inputs across the seventeen countries. Since the vast majority of firms report product upgrades, the few others that do not innovate in this manner seem to be.

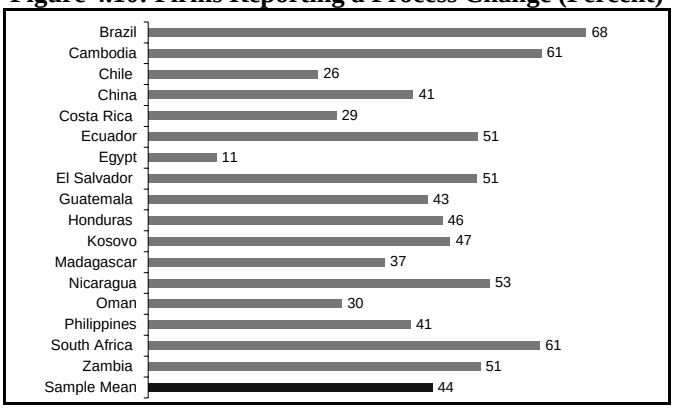
Table 4.3: Product Upgrade versus Non-Innovative Firms: % Firms with Key Characteristics

	Training		*Exporter*		*Foreign Owned*		*Technology from Foreign Firms*		*Licensing*		*R&D*	
	Firms that Upgraded Products	*Other Firms*	*Firms that Upgraded Products*	*Other Firms*	*Firms that Upgraded Products*	*Other Firms*	*Firms that Upgraded Products*	*Other Firms*	*Firms that Upgraded Products*	*Other Firms*	*Firms that Upgraded Products*	*Other Firms*
Brazil	96	45	96	14	95	4	95	7	95	9	98	20
Cambodia	90	33	98	11	98	11	96	11	95	33	100	0
Chile	76	52	79	21	74	13	85	9	71	16	88	7
China	50	24	44	27	51	20	89	1	55	5	68	24
Costa Rica	90	27	92	12	87	7	89	20	88	24	94	3
Ecuador	85	61	86	77	82	13	84	22	85	38	87	32
Egypt	48	7	45	14	37	3	55	6	40	15	51	5
El Salvador	89	23	89	24	84	7	89	8	85	29	90	10
Guatemala	89	25	84	29	80	11	87	14	82	31	86	27
Honduras	79	32	74	32	80	11	76	13	79	26	83	7
Kosovo	88	7	50	13	100	0	83	10	64	53	81	10
Madagascar	71	29	67	24	54	40	63	7	63	44	67	13
Nicaragua	96	7	87	19	89	7	92	4	88	28	97	3
Oman	42	20	72	13	33	14	73	5	57	36	50	5
Philippines	79	10	60	37	67	20	79	9	63	33	76	13
South Africa	89	42	89	30	88	15	89	16	85	18	91	28
Zambia	67	32	78	24	76	24	73	8	76	42	93	4
Sample Mean	*74*	*39*	*71*	*24*	*67*	*15*	*84*	*6*	*74*	*16*	*82*	*16*

Source: World Bank Investment Climate Survey (2005).

31. ***Process change.*** **The incidence of firms innovating *via* process change is rather low in Costa Rica (less than 30 percent of surveyed firms mention doing so) and below neighboring El Salvador, Guatemala, Honduras and Nicaragua.** Among benchmarked countries, only Chile and Egypt have a lower rate of respondent firms mentioning process change as a type of innovation (Figure 4.10). Nevertheless, the data suggest that process changes are relatively rare compared to product upgrades (66 percent of the sample) and similarly frequent as the introduction of new products (43 percent of the sample).

Figure 4.10: Firms Reporting a Process Change (Percent)



Source: World Bank Investment Climate Survey (2005).

32. **The fraction of firms in Costa Rica that innovate by means of process changes and also report being foreign owned or being an exporter, or investing in licensing or R&D tend to hover around 40 percent. Although these percentages seem low, they are even lower for the sample of Costa Rican firms that do not innovate through process changes**. For example, of the non-innovative firms, only 9 percent report investments in R&D and 8 percent report being foreign owned. For the sample average, licensing technology and R&D seem to be notable characteristics of firms that report process changes, as 59 percent and 61 percent of innovators report licensing payments and R&D respectively. The corresponding shares of non-innovative firms are well below those numbers. In several countries (Cambodia, China, Nicaragua, and the Philippines) this type of innovation is associated with firms that license foreign technology to a greater extent that R&D.

33. ***Quality standards (ISO).*** **In Costa Rica, only 9 percent of surveyed firms report having ISO quality certification for their products**. This is similar to firm responses in other countries in the region (except for Brazil), but considerably lower than China (46 percent) or South Africa (42 percent), as shown in Table 4.4.

Table 4.4: Process Change versus Non-Innovative Firms: % Firms with Key Characteristics

Country	*Offered Formal Training*		*Exported previous year*		*Foreign Ownership*		*Paid for Licensed Technology from Foreign Firms*		*Use Imported Inputs*		*Made R&D Expenditures*	
	Firms w/ Process Change	*Other Firms*	*Firms w/ Process Change*	*Other Firms*	*Firms w/ Process Change*	*Other Firms*	*Firms w/ Process Change*	*Other Firms*	*Firms w/ Process Change*	*Other Firms*	*Firms w/ Process Change*	*Other Firms*
Brazil	72	57	67	19	63	6	67	8	62	11	74	36
Cambodia	83	10	75	29	74	27	83	8	72	35	64	8
Chile	32	62	33	27	26	15	36	15	34	15	37	14
China	44	25	41	26	42	23	71	3	51	5	60	28
Costa Rica	41	39	40	21	37	8	42	26	36	30	40	9
Ecuador	56	62	58	64	43	14	53	23	58	36	61	32
Egypt	30	8	24	16	32	3	49	6	21	17	27	6
El Salvador	63	27	63	29	53	8	69	8	60	29	60	14
Guatemala	47	39	58	24	52	9	52	17	49	30	49	32
Honduras	53	36	48	32	51	14	49	14	57	27	61	9
Kosovo	71	12	63	7	100	0	72	12	44	61	75	10
Madagascar	49	35	51	25	50	30	67	4	50	42	55	12
Nicaragua	65	19	52	23	44	12	74	5	48	39	63	10
Oman	16	23	36	23	17	14	36	10	40	40	33	6
Philippines	60	12	47	32	61	15	70	8	49	29	47	18
South Africa	65	55	64	41	62	19	69	18	62	19	69	39
Zambia	60	22	52	30	52	28	60	7	54	46	63	13
Sample Mean	*53*	*42*	*50*	*25*	*48*	*14*	*59*	*9*	*50*	*20*	*61*	*21*

Source: World Bank Investment Climate Survey (2005).

34. **In Costa Rica, among the few firms that have quality certification, exporting and foreign ownership seem to be the most common traits**. In contrast, in countries like China or South Africa where certification is a much more common practice, foreign ownership, licensing technology, importing inputs and investing in R&D (except for South Africa) are common characteristics of these firms (Table 4.5). Hence for the sample of firms from the seventeen countries as a whole the most notable difference between quality-certified and non-certified firms seems to be the share of firms that report being foreign owned (41 versus 12 percent).

Table 4.5: Quality Certification versus Non-Innovative Firms: % Firms with Key Characteristics

Country	*Offered Formal Training*		*Exported previous year*		*Foreign Ownership*		*Paid for Licensed Technology from Foreign Firms*		*Use Imported Inputs*		*Made R&D Expenditures*	
	Firms w/ Quality Certification	*Other Firms*	*Firms w/ Quality Certification*	*Other Firms*	*Firms w/ Quality Certification*	*Other Firms*	*Firms w/ Quality Certification*	*Other Firms*	*Firms w/ Quality Certification*	*Other Firms*	*Firms w/ Quality Certification*	*Other Firms*
Brazil	26	59	38	14	74	2	47	5	31	8	23	43
Cambodia	10	21	10	42	8	39	13	16	9	46	9	8
Chile	32	61	33	27	39	13	47	12	39	14	31	15
China	54	23	49	24	55	19	75	2	60	5	65	26
Costa Rica	18	42	32	18	43	6	23	27	21	28	14	10
Ecuador	21	66	27	70	34	10	29	20	23	39	19	39
Egypt	32	8	27	15	32	3	36	7	20	17	32	6
El Salvador	9	35	11	36	5	8	8	13	7	35	6	17
Guatemala	5	41	5	32	11	9	8	19	7	31	4	36
Honduras	8	40	9	32	14	14	18	13	10	33	7	12
Kosovo	18	21	25	9	0	2	33	18	13	58	13	21
Madagascar	11	41	9	32	9	37	21	7	10	50	10	16
Nicaragua	5	25	3	22	2	10	10	8	5	35	5	13
Oman	21	17	16	24	17	11	45	7	21	42	50	3
Philippines	40	12	30	30	45	15	46	10	30	27	25	17
South Africa	58	46	55	35	68	11	70	12	59	14	47	46
Zambia	2	28	7	29	4	28	0	9	8	47	10	16
Sample Mean	*35*	*43*	*31*	*25*	*41*	*12*	*39*	*10*	*23*	*21*	*38*	*24*

Source: World Bank Investment Climate Survey (2005).

35. **Overall, the descriptive microeconomic data provides a mixed picture of Costa Rica's performance in terms of common measures of innovation outputs at the firm level.** On the one hand, in our sample of seventeen countries, Costa Rica outperforms the sample average in terms of the percentage of firms that introduced new products and product upgrades, but underperforms in terms of changes in production processes and quality certification. Regarding the bivariate correlations between innovation outputs and inputs, the descriptive data suggest strong positive correlations of innovation outcomes concerning the development of new products, product upgrades, and changes in production processes with innovation inputs, especially licensing and R&D investments. But there are other firm characteristics that appear closely associated with innovation, namely the status of being an exporter and being foreign owned. In the case of quality certification, its strongest bivariate correlate is foreign ownership rather than innovation inputs. As mentioned, few strong policy recommendations can be derived from these descriptive statistics, since it is impossible to know from this evidence whether exporting or being foreign owned cause innovation or even if increases in innovation inputs will lead to greater innovation since innovation itself can lead to innovation investments, such as training programs for employees or additional investments in licensing or R&D. Moreover, the firm-level data does not easily provide evidence of the existence or magnitude of market failures that justify government interventions to spur private-sector development. We now turn to a discussion of macroeconomic evidence that might move us in that direction.

4.4 Macroeconomic Evidence on the Role of Innovation in Promoting Economic Development

36. **The use of macroeconomic or national-level data to assess the impact of innovation on development has multiple advantages.** One is that national data allows for transparent comparisons across a large number of countries, which is not usually the case with firm-level or microeconomic data. The data and corresponding analyses presented in section 5 of this chapter below includes data from 17 countries and even there it is questionable that this sample is truly representative of firms operating in developing countries, although we assume that this is the case. Another important advantage of macroeconomic analyses is that they can capture economy-wide effects. When the phenomenon being studied is characterized by market failures and thus by social returns being higher than private returns, then the developmental effects of such phenomena is easier to capture with aggregate data.

37. **Here we address three policy relevant questions**. First, are indicators of innovation outputs, such as patents, associated with improvements in the level of development across countries? Second, what are the social returns of innovation inputs, such as investments in R&D? Third, do market failures really affect the frequency of simple, non-scientific innovations such as the introduction of new export products or export "discoveries"? We tackle each question in the following paragraphs.

4.4.1 Does Patenting Activity Improve a Country's Prospects for Development?15

38. **To examine the role of innovation in the context of institutional weaknesses on long-run development it is appropriate to estimate the effect of innovation outcomes at the national level on GDP per capita.** To approach this question the subsequent analysis follows an academic literature that examines the empirical determinants of the levels of GDP per capita across countries–this literature is briefly reviewed in Box 4.1. In fact, there are strong theoretical reasons to expect that certain factors, such as geography, trade, institutions, and even innovation might explain levels of development but not necessarily the observed growth rates of GDP per capita. For example, in theoretical models by Aghion and Howitt (1998), Howitt and Mayer (2002), and Klenow and Rodriguez-Clare (2003), all countries grow at the same rate in their steady states, but those with higher innovative activity have higher steady state levels of development. These dynamics are due, in theory, to the way in which technological improvements are diffused across borders. Innovation leaders push the technological frontier forwards, and subsequently the followers can benefit from the growth of productivity. But the leaders are permanently richer in these models and thus there is not convergence of income levels between followers and leaders. In any case, here we follow this academic empirical literature.

[15] This section is taken from Lederman and Saenz (2005).

Box 4.1. An Empirical Literature on Long-Run Development

An important challenge in the empirical literature is to identify the impact of *exogenous* components of different variables on the level of development. Frankel and Romer (1999) used a model to estimate the share of trade over GDP that is due to geographical factors, such as distance to the major consumption markets. In turn, they estimated the effect of this exogenous portion of trade shares on GDP p.c. Acemoglu et al. (2001) instigated a number of studies that used settlers' mortality rates in the 17th and 18th century as a historical determinant of institutional quality. Other studies that followed this line of inquiry include Rodrik et al. (2002) and Easterly and Levine (2003). These studies also control geographic factors such as the condition of being a landlocked territory and latitude. Dollar and Kraay (2003) have raised some doubts about the ability of these models to identify the impact of trade and institutions on levels of development due to the fact that the instrumental are highly correlated among them and with the existing indicators of institutional quality (see Kaufmann and Kraay 2002). Sachs (2003) further argued, "institutions do not rule" in terms of being the only statistical significant determinant of levels of development. In spite of the potential pitfalls of this literature, we follow it in order to assess the extent to which levels of innovation outputs are good predictors of the level of development. We use Park's (2001) index of intellectual property rights as an instrument for patents p.c. Barro (1999) suggested using this variable as an instrument of innovation. We also include the explanatory variables suggested by the aforementioned authors.

Methodology and Specification Tests

The results discussed below include a series of specification tests to assess the adequacy of the instrumental variables, which we use to capture the exogenous components of determinants of the level of GDP p.c. across countries. The models contain two endogenous explanatory variables: the index of rule of law provided by Kaufmann and Kraay (2002) and our indicator of the stock of patents received from the U.S. PTO and the EPO. To identify the exogenous component of rule of law we try two other instruments: Acemoglu et al.'s (2001) settlers' mortality rates and Rodrik et al's (2002) portion of the population that speaks European languages. We use the (log of the) average of Park's (2001) index of IPR protection during 1960-1995 to capture the exogenous portion of the accumulated stock of patents p.c. since the 1960s. The variable to be explained is the (log of the) PPP-adjusted GDP p.c. capita in 2000.

To assess the validity of the instruments, the exercises include a set of specification tests. First, the Hausman test compares the OLS to the IV coefficients. If the null hypothesis of similar coefficients cannot be rejected, then it is questionable that the rules of law and/or patents p.c. variables are endogenous. Second, we present results from an auxiliary regression concerning the direct impact of the portions of rule of law and patents that are not explained by the instruments on GDP p.c. This is an alternative test of the endogeneity of these explanatory variables. If these residuals are not significant, then it is possible that rule of law/patents are not endogenous, and thus the OLS regression results are informative. Third, we present the coefficient of the partial effect of the chosen instruments on the supposedly endogenous variables. The instruments are adequate if they are significant determinants of the explanatory variables. Fourth, the analysis includes an estimate of the partial correlation between the instruments and the dependent variable. If there is a significant correlation, then the instruments themselves are either endogenous or should be included as direct determinants of GDP p.c. Fifth, the final specification test is due to Shea (1997). This statistic is the "partial R-squared," which is an indication of how much of the variance of the endogenous variables (rule of law and patents) are explained by the chosen instruments. "High" partial R-squares are an indication that the chosen instruments are relevant in the sense that they do explain a significant portion of the variance of the endogenous variables after controlling for the correlation between the instruments and between them and the endogenous variables. This is important to consider, (Dollar and Kraay 2003), because if there are high correlations among the instruments, between them and the two endogenous variables, it is possible that the remaining variance of the endogenous variables might be too small to really be helpful in identifying a major portion of the endogenous variables. The results of these exercises and the corresponding specification tests are presented in Table 4.6.

Table 4.6: Regressions Results: Determinants of Long-Term Development – Institutions versus Innovation

Dependent Variable: Log of GDP per Capita in 2000 (PPP adjusted)

	Explanatory Variable	Instrument	OLS Coeff.	IV Coeff.	Hausman Test for Endogeneity	Sig. of Residuals (rule, lpats) in Income	Coefficient of 1st. Stage Regression	Sig.of Instrument in Income	Shea Test for IV Relevance (adj. partial R^2)	Obs.
1)	rule	lmort	0.80 *	1.14 *	Fail to reject Null Hypothesis	No	-0.30 *	No		66
	oil		0.48 *	0.57 *						
	landlock		-0.29 **	-0.14						
	Sub-Saharan Africa		-0.60 *	-0.61 *						
	malaria		-0.51 *	-0.29						
2)	rule	lmort	0.83 *	0.95 *	Fail to reject Null Hypothesis	No	-0.34 *	No		53
	oil		0.35 *	0.39 *						
	latitude		-0.01 *	-0.02						
	landlock		-0.34 **	-0.27						
	Sub-Saharan Africa		-0.51 *	-0.52 *						
	malaria		-0.74 *	-0.66 *						
							rule lpats			
3)	rule	lmort	0.55 *	0.45 **	Fail to reject Null Hypothesis	No	-0.34 * -0.76 *	No	0.25	53
	Log(patents per capita)	lip	0.17 *	0.24 *		No	0.06 1.31 *	No	0.31	
	oil		0.36 *	0.38 *						
	latitude		-0.01 *	-0.01 *						
	landlock		-0.36 **	-0.36						
	Sub-Saharan Africa		-0.38 **	-0.33						
4)	rule	eurfrac	0.80 *	1.28 *	Fail to reject Null Hypothesis	No	0.36 **	No		108
	oil		0.44 *	0.58 *						
	landlock		-0.29 *	-0.15						
	Sub-Saharan Africa		-0.60 *	-0.59 *						
	malaria		-0.47 *	-0.20						
5)	rule	eurfrac	0.80 *	1.18 *	Fail to reject Null Hypothesis	No	0.38 **	No		86
	oil		0.35 *	0.52 *						
	landlock		-0.22 **	-0.15						
	Sub-Saharan Africa		-0.59 *	-0.55 *						
	malaria		-0.65 *	-0.45						
							rule lpats			
6)	rule	eurfrac	0.50 *	-0.01			0.37 ** 1.75 *	No	0.14	
	Log(patents per capita)	lip	0.15 *	0.23 *	Fail to reject Null Hypothesis	No	0.04 1.26 *	No	0.17	86
	oil		0.40 *	0.26						
	landlock		-0.34 *	-0.47 *						
	Sub-Saharan Africa		-0.44 *	-0.41 *						
	malaria		-0.41 **	-0.49						

Notes: Confidence Levels: *5%, **10%. All regressions include a constant, dummy for net exporters of non-oil commodities, absolute value of latitude, and the log of Frankel and Romer's (1999) constructed trade shares.
Instrumental Variable Definition: lmort: Settler's mortality rate; lip: PR Index; eurfrac: Fraction of the population that speaks a European language.
Source: Lederman and Saenz (2005).

39. **The evidence suggests that innovation is as important for long-run development as the quality of governance, if not more.** The first column of Table 4.6 above lists the explanatory variables that were statistically significant. Some variables that were not significant in any specification are not listed. The second column lists the instrumental variables used in each of the six regressions. The rest of the columns contain the estimated coefficients for each explanatory variable and the specification tests discussed above.

40. **The results reported in the first two rows show that the results reported in most studies that followed Acemoglu et al. (2001) are reproduced with our data and sample.** The impact of rule of law on income per capita is positive and significant in both OLS and IV estimates. Also, the IV coefficient is larger than the OLS coefficient, which might indicate that the OLS estimates suffer from attenuation bias possibly due to measurement error in the rule of law indicator. Furthermore, the Hausmann specification tests suggest that the whole set of estimated coefficients from the OLS and IV estimates are not statistically different. Hence, it is not absolutely clear that the OLS estimates suffer from severe endogeneity problems. This is also suggested by the fact that the residuals of rule of law are not significant in the auxiliary regression that includes this portion of the institutional indicator. When the patents per capita variable is included (row 3), the results change a bit with respect to the second regression, which is based on the same sample of countries. Of particular relevance is the finding that in both OLS and IV estimates, the magnitude of the rule of law coefficient is significantly below those previously obtained from the models that ignored the role of innovation.

41. **The result that innovation is key for long-term development is robust to various methodologies.** If readers do not trust the OLS estimates, even though the endogeneity tests cannot reject the possibility that the explanatory variables are exogenous, the subsequent specification tests associated with the validity of the instruments are satisfactory. The settlers' mortality rates are good predictors of rule of law; the log of the IPR index is a good predictor of patents per capita. Also, the instruments themselves do not seem to be correlated with GDP per capita. Furthermore, Shea's partial R-squares are quite high. The unexplained (by the other exogenous variables) portion of settlers' mortality rate seems to explain about 25% of the variance of the unexplained portion of rule of law. Similarly, the unexplained portion of the log of the IPR protection index explains about 30% of the unexplained part of the log of patents per capita. Thus the instruments seem quite relevant in terms of having strong partial effects on the endogenous variables.

42. **Given the current Costa Rican context, the result that innovation is at least as important as governance for long-term development merits further sensitivity analysis.** To check for robustness of these results, the regressions reported in rows 4-6 were derived from a different sample and a different instrumental variable for rule of law, namely the fraction of the population that speaks a European language, which could be a suitable instrument if a fundamental source of the quality of public institutions today depends on historical colonial ties with Europe and that such ties affected all colonial territories equally. This latter assumption has come under attack by Acemoglu (2005) for obvious reasons, and thus we should treat the results with much care. The results in rows 4 and 5 show the same result concerning rule of law when patents are not included. That is, the estimated impact of rule of law on the level of development is larger in the IV models than in OLS. Similar to the previously discussed specifications, we cannot reject the possibility that the explanatory variables are exogenous, which is suggested by the Hausman test and the lack of significance of the residuals of rule of law (and patents p.c. in regression 6) as direct regressors of income. In the OLS regression, the magnitude of the rule of law coefficient maintains its significance when patents are included, but, again, its magnitude is curtailed. However, when patents p.c. is included – row 6 – rule of law is not significant in the IV regression.

43. **The magnitude of the effects of governance and innovation on long-term development seem to be comparable, and innovation is perhaps more important than governance**. Since we have two competing explanatory variables – rule of law and log patents p.c. – it is worthwhile to assess the economic magnitude of the estimated effects of each of these on the level of development. To accomplish this, the coefficients reported in regression three and six could be used to simulate the impact of a one standard deviation increase in each variable.[16] The standard deviation (reported in the Annex) of rule of

[16] Due to the fact that these two variables are measured in different units, it is not economically meaningful to assess the impact of a unit change or even of a percent increase in each.

law is 0.92, whereas the standard deviation of log patents p.c. is 3.14. Multiplication of these values with the corresponding OLS and IV coefficients indicate that in all specifications the magnitude of the effect of innovation on the level of development is either slightly higher than that of rule of law or much higher. The OLS estimates of model 3 imply that a standard deviation improvement in rule of law is associated with a 0.51% increase in income p.c.. The same improvement in innovation is associated with a slightly higher 0.53% increase in the level of development. The corresponding IV estimates imply a much larger difference: 0.41% increase from rule of law versus 0.75% increase in GDP p.c. as a consequence of a one standard deviation improvement in innovation. Very similar estimates of the magnitude of these effects are obtained from the coefficients from model 6, except that in this case rule of law would have no impact on development if we consider the IV estimates. In sum, innovation seems to be positively and significantly correlated with the level of development, and its impact seems to be either similar or much larger in economic magnitude than that of institutions. Thus innovation should be considered a fundamental determinant of long-run development, which is at least as important as one of the most popular explanatory variables. We now turn to the analysis of the social rates of return to investments in research and development.

4.4.2 What Are the Social Rates of Return to R&D Investments Across Countries?

44. **Any public expenditure should be judged in terms of the social benefits that it brings to its population, especially in the context of fiscal policy challenges.** It cannot be overstated that the descriptive benchmarking of Costa Rica in terms of its innovation outputs and inputs is insufficient for justifying public expenditures in this area. Hence estimates of the potential social returns, which includes the returns to private firms as well any spillovers, are important factors to consider in discussions about policy priorities.

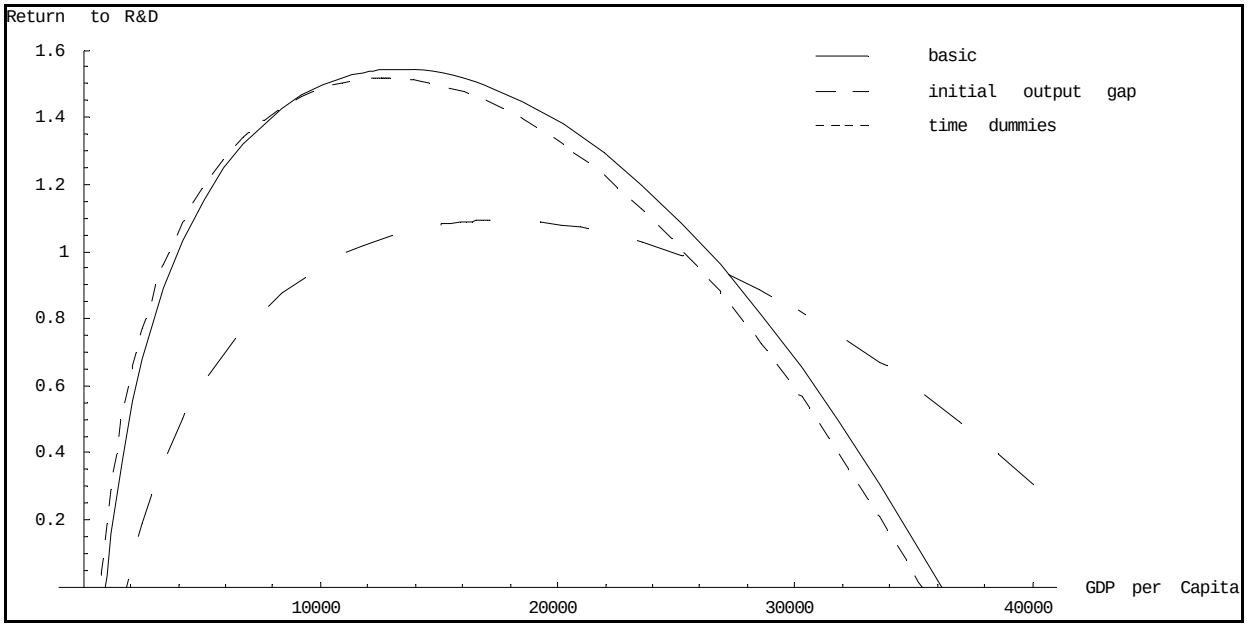
45. **Robust estimates of the social rates of return of national R&D investment require the use of macroeconomic data that are not readily available.** Our empirical analysis relies on the R&D data collected by Lederman and Saenz (2005) covering 1960-2000 combined with GDP, labor, and investment rates from WB databases. Lederman and Maloney (2006) estimated the social returns to total R&D investments across countries and over time during 1960-2000, but allowed for the rates of return to vary across countries, depending on their level of development. The underlying intuition of this exercise is that aggregate or national effects of R&D investments can capture the corresponding benefits as the positive spillovers across firms can only be measured at the aggregate level. Furthermore, the magnitude of these spillovers can depend on the infrastructure of the national innovation system, which includes the ties among firms through labor and other markets, between the private sector and universities/research centers, as well as institutions such as intellectual property rights and enforcement. Since all these features are probably highly correlated with the level of development, then we expect that the social returns to R&D will vary across countries with different levels of development due to these factors. In addition, the rates of return will vary across levels of development if there are diminishing returns to R&D capital. This consideration leads to expect that the rates of return to R&D can be higher in poor than in rich countries, but the factors related to the quality of the national innovation system lead us to expect that poor countries can have lower rates of return to R&D. Hence it is an empirical question whether developing countries such as Costa Rica can experience high rates of return to R&D.

46. **Technical econometric analysis is unavoidable for estimating reliable social returns to innovation investments.** The main results provided by Lederman and Maloney and discussed herein were derived from econometric techniques that may help deal with potential endogeneity biases. More specifically, the results presented come from the GMM system estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998). Three different specifications are reported for all regressions: (1) using a basic model with R&D, investment, labor, GDP p.c. as explanatory variables; (2) including the

initial output gap as defined by Loayza et al. (2005) as a measure of convergence toward each country's steady-state level of income p.c.[17]; (3) including time dummies to control for time specific effects.[18]

47. **The social rates of return to R&D investments in countries with a similar level of development as Costa Rica seem to be huge.** Figure 4.12 presents the estimated returns to R&D at different levels of GDP p.c. It is interesting to note: First, for developing countries we observe a positive slope as GDP p.c. increases. This might have to do with "efficiency problems inherent to the process of development". Second, as GDP p.c. reaches a certain level, the returns to R&D gets to a maximum point, which coincides with the level of development of countries like Spain, Korea, Italy and others (as of 1996). This means that Costa Rica is fast approaching the level of development (just under US$10,000 in 1996), where in general we observe the highest potential social rates of return to R&D investments across the globe. Third, these results are also consistent with Griffith, Redding and Van Reenen (2001) who find decreasing returns for developing countries. Fourth, it is worth mentioning that the predicted return magnitudes are in accordance with most of the studies in the literature. Thus this evidence suggests that Costa Rica may benefit tremendously in the future from significant increases in R&D investments, which should preferably come from the private sector and unlikely to surge without public assistance. The remaining question is whether there are market failures deterring innovations which are more common among developing than industrialized countries, and thus can be considered to be the most common type inside the global technological frontier.

Figure 4.11: Predicted Returns to R&D Using System GMM Estimators



Source: Lederman and Maloney (2006).

[17] Based on a band-pass-filter developed by Baxter and King (1999) to assess the magnitude of deviations of GDP per capita from a long-run trend.

[18] All the regressions pass the Hansen-Sargan test for the validity of the instruments and there is no evidence that they suffer from residual second order serial correlation.

4.4.3 Do Market Failures Hinder Innovation Inside the Global Technological Frontier?[19]

48. **Since developing countries are in the process of diversifying their economies, we expect countries at relatively low levels of development to have more frequent episodes of export "discoveries," as defined by Klinger and Lederman (2006), and discussed in previous sections above.** As income rises, the frequency of these events declines, particularly at high levels of development when economies experience rising specialization.

49. **The data support the view that developing countries introduce new export products more frequently than rich countries, and Costa Rica is not an exception**. To examine these effects in our data, we estimate the relationships between both inside-the-frontier innovation (export discoveries) and on-the-frontier innovation (U.S. patent counts from Lederman and Saenz 2005) and the level of development. Table 4.7 shows the results from Negative Binomial estimators, which are appropriate for count data. As expected, the frequency of discovery falls as countries develop, after peaking at the lower-middle income level. Although low among the world's poorest countries, the frequency of discovery rises quickly, reaching a maximum somewhere in the neighborhood of GDP p.c. of $4000 USD (in PPP adjusted and constant dollars of 2000) as countries undergo productive diversification. As the level of development continues to rise, inside-the-frontier innovation is replaced by on-the-frontier innovation, which increases exponentially with GDP per capita.

Table 4.7: The Changing Nature of Innovation

	Inside-the-Frontier: Discoveries	***On-the-Frontier: Patents***
ln(GDP p.c.)	8.667	-16.237
	(6.53)***	(2.96)***
$\ln(\text{GDP p.c.})^2$	-0.514	1.059
	(6.67)***	(3.43)***
Constant	-32.289	65.872
	(5.71)***	(2.74)***
Observations	73	68

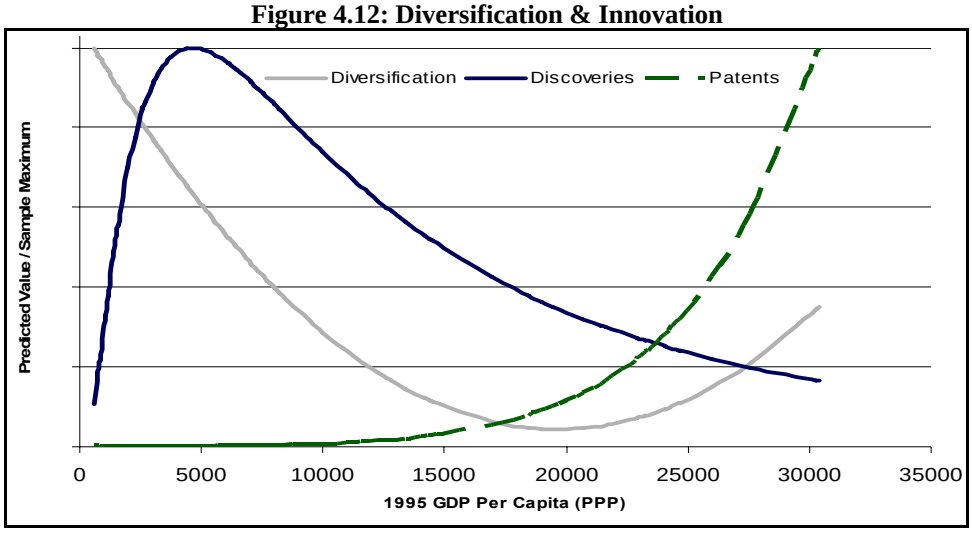
Notes: Absolute value of z statistics in parentheses.
*** Significant at 1%
Source: Klinger and Lederman (2006)

50. **These relationships are illustrated in Figure 4.13, which shows the estimated relationships of export discoveries, patents, and export diversification with respect to the level of development**.[20] Discovery activity peaks early in the development process, and declines as the process of diversification slows. At higher levels of development, economies begin to specialize, and innovation is driven by on-the-frontier advances that are patented. This relationship between distance to the frontier, the nature of innovation, and the stages of productive diversification reveals that we must control for the level of development (in quadratic form) when testing the model of innovation and imitation.

[19] This section draws heavily from Klinger and Lederman (2006).

[20] Each is scaled by its maximum value for illustrative purposes.

Figure 4.12: Diversification & Innovation



Source: Klinger and Lederman 2006

Box 4.2: Econometric Identification of Market Failures Affecting the Introduction of New Exports

As mentioned, because our innovation indicator in this case is the number of discoveries with a substantial number of zeros, we estimate the following model with an exponential functional form using a negative binomial estimator.

$$D_{i,c} = \exp\left(\overline{\pi}_{i,c}^{\beta_1}\left(\overline{\pi}_{i,c} \times \alpha_c\right)^{\beta_2} \alpha_c^{\beta_3} X_{i,c}{}^{\gamma} + \lambda D_i\right)\eta_{i,c}$$

Subscripts *i* and *c* correspond to Leamer's commodity groups and countries, respectively. $\eta_{i,c}$ is the aforementioned commodity-group and country fixed effect, which is unobserved and captured by the pre-sample number of export discoveries. α_c is an index of barriers to entry measured at the country level, based on data concerning five labor market regulations and other regulations that raise the costs of entry by firms. *X* is a vector of other control variables discussed below, and D_i is a dummy variable for each Leamer commodity group. The latter controls for unobserved sector-specific effects but also captures the number of product lines in each category, which affects the number of observed discoveries across commodity groups.

As is commonplace in count-data models, the explanatory variables were transformed into their natural logarithms or were included in growth rates, which then allows for the estimation of the relevant elasticities. The exceptions were the commodity-group dummies, the indicator of comparative advantage of each country in each of the commodity groups (proxied by net exports per capita), and the barriers index. The latter was calculated as the first principal component of the five regulatory indicators discussed above, after they were normalized to have means equal to zero and standard deviations equal to one. The sign and significance of β_2 in (6) encompass our test of the market failure hypothesis.

Source: Klinger and Lederman (2006).

51. **Technical econometric analysis suggests that market failures hamper the introduction of new export products, thus justifying public subsidies for export diversification.** Box 4.2 discusses the technical aspects of the statistical analysis utilized to test for the presence of market failures and their deleterious effects on new exports and table A1 in Appendix 1 shows the basic estimation results.

52. **Even after controlling for market failures and other factors, the expected inverted-U relationship between discoveries and GDP p.c. persists and is highly significant across all specifications**. In addition, historical discoveries enter as positive and significant, signaling that we are effectively correcting for fixed country/commodity effects leading to discovery. As suggested by the similarity in maximum points across Leamer categories shown in Table 4.8, factor endowments are not significant, a result that persists without controlling for historical discoveries (not reported).

53. **The returns to discovery, measured as the growth rate of the Leamer commodity cluster export growth minus non-export GDP growth, enters as positive and jointly significant with the interaction term in all specifications, as predicted by the market-failure hypothesis**. Given that we tested a variety of additional control variables that were mentioned above, these results suggest that the predictions of the market-failure model are robustly supported by the data. That is, export growth has a positive and significant effect on the frequency of export discoveries, but the magnitude of this effect seems to rise with barriers to entry. In addition, the direct effect of barriers to entry on discovery frequency is largely insignificant and not robust, which was also predicted by our model, where barriers only affect discovery either through their impact on export profitability as in equation (3) or through its interaction with export returns as in equation (2). This result does not imply, however, that barriers to entry do not have an impact on discovery through its negative effect on export growth, given their offsetting stimulus to discovery through increased suitability and drag on discovery through higher costs for the first mover. Furthermore, the results suggest that barriers to entry raise the magnitude of the effect of export profitability on discovery counts, but this comes at the cost of reducing the social gains from imitation, and thus worsening the regulatory burden on the private sector is not a good policy stance. appropriate

54. **The evidence does suggest, however, that the suitability problem is a real concern for promoting inside-the-frontier innovations, and thus the clear policy implication is that developing countries should experiment with policies designed to stimulate private-sector attempts to introduce new export products, which might not be protected by various forms of intellectual property rights**. In general, therefore, this evidence can be interpreted as supporting the role played by export promotion agencies and PROCOMER in the case of Costa Rica, which provides services to aid new exporters. Unfortunately, there is little empirical evidence concerning what types of export-promotion activities work best and thus this should be an area for future research.[21] Nonetheless, the conclusion could be generalized to policies designed to stimulate new product development by private firms. The following section takes a microeconomic look at the correlates of firm-level innovation in seventeen developing countries, including Costa Rica, and Section 6 provides a close examination of the performance of related Costa Rican policies.

[21] The Office of the Chief Economist for Latin America and the Caribbean of the World Bank is currently undertaking a study of the effectiveness of export promotion agencies in the region and elsewhere.

4.5 Costa Rica's Current Innovation Structure, Policies, and Programs

4.5.1 Empirical Strategy

55. **In estimating what influences firm-level innovation, researchers face two serious challenges**. First, many of the potential factors of interest, especially R&D and licensing expenditures as a percentage of sales, are notoriously difficult to measure in developing country firm surveys. This is due to the fact that local entrepreneurs can have different perceptions of what is "R&D" or a licensing payment. In addition, the value of sales are also difficult to measure accurately if the survey does not get the right firm managers, and often the answers provide only a ballpark of the range of sales values. Second, as mentioned earlier, our empirical models are meant to test for *partial correlations* and links between innovation outputs and inputs, but it is not an attempt to identify *causal effects* between these variables. The problem of endogeneity clearly arises with certain variables, most notably with training, also mentioned earlier. But there is a deeper problem of endogeneity with respect to omitted variables. For example, entrepreneurial talent is not measured in firm surveys, and thus it is possible that positive partial correlations between innovation outputs and inputs are due to entrepreneurial talents, which lead firms to innovate and invest innovation input, but it is the talent that drives the relationship between these variables. Consequently, even error-free partial correlations cannot be interpreted as causal effects, and thus cannot by themselves justify any type of policy intervention.

56. **Estimating robust partial correlations (which are not equivalent to causal effects) helps us characterize the relationship between innovation outputs and inputs, but measurement errors in the responses from firms about how much they spend in R&D and other innovation inputs blurs the true relationship between innovation outputs and inputs and complicates any rigorous analysis**. If there were no measurement errors in any of the variables, standard regression models would suffice to estimate partial correlations. Unfortunately, we know that this is not true. Indeed, we estimated, but do not report the partial correlation between innovation outcomes, R&D, and licensing investments, which were unsatisfactory. Box 4.3 describes the technical analyses that were pursued to uncover the true relationship between R&D, licensing, and firm-level innovation outputs.

Box 4.3: Uncovering the Role of R&D and Licensing in Non-Patentable Firm Innovations

We first estimated the following model with the data for Costa Rica, combined with data from the other sixteen developing countries listed above:

$$InnovationOutput = Bo + B1\ Country|SectorIndex/size + B2\ InnovationInput + B3\ FirmCharacteristic + \varepsilon.$$

where *InnovationOutput* represents one of our four innovation proxies–the introduction of a new product, upgrade product, process change or quality certification. Three categories of control variables are relevant, starting with InnovationInputs, which includes variables that directly contribute to an innovation outcome, such as: education and training of the labor force, measured as the average years of schooling of the workforce; and the percentage of skilled and unskilled workers who received formal training; investment in R&D, measured as R&D expenditures over sales; licensing of foreign technology, measured as a dummy variable equal to 1 when a firm licenses technology; purchases of foreign inputs, measured as the percentage of direct and indirect imported inputs from a foreign-owned company; and sales to multinationals, measured as the percentage of domestic sales to multinationals. The second category *FirmCharacteristics*, refers to firm-level traits that may affect a firm's proclivity to innovate, such as: firm size or scale, measured as the natural logarithm of the average number of permanent and temporary workers or as the square root of this same variable to test for a nonlinear relationship; a firm's exporter status, measured by a dummy variable equal to 1 when a firm exports; firm ownership, measured by a dummy variable equal to 1 for foreign ownership; capacity utilization, measured as the average utilization over the last year; and firm location, measured by a dummy variable equal to 1 when a firm is located in the capital city. Lastly, *Country|SectorIndex/size* are variables generated from the interaction of country, industry, and labor-force size dummies to create the variable indexι, included in each regression. In other words, this allows us to capture the effect on innovation of operating in a specific country and a specific industry—i.e., the effect of the investment climate, after controlling for firm-level characteristics. In this specification, R&D investments as a share of firm sales never appeared with a significant partial coefficient, due to the presence of severe measurement errors that produced the well know problem of "attenuation bias" (see Hausmann 2001).

"Reverse regressions," as suggested by Leamer (1978), are used to estimate true partial correlations between innovation outputs and inputs in our sample of firms from developing countries. This approach entails the estimation of the reverse regression of the previous model, which can be re-written as follows by solving for InnovationInput:

$$InnovationInput = (1/B2)*InnovationOutput-(Bo/B2) - (B1/B2)\ Country|SectorIndex/size - (B3/B2)\ FirmCharacteristic + \varepsilon\ .$$

With certain types of measurement errors and since the outputs are measured without errors (or at least with less error than the R&D and other input variables) this coefficient does not suffer from attenuation bias.1 A smaller and significant coefficient implies a larger and significant corresponding partial correlation from the original direct regression model. In addition, we substituted a set of *ICAConstraint* variables instead of the *Country|SectorIndex/size* to explore the relationship between the investment climate and firm innovation inputs (as well as other relevant firm characteristics). The investment climate constraints used in this analysis refer to five factors: corruption, infrastructure, regulation, transport, and finance.

Table 4.8 contains the relevant results from these reverse regressions, based on a sample of over 5,000 firms from the aforementioned seventeen countries. The sample from Costa Rica, which is part of the global sample, covers 327 firms. Due to this small sample, estimations conducted with the Costa Rican sample alone were not satisfactory. For example, in the regressions with R&D as the dependent variable, only 34 firms in the sample reported some R&D expenditures. Consequently, the sample does not have enough variance for the regressions to reveal useful information. Finally, the largest possible international sample of firms was required to identify the effects of the investment climate variables, which logically must be measured at an aggregate level.

57. Firm size and the average education of the work force employed are positively correlated with the probability of innovation by the firm. The coefficients of the size of the firm measured by (natural logarithm of) the number of employees and the average education of the employees are not reported in Table 4.8. We did find, however, that firm size (measured by the log of number of employees) had a positive effect on all of dependent variables, thus suggesting that scale is a factor to consider in the context of innovation policies. Also, the average years of education of the employees is positively correlated partially with licensing payments and sales to multinational corporations only.

Table 4.8: Seventeen Developing Countries: Indirect Investment-Climate effects on Innovation Outputs and True Inverse Partial Correlations between Innovation Inputs and Outputs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	**Share of Skilled Workers Receiving Training**	**Share of Unskilled Workers Receiving Training**	**Exporter Status (=1)**	**Foreign Ownership Status (>50%=1)**	**Makes Licensing Payments (=1)**	**Share of Sales to MNCs**	**Share of R&D in Sales**	**Share of Imported Inputs**
Estimator	Tobit	Tobit	Probit	Probit	Probit	Tobit	Tobit	Tobit
Investment-Climate Marginal Effects on Firm Innovation Inputs and other Characteristics (measured by groups of firms clustered by size (medium/large vs others), 7 sectors, and 17 countries)								
Corruption	**0.598*** **	**1.025*** **	-0.003	-0.002	-0.002	**-1.155*** **	**0.005** **	**-1.509*** **
	[0.136]	[0.174]	[0.003]	[0.002]	[0.002]	[0.266]	[0.002]	[0.192]
Infrastructure	**-2.429*** **	**-3.946*** **	**-0.013***	0.001	-0.002	**-5.024*** **	**-0.012** **	**2.261*** **
	[0.347]	[0.474]	[0.008]	[0.003]	[0.003]	[0.684]	[0.006]	[0.452]
Regulation	0.102	-0.100	**0.003** **	**-0.002***	0.000	**-2.174*** **	-0.002	**-1.253*** **
	[0.099]	[0.133]	[0.001]	[0.001]	[0.001]	[0.219]	[0.002]	[0.141]
Transport	**2.783*** **	-0.116	-0.006	**-0.009***	**0.012*** **	0.109	**-0.015***	**2.261*** **
	[0.427]	[0.618]	[0.011]	[0.006]	[0.004]	[0.851]	[0.009]	[0.612]
Finance	0.007	-0.005	0.000	**0.000***	**-0.000** **	**0.032*** **	0.000	**0.026*** **
	[0.005]	[0.010]	[0.000]	[0.000]	[0.000]	[0.008]	[0.000]	[0.007]
Inverse Marginal Partial Coefficients between Innovation Inputs and (Firm Characteristics) and Innovation Outputs (=1/B2 as in text)								
New Product	**4.680*** **	2.485	0.008	-0.005	0.005	**13.227*** **	**0.127*** **	**8.361*** **
	[1.368]	[1.759]	[0.023]	[0.008]	[0.008]	[2.722]	[0.023]	[1.964]
Product Upgrade	**8.403*** **	**9.055*** **	**0.052*** **	**-0.028** **	**0.027** **	5.457	**0.167*** **	**7.203*** **
	[1.808]	[2.420]	[0.019]	[0.011]	[0.011]	[3.564]	[0.032]	[2.445]
Process Change	**2.722** **	**4.176** **	-0.008	-0.009	**0.029** **	3.972	**0.085*** **	1.927
	[1.370]	[1.751]	[0.016]	[0.009]	[0.015]	[2.666]	[0.022]	[1.959]
Quality Certification	**11.181*** **	**9.632*** **	**0.057** **	**0.035** **	**0.089*** **	**32.475*** **	0.011	2.332
	[1.656]	[2.102]	[0.023]	[0.015]	[0.020]	[3.151]	[0.027]	[2.423]
Observations (Firms)	5377	5377	5377	5377	5377	5377	5377	5377
Pseudo R-squared	0.11	0.12	0.22	0.3	0.19	0.04	0.08	0.05

Notes: Robust standard errors in brackets; errors clustered around firm groups used to measure the investment-climate indicators at an aggregate level. * significant at 10%; ** significant at 5%; *** significant at 1%
These are results from the "reverse" regressions discussed in the text. The inverse of the coefficients of innovation "output" can be interpreted as the true partial coefficient of each innovation input in the corresponding "direct" regression when the inputs are measured with error. A common intercept, log of number of employees, log of average years of education of employees, dummy for full capacity utilization, dummy for firms in a capital city. The sample of firms is drawn from 17 countries with comparable data.
Source: Klinger and Lederman (2006)

58. **The evidence suggests that both licensing and R&D expenditures are significantly and positively correlated with three of our innovation output variables.** Licensing, which is the main channel through which local firms adopt and adapt foreign technologies is also significant, except for the case of probability of innovation through a product upgrade. Moreover, the reverse-regression coefficients of R&D divided by sales are not only significant but very small compared to those on the reverse regressions for sales to multinationals and the share of imported inputs. These findings suggest that the true partial correlation between R&D and the corresponding innovation outputs tend to be quite larger than those of the other aforementioned continuous variables. In the case of the reverse regression with the licensing variable as the dependent variable, the coefficient of the new product variables is smaller than the corresponding one for the exporter dummy. This suggests that at least for the case of new products, the true partial correlation between the probability of introducing a new product and licensing is stronger than the one of being an exporter.

59. **Regarding the investment climate variables, the most robust effects on firm-level innovation inputs and other characteristics that are correlated with innovation outputs come from the availability of non-transport infrastructure, although transport infrastructure also seems to be a constraint for R&D investments.** If these are not causal effects, the coefficient can be interpreted as an indication that firms that invest less in R&D tend to see problems in infrastructure. If these results reflect causal effects, and since R&D is also correlated with innovation outputs, this evidence suggests that indeed the investment climate as captured by our infrastructure variables tend to deter firm-level innovation indirectly by reducing their investments in innovation inputs (R&D) and by limiting their links with multinationals, which might also be an important source of local firm innovation.

4.6 The Costa Rican Experience with Innovation Policies

4.6.1 Matching Grants and PROPYME[22]

60. **There are theoretical and empirical justifications for government to promote private investment in R&D and innovation.** Section 4 provided empirical evidence suggesting the developmental gains of these policies can be substantial. In addition, macroeconomic evidence suggested that there are notable market failures that limit the private sector's investment in the development of new export products. Whereas an assessment of the performance of PROCOMER or of the Ministry of Science and Technology as a whole falls well beyond the scope of this study, the following paragraphs take a closer look at one of Costa Rica's public programs designed to stimulate both private-sector investments in R&D as well as closer links between firms and research organizations.

61. **International experience suggests that best practices in public financing of private-sector innovation entail the use of matching grants, rather than tax incentives, unmatched subsidies, the establishment of public research centers without private-sector participation or protection from international competition.** Examples of well known matching grant subsidies range from the TEKES program in Finland to the Costa Rica's own program, which is discussed in the following paragraphs. Maloney (2005) and Hall (2005) discuss various international experiences. These programs have several positive features. First, they do not require the public sector per se to have the scientific or technical expertise to make decisions about the potential benefits of different types of innovations or sectors that could produce the next big idea. Second, whereas tax incentives require that tax auditors know a lot about innovation investment in order to differentiate between true innovation investments and capital investments that firms can argue are part of the innovation process, matching grants systems do not require auditing the accuracy of tax-related information. However, given the fact that Costa Rica must

[22] This subsection draws heavily from Monge-Gonzales and Monge-Ariño (2005).

soon reform its EPZ incentives to make them compatible with WTO norms, it worth considering the use of these tax incentives that already exist to promote private-sector innovation by firms established in the EPZs. Again, while this option is definitely not ideal, the current context could justify the use of tax incentives. Third, when the matching grants are offered on the condition that private firms work together with universities or the scientific community, they help by providing concrete incentives to innovators in these venues that do not usually face market incentives. Finally, whereas trade protection has well known detrimental effects on innovation by reducing the extent of international technology diffusion, matching grants can be targeted for commercial innovation, regardless of the geographic origin of the idea.

62. **In Costa Rica, the government has supported investment in R&D since 2000, through a Matching Grant System (FRC, for its Spanish initials Fondo de Recursos Concursables).** This program was modified in 2002 and replaced with the *SME Strengthening Law*[23] that created PROPYME—a comprehensive program to promote and facilitate the management and competitiveness of Costa Rican SMEs, through innovation and technology development without targetting any particular industry.[24] PROPYME is funded by Costa Rica's Public Budget and resources are allocated by the Incentive Commission at the Minister of Science and Technology[25]on an annual basis. The National Council for Scientific and Technological Research (CONICIT, for its initials in Spanish) administers the funds to avoid problems of political influence, corruption or moral hazard due to discretion.

63. **PROPYME resources can be used to finance various projects.** These include technology development, innovation patents, technology transfer, human capital development, technological services, or combinations of these objectives. The program operates in two phases: first, a firm or **consortium** of firms submits a project proposal to the Incentives Commission, which evaluates it according to specific criteria concerning the targeted activity or technological area, expected impact on firm and country productivity, scientific and technological capabilities of firms, and management capacity of the tender, among others. Second, projects that qualify are submitted to Research Units (RU)[26], who then place bids for the development of these projects. Winning bids are selected according to the quality, capabilities, and overall conditions offered by the RU, as well as any other criteria introduced by the Incentives Commission. Once a RU is chosen to undertake a project, PROPYME may finance as much as 80% of its total cost with the SME financing the rest of project. The main objective is to encourage entrepreneurs to invest more in R&D linked to the national scientific and research community.

64. **In a previous review of the Matching Grant System (FRC) Rodriguez-Clare (2003) claims that the system has three interesting features: (i) demand comes from the private sector and not from the research units, as was the case before; (ii) competition is created amongst research units for each project (in the past, research units presented their own projects, making it hard to select among projects and follow objective criteria); and (iii) the formal nature of the system leads to the generation of information about the projects that are presented and those that eventually get financed.** This information serves as input to the country's Science and Technology Policy and allows for periodic evaluations that provide feedback on how to improve the system.

[23] Ley de Fortalecimiento de las Pequeñas y Medianas Empresas, in Spanish.

[24] PROPYME stands for *Programa de Fortalecimiento para la Iinnovación y Desarrollo Tecnológico de las PYMES.*

[25] According to the *Ley de Fortalecimiento de las Pequeñas y Medianas Empresas*, this Commission consists of the Minister of Science and Technology, three representatives from the Board of Public Universities (CONARE), one representative from the Ministry of Agriculture, one representative from the Ministry of Economy, Industry and Commerce, two representatives from the Ministry of Finance, one representative from the Manufacturing Chamber, one representative from CONICIT, and one representative from the Private Sector Union of Chambers (UCCAEP).

[26] This Research Unit may belong to either a public or private university from Costa Rica or abroad, as well as can be a private research unit independent from any university, e.g. NGOs or the own RU from a firm.

65. **There is insufficient information to properly evaluate this program, but there are clear indications that it can be improved including an apparent recent fall in demand for these subsidies by the private sector**. Although a formal evaluation of the Matching Grant System exceeds the scope of the present effort, Monge-Gonzales and Monge-Ariño (2005) provide relevant information concerning the program's performance since 2000. According to CONICIT's database, 50 projects have been financed through FRC and PROPYME, with government grants accounting for US$ 2.6 million since the program's inception. It is worth noting that a back-of-the-envelope calculation of the government's contribution to the program between 2000 and 2004 represent a little more than 1 percent (1.34%) of Costa Rica's total investment in R&D during the same period.[27] This result should be carefully considered, since the Matching Grant System is the only program that explicitly promotes investment in R&D through joint venture innovation projects between research centers and firms.

66. **The Matching Grant System has financed all types of economic activities but the most important ones are manufacturing and agriculture, livestock and fishing, but services firms seem to be gaining interest**. Some basic data are on the sectoral distribution of the grants are shown in Table 4.9. Since PROPYME's inception, no new projects have been financed on agriculture, livestock and fishing, while the services sector has increasingly been funded, especially firms engaged in software development.

Table 4.9: Matching Grants by Activity and Year

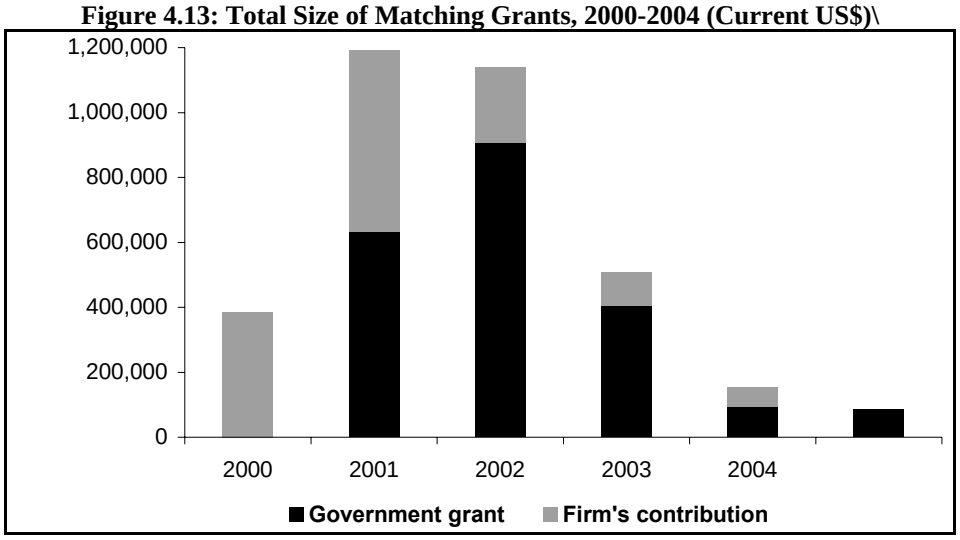
	2000		2001		2002		2003		2004		Total	
Sector	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value	No.	Value
Fishing	1	91,896.61	4	393,587.35	2	123,155.75	0	0	0	0	7	606,639.71
Agriculture & Livestock	6	535,270.73	5	473,381.57	1	182,213.41	0	0	0	0	12	1,190,865.70
Food Processing	3	297,027.58	5	116,512.95	1	123,717.65	1	14,133.02	1	7,096.96	11	558,488.17
Manufacturing	1	94,928.45	5	480,155.52	1	19,139.25	2	28,266.04	3	81,724.37	12	704,213.64
Services	0	0	0	0	1	191,841.24	5	156,216.79	2	56,966.68	8	405,024.71
Total	**11**	**1,091,123.37**	**19**	**1,463,637.39**	**6**	**640,067.30**	**8**	**196,615.85**	**6**	**145,788.03**	**50**	**3,467,231.93**

Source: Matching Grants Program, CONICIT (2005)

67. **The apparent decline in demand started around 2002, which might have been due to the design of the program. Figure 4.14 shows the growth of the Matching Grant System between 2000 and 2001, as well as the decline since 2002.** According to Monge-Gonzales and Monge-Ariño (2005), CONICIT representatives explained that this decline might be due to uncertainty in project co-financing. Since the amount of co-financing is determined only during the project approval phase and once it is assigned to a RU, firms do not have this information in advance and may not agree with the financing terms proposed by the Incentives Commission after the fact. In fact, during 2000 firms did not execute six projects because they disagreed with the share of financing set by the Incentive Commission. Still, this information is clearly insufficient to firmly identify the causes of the reduced demand for the funds in recent years, because said decline could be due to number of reasons, including the fixed-date system that establishes the dates when firms can apply for the funds and the rather limited scope allowed for the use of the funds. That is, demand could be low because it funds only innovations that are conducted jointly with research centers, rather than other forms of innovation, such as new product development that is not based on the diffusion of knowledge from researchers.

[27] This result was estimated using the fact that in Costa Rica, the average GDP between 2000 and 2004 was $17,082 billion dollars. Besides, according to statistics obtained at www.ricyt.org (Inter-American Network of Indicators on Science and Technology), the public investment in R&D accounts on average for 0.22% of GDP (the total national investment in R&D corresponds to 0.39% of GDP, 56% of which corresponds to public investment in R&D).

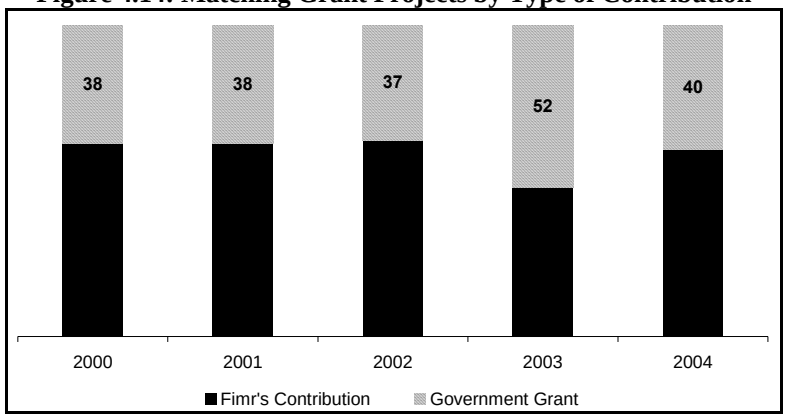
Figure 4.13: Total Size of Matching Grants, 2000-2004 (Current US$)



Source: Matching Grants Program, CONICIT (2005)

68. **Another potential explanation for low demand for the matching grants is that the amounts funded by the public funds could be too low relative to the benefits of the projects**. Figure 4.15 shows, however, that the share of the grant provided by the government has not changed significantly since the program's inception, averaging 59% per year and ranging between 55 to 75% of total project costs during 2000-2004. This matching grant scheme responds to the need for passing on to firms some project responsibility, thus reducing the risks associated with moral hazard. Although the government's grant contribution appears to be acceptable, further analysis may be needed to correctly assess the extent to which demands on firms' contributions are a deterrent.

Figure 4.14: Matching Grant Projects by Type of Contribution



Source: Matching Grants Program, CONICIT (2005)

69. **Another relevant trend is the decreased participation from the leading public university RU's in project implementation.** During the first three years of this program about 75 percent of projects were implemented by RUs from the three most important public universities in Costa Rica, as shown in Table 4.10. Yet during the last two years of the period under examination, this trend changed dramatically, with most implementing RUs located in the private sector or NGOs. This is a concern only to the extent that best relevant knowledge is available in the public research universities. But the

increased participation of the private sector can itself be an advantage, since it reduces the extent of the implicit duplicate subsidy implied by the fact that knowledge emanating from the public universities is already funded by public funds. In this context, however, it would be beneficial to re-assess the procedures and criteria for project preparation and proposal presentation to the Incentives Commission so that both public and private universities are more inclined to participate.

Table 4.10: Number of Matching Grant Projects by Research Unit

Research Center	*Number of Projects Funded*					
	2000	*2001*	*2002*	*2003*	*2004*	*Total*
Universidad de Costa Rica	7	5	1	0	2	15
Universidad Nacional de Costa Rica	1	4	3	0	0	8
Instituto Tecnológico de Costa Rica	2	3	1	0	0	6
NGOs [a]	1	7	1	6	0	15
Firm's Own R&D Units	0	0	0	2	4	6
Total	**11**	**19**	**6**	**8**	**6**	**50**

[a] Centro de Producción Más Limpia, Centro de Gestión Tecnológica e Informática Industrial (CEGESTI) and Centro de Formación de Formadores (CEFOF)
Source: Matching Grants Program, CONICIT (2005)

70. **Since the Marching Grant System became PROPYME, large firms cannot participate in the program, although the extent to which this criteria is worrisome depends on the definition of small and medium enterprises.** Since the vast majority of firms in Costa Rica tend to have less than one hundred employees, the focus on SMEs might not be an issue. Nevertheless, Costa Rican authorities could consider using other R&D-oriented grant programs administered by CONICIT to offer funding for innovation projects by large firms. Although this may be a bit controversial from an income distribution (and political) viewpoint, it is valid from a technological progress perspective. In fact, the results discussed in Section 5 above suggest that scale is an important correlate of innovation inputs and outputs, thus suggesting that larger firms tend to be more innovative. This implies that limiting innovation subsidies to SMEs might be reducing the developmental effect of such policies, since the main objective should be to subsidize the creation of innovations that can then be widely imitated throughout the economy. If large firms are more able to undertake these types of innovations, then the overall effectiveness of publicly-funded innovation programs can be enhanced by allowing large firms to participate. Moreover, their participation could be subject to higher co-financing requirements, thus making the whole package of policies more equitable and more effective in the long run.

71. **In terms of types of innovation that are being financed by the Matching Grant System, there has been a recent trend toward specializing on certain types of innovations**. Initially, the program's inception grants were evenly distributed across different innovation types. However, during the last years most resources have been allocated to investment projects aimed at protecting the environment and increasing the sophistication of productive processes (Table 4.11).

Table 4.11: Matching Grants by Type of Innovation (US$)

	2000		2001		2002		2003	
Sector	No.	Value	No.	Value	No.	Value	No.	Value
Protection of the Environment	1	122,026	7	696,206	3	497,772	0	0
Sanitation & Innocuousness	2	119,594	1	33,902	0	0	0	0
Biotechnology Improvement	3	175,215	2	222,989	1	94,580	0	0
Quality Improvement	2	264,580	0	0	0	0	4	56,532
Sophistication Production Processes	3	337,706	9	510,540	2	47,715	4	142,084
Total	11	1,091,121	19	1,463,637	6	640,067	8	198,616

Source: Matching Grants Program, CONICIT (2005)

72. **Most of the program's funded innovations have not been protected by any type of IPRs rights, which poses a risk of imitation.** Indeed, this could be another reason why demand for the funds has fallen in recent years. The terms and conditions of the grant contract stipulate that the firm must transfer to CONICIT as much as 80% of the revenue generated by the commercial exploitation of any intellectual property rights. On the one hand, this is a desirable feature of the program because such subsidies are justified especially in cases where resulting innovations are not patentable. If they are patentable, then the private sector can use IPRs as the vehicles for appropriating the returns to their investments in innovation. On the other hand, this contract obligation may be creating perverse incentives for firms to skip property right protection in order to reduce the profits that would need to be returned to CONICIT, and it could also be limiting the demand for the matching grants.

73. **It is also worth noting that Monge-Gonzales and Monge-Ariño (2005) argue that IPRs in Costa Rica are underutilized, perhaps due to a lack of private-sector awareness about the numerous types of IPRs, only one of which are patents**. Other IPRs include trade secrets, trademarks, and protections for experimental data. Hence an alternative explanation for the lack of demand for matching grants is the fact that awarded research projects may have little patentable results, and when they do attain such results, a large share of the corresponding rewards are transferred to CONICIT.[28] Thus, one may expect that the interest to engage in the system decreases as the sophistication of the innovation increases. In any case, changing this requirement may be difficult for legal and political reasons.

74. **In sum, Costa Rican authorities could revise the current procedures and the institutional framework of the Matching Grant System in order to promote a broader use—by both firms and RUs—and increase investment in R&D**. Among the features that could be reviewed are: (i) the limits on the participation of large firms; (ii) the narrow scope of the grants, which are currently targeted on joint ventures between firms and research centers that are not chosen by the firms themselves; and (iii) the fixed-time grant competitions, which limit the grant applications to those submitted by certain dates, could be changed to an open window allowing firms to submit proposals at any time. However, it is difficult to derive strong recommendations from the available data, and thus the it is arguable that the main reform in the near future should focus on the future monitoring and evaluation of the program.

[28] By patentable we refer to the propensity of an innovation to be protected by patents or any other form of IPR.

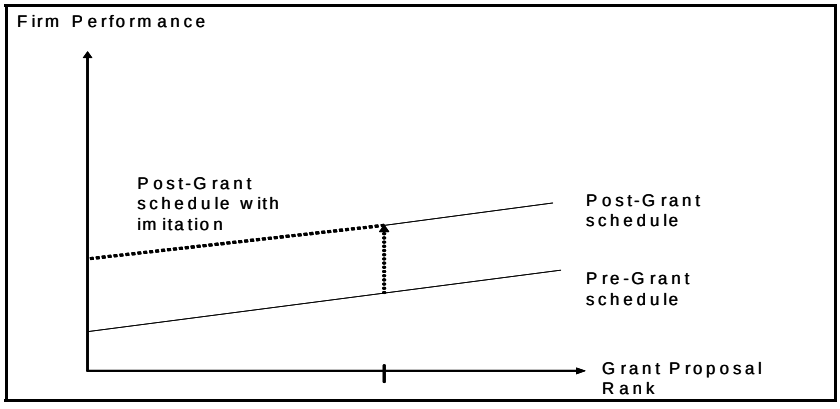
4.6.2 Future Monitoring and Evaluation of the Matching Grants Program

75. **The Costa Rican matching grants program has not been subject to any form of formal evaluation beyond the evaluations of the grant proposals themselves and existing mechanisms for monitoring the use of funds to limit the scope for corruption.** Ideally, any such program should also be evaluated in terms of the impact the grants have on firm performance, particularly in the context of setting budgetary priorities in order to achieve fiscal consolidation. It is likely that future rigorous evaluations of this modestly financed program will add to its legitimacy as a worthwhile public investment.

76. **Most of the empirical work evaluating the effectiveness of subsidy programs for innovation policies around the world has centered on "after-the-fact" evaluation**. This approach attempts to infer the effects of subsidies using observed data collected after the implementation of a grant (Jaffe 2002). "After-the-fact" evaluations are hampered by a "selectivity bias" due to the fact that public funding goes to proposals judged in advanced to be the most likely to succeed. In other words, the projects that are the best candidates for funding–in the sense of maximizing the impact of public support–are also the projects that would have the largest expected R&D output in the absence of funding. Thus, the after-the-fact effect of the subsidy can be confused with the performance of the best firms, which are also the ones that receive the grants. In other words, the best performing firms are also the most likely to present the best grant proposals, and ex-post evaluations can thus be misleading.

77. **There are other alternative methodologies for evaluation matching-grants programs, which can require substantial additional information**. Jaffe (2002) proposes an alternative to evaluate matching grants based on regression analysis. This approach entails collecting information about firm performance from all applicants, including those who did not get funding, after the grants have been implemented. With the collected information, regression analysis can be applied to determine the effect of the grants on the performance of the winning firms by comparing their performance with that of the firms that did not receive a grant. Figure 4.16 below illustrates this idea. The selectivity problem is captured by the positive relationship between grant selection rank and firm performance, which could be measured by productivity indicators, such as the value of production per worker, adjusted by the amount of capital invested by the firm. As shown, the best proposals have both higher expected firm performances with or without the effect of a grant, and only the proposals that surpass a threshold are funded. In other words, both the pre-grant and post-grant schedule show a positive relationship between grant rank and firm performance, while the effect of the grant itself could be captured by an upward shift of the performance schedule.

Figure 4.15: Dealing with the Selectivity Problem in Evaluating Matching Grants Programs



Source: Adapted from Jaffe (2002).

78. **This evaluation approach based on regression analysis undoubtedly has some weaknesses.** First, the information requirements for conducting this type of evaluation might be a further deterrent for firms to apply for grants. Moreover, the data collection requirements after the implementation of grants can be costly, since unsuccessful firms would need to be surveyed on site after they have been rejected. However, the costs might not be that large.

79. **Second, this methodology requires a large number of participating firms in order for the assessment to be robust.** Given the scant participation in the current program, it probably cannot be implemented for some time until enough firms have participated and the appropriate information has been collected. But the information collection should be initiated as soon as possible in order to achieve a large sample for meaningful evaluation in the near future.

80. **Third, there is no guarantee that the impact of the grant on the successful firms will be characterized by a shift in the performance schedule**. It could be characterized by the change in the slope of the schedule. This possibility is easy to capture through regression analysis, and thus it is not a major concern.

81. **Fourth, imitation by other firms that did not get the grant can result in changes in their performance, which could muddle the evaluation.** Ideally the innovation projects funded by the matching grants program would be imitated by unsuccessful applicants, and hopefully by numerous firms that did not apply, as it is this imitation process that yields high rates of social returns. Consequently it is desirable to observe a shift in performance by the unsuccessful firms, as shown in Figure 4.16 by the dotted portion of the post-grant schedule. This implies that firm-performance data collected after the implementation of the grants might capture not only the effects of the grants on the successful firms, but also the imitation by the unsuccessful firms. If so, a simple regression would not be able to identify the impact of the grants. This challenge could be overcome if performance data on both groups of firms is collected after grant implementation in a sufficiently high frequency to be able to capture the impact of the grants on the receiving firms before the innovations are imitated by others, assuming that such a lag exists. Again, this consideration raises the data collection requirements.

82. **Fifth, it is possible that the rankings of the grant proposals are not satisfactory indicators of quality differences among the proposals**. For example, the jump in quality between the third best and second best might be different than the jump between the second and the best proposals. Hence it might be best to use scores rather than the rankings of the proposals, thus attempting to capture the magnitude of the quality differences among the proposals. This suggestion should be easy to implement.

83. **Sixth, if our previous suggestion concerning the use of an open window for receiving grant applications is implemented, then the data collection from applicant firms would not coincide, thus complicating the evaluation of impacts across firms.** This might be a problem over time, as market conditions that are unrelated to the matching grants program might affect firm performance. This could be dealt with ideally by implementing economy-wide firm surveys to collect the necessary performance information, which could then be used in regression analysis (through "differences in differences" estimations, for example) to control for economy-wide fluctuations. If this type of survey is not possible, data on industrial production or sectoral production could be used to control for factors affecting all firms in a given industry over time.

84. **This brief review of technical issues concerning the design of rigorous evaluations of the matching grant program clearly suggests that evaluation is not an easy task**. But it can be done. If the program succeeds and grows over time, the need for rigorous evaluation would also become more pressing. Fortunately, as the program succeeds and more firms participate, a number of challenges become easier and relatively less costly to overcome. Our hope is that our readers have at least gained

some insights about the potential benefits of public subsidies for innovation, but also about how difficult it is to design such programs in order to maximize their developmental effects.

4.7 Summary and Policy Recommendations

85. **Enhancing the educational attainment of the work force by emphasizing secondary school enrollment is a key challenge for Costa Rica's long-term growth and innovation agenda**. Existing empirical evidence suggests that overall educational attainment affects the rates of return to R&D investment across countries and over time. Also, microeconomic evidence presented above suggests that there is a strong association between the level of education of employees and private-sector innovation outputs and inputs, although it is difficult to establish the direction of causality. Nevertheless, it seems prudent to prioritize achieving full coverage in secondary enrollment as part of the innovation agenda, because the country's secondary enrollment gap threatens Costa Rica's long-term ability to raise the overall educational attainment of its workforce.

86. **It is difficult to conclude that Costa Rica should prioritize the innovation agenda based purely on descriptive statistics that compare the country's performance in terms of innovation outcomes and inputs with similar economies**. This is so because it is unclear what the benchmarks mean in terms of policy implications since the benchmark can be a mediocre performance in the presence of market failures. Moreover, benchmarking alone says little about the potential social rates of return to national investments in innovation inputs.

87. **Macroeconomic evidence presented above, however, suggests that in fact Costa Rica should put innovation at the top of its development agenda**. First, innovation outcomes, measured by the accumulated number of patents over a long time period, seem to be positively correlated with the level of development across countries in a causal sense. In fact, in this context, innovation seems to be perhaps even more important for long-term economic development than governance or the quality of public institutions. Of course, it is unlikely that innovation policies will have a high rate of social return if the institutions and organizations that encompass the national innovation system (public sector policies, research centers and universities, and the private sector) are not well integrated.

88. **Second, the social rates of return to R&D, one of the key innovation inputs, seem to be quite high, especially for countries with levels of development just above that of Costa Rica.** This evidence suggests that if Costa Rica can provide the correct incentives and institutional framework, the social returns to R&D can be incredibly high, and the payoffs from innovation policies can be substantial.

89. **Third, market failures seem to hamper the most common type of innovation in developing countries, namely the introduction of export products that already exist around the globe**. Consequently, the benchmarking exercises that portrayed Costa Rica as an under-performer in R&D, scientific publication, and export discoveries become worrisome when the empirical evidence suggests that the potential gains from improving either the level of investments in innovation inputs or improving the quality of public policies and institutions that affect the efficiency with which the country uses its scarce innovation inputs.

90. **Contrary to the conventional wisdom, non-patentable private-sector innovation outputs are strongly associated with investments in R&D and licensing payments, but the direction of causality remains murky**. To aid the targeting of innovation policies in Costa Rica, this study provided a comprehensive empirical assessment of firm characteristics and innovation inputs that are associated with various indicators of innovation outputs, namely the introduction of new products, product upgrading, changes in production processes, and meeting international product-quality standards. In spite of severe measurement errors in the data, the international firm-level evidence suggest, that there are in fact strong

positive partial correlations between innovation inputs and outputs, and the strongest correlations are those of investments in licensing of foreign technologies and investments in R&D. As discussed at length in previous sections, these variables tend to measured with error in developing countries, which causes standard direct regressions to underestimate the magnitude and significance of the partial correlations of R&D and licensing with respect to innovation outcomes. One of the analytical contributions of this chapter is, therefore, the application of reverse regressions to estimate the true partial correlations between innovation outcomes and critical inputs, which are often found not to be significant in developing countries.

91. **Private-sector costs associated with transport and non-transport infrastructure appear to be associated with key innovation-related practices, including worker training and R&D investments in developing countries, including Costa Rica.** Thus, combined with the evidence and policies discussed in the previous chapter, an important policy implication is that dealing with infrastructure challenges will be an important factor determining the country's long-term growth prospects.

92. **Although Costa Rica's matching grants program that subsidizes private-sector innovation projects is consistent with global best practices, various aspects can be reformed in order to improve its performance**. Some of the features that could be reviewed are: (i) the limits on the participation of large firms; (ii) the narrow scope of the grants, which are currently targeted on joint ventures between firms and research centers that are not chosen by the firms themselves; and (iii) the fixed-time grant competitions, which limit the grant applications to those submitted by certain dates, could be changed to an open window allowing firms to submit proposals at any time. However, it is difficult to derive strong recommendations from the available data, and thus it is arguable that the main reform in the near future should focus on the future monitoring and evaluation of the program.

93. **The future performance of the matching grants program as well as of the activities of PROCOMER and of the Ministry of Science and Technology in general should be monitored and evaluated with as much rigor as possible so that their design and areas of operations can be improved over time.** Such evaluations are technically difficult to design and might require substantial firm-level information to be collected at various stages. For various reasons detailed in this chapter, we do not necessarily recommend that such an evaluation system be implemented immediately, especially not in the context of lackluster demand for the matching grants system, but data collection from participants should commence soon, so that rigorous evaluations can be applied in the medium term.

94. **Similarly, a detailed evaluation of the effects of EPZ tax incentives on Costa Rica's economic performance is not feasible for the current study, but the option of transforming said incentives into R&D incentives should be considered carefully.** On the one hand, tax incentives are clearly not a first-best policy option for promoting private-sector R&D. On the other hand, such incentives already exist to promote exports, which will soon become incompatible with WTO norms.

95. **Finally, education, innovation, and infrastructure, seem to be worth prioritizing in the country's public policy agenda.** The evidence set forth in this chapter strongly suggests that Costa Rica's public expenditures related to secondary schooling, the matching grants program, and perhaps the budget of the Ministry of Science and Technology, as well as those expenditures related to improving the quality of its infrastructure, should be protected as much as possible in the context of fiscal consolidation. If budget cuts in these areas are required to maintain the country's cherished macroeconomic stability, then the recommendations regarding the efficiency of public expenditure outlined above and in the previous chapter become even more important.

Appendix 1

Table A1: Negative-Binomial Estimation Results: Determinants of Export Discovery Counts during 1994-2003

	(1)	(2)	(3)	(4)	(5)
Ln(GDP p.c.)	8.436	8.245	8.310	6.657	13.927
	(9.09)***	(8.83)***	(8.14)***	(3.76)***	(3.88)***
Ln(GDP p.c.)^2	-0.507	-0.495	-0.498	-0.404	-0.812
	(9.24)***	(8.91)***	(8.32)***	(3.90)***	(4.04)***
Ln(historical discoveries)	0.305	0.305	0.304	0.249	0.257
	(3.39)***	(3.39)***	(3.37)***	(2.87)***	(2.88)***
Factor Endowments	0.349	0.354	0.355	0.397	0.383
	(0.98)	(0.99)	(1.00)	(1.08)	(0.98)
π	0.368	0.501	0.493	0.434	0.523
	(1.71)*	(2.08)**	(2.04)**	(1.75)*	(2.06)***
	0.674	0.748	0.736	0.652	0.774
	(1.77)*	(2.13)**	(2.09)**	(1.80)*	(2.09)**
barriers	-0.003	0.026	0.237	0.583	4.733
	(0.04)	(0.25)	(0.28)	(0.56)	(1.82)*
D_Raw Materials	2.357	2.380	2.382	2.382	2.366
	(5.40)***	(5.41)***	(5.43)***	(5.06)***	(5.00)***
D_Forest Products	1.922	1.943	1.943	1.948	1.949
	(4.41)***	(4.43)***	(4.44)***	(4.15)***	(4.14)***
D_Tropical Agriculture	1.728	1.755	1.754	1.704	1.717
	(3.85)***	(3.88)***	(3.88)***	(3.57)***	(3.57)***
D_Animal Products	2.291	2.314	2.314	2.309	2.317
	(5.28)***	(5.29)***	(5.30)***	(4.96)***	(4.92)***
D_Cereals	1.934	1.953	1.953	1.969	1.983
	(4.52)***	(4.53)***	(4.53)***	(4.28)***	(4.27)***
D_Labor Intensive	2.709	2.719	2.721	2.708	2.678
	(6.19)***	(6.18)***	(6.21)***	(5.88)***	(5.80)***
D_Capital Intensive	3.260	3.284	3.284	3.278	3.268
	(7.49)***	(7.48)***	(7.50)***	(7.05)***	(7.00)***
D_Machinery	3.024	3.037	3.038	3.048	3.039
	(6.94)***	(6.93)***	(6.96)***	(6.56)***	(6.50)***
D_Chemicals	3.669	3.686	3.685	3.657	3.654
	(8.25)***	(8.23)***	(8.24)***	(7.72)***	(7.66)***
$\pi \times \ln(GDPpc)$			-0.022	-0.050	-0.476
			(0.24)	(0.45)	(1.72)*
Africa				-1.102	1.838
				(3.13)***	(1.41)
East Asia				-0.337	-0.259
				(1.22)	(0.40)
Eastern Europe				-0.114	-0.607
				(0.33)	(1.01)
High-Income				-0.584	-0.133
				(1.75)	(0.20)
Latin Am.				-0.811	-0.447
				(3.04)***	(0.70)
Middle East				-0.338	-0.064
				(1.08)	(0.11)
*Barriers**Latin America					-0.674
					(1.09)
*Barriers*_Africa					-3.201
					(2.34)**
*Barriers*_High Inc.					-0.078
					(0.16)
*Barriers**East Asia					-0.118
					(0.20)
*Barriers**Middle East					-0.794
					(1.43)
*Barriers**Eastern Europe					1.655
					(2.79)***
Constant	-35.753	-35.043	-35.369	-27.627	-60.129
	(9.24)***	(9.08)***	(8.23)***	(3.71)***	(3.81)***
Observations	510	510	510	510	510

Notes: 1) Robust z statistics in parentheses 2) * significant at 10%, ** significant at 5%; *** significant at 1%
Source: Klinger and Lederman (2006, Table 4).

96. **Table A1 above shows the basic estimation results under the first column, and the remaining columns show the results of additional regressions that test their robustness.** The second column shows the basic specification but using the barriers index that excludes the costs of starting a new business, which was based on questionable data. Column 3 contains estimates based on the same composite index of barriers, but also includes the interaction between barriers and (log) GDP p.c., which is a rather strong robustness test of whether the key estimated effect of the interaction between barriers and export profitability is not due to an interaction with the level of development. Column 4 shows the estimated coefficients after controlling for unobserved regional characteristics. The interpretation of the corresponding regional dummy variables needs to be done with care, since the model already controls for the pre-sample discovery counts by country/commodity groups. They reflect any additional impact emanating from time invariant regional characteristics. Finally, column 5 shows the results after adding interactive variables between the regional dummies and the barriers index to help us ascertain that the interaction that matters is the one with export profitability rather than some other regional factor.

ANNEX 1: STATISTICAL TABLES

Table A1.1

Ranking GDP per capita (Average 1990-2005)

Middle Income Countries (3,000-15,000 GDP US$ per capita)

	COUNTRY	GDP PPP US$ (Billions)	GDP Growth	GDP Growth Volatility	GDP per capita PPP US$
1	Saudi Arabia	243.09	3.32	3.04	12424.47
2	Argentina	397.44	3.25	6.35	10999.17
3	Seychelles	0.82	2.61	5.17	10494.30
4	Libya	45.74	1.75	6.96	9036.99
5	South Africa	384.82	2.20	1.98	8979.11
6	Antigua and Barbuda	0.61	3.26	2.72	8933.00
7	Poland	338.41	2.78	4.22	8805.68
8	Mauritius	10.20	5.53	1.92	8767.47
9	Croatia	38.58	2.22	5.53	8586.94
10	Chile	122.41	5.59	3.20	8211.58
11	Uruguay	26.15	2.33	5.55	7993.19
12	Latvia	19.50	1.64	11.05	7961.67
13	Malaysia	179.30	6.49	4.53	7957.76
14	Mexico	759.23	3.11	3.16	7954.50
15	**COSTA RICA**	**29.38**	**4.65**	**2.65**	**7,786.43**
16	Russia	1114.03	-0.10	7.99	7626.05
17	Botswana	10.79	5.24	1.61	7139.77
18	Brazil	1139.21	2.16	2.58	6834.83
19	Gabon	7.67	1.93	3.88	6707.15
20	Bulgaria	53.85	-1.42	6.61	6569.02
21	Grenada	0.62	2.79	3.60	6259.16
22	Macedonia, FYR	12.32	0.29	4.03	6159.18
23	Turkey	384.32	4.14	5.45	6027.06
24	Colombia	245.26	2.97	2.39	6003.25
25	Tonga	0.60	2.23	2.82	6003.03
26	Thailand	365.93	5.09	5.19	5950.41
27	Romania	132.63	0.53	6.32	5883.10
28	Tunisia	52.98	4.86	1.80	5659.55
29	Namibia	9.78	3.65	2.38	5582.55
30	Iran, Islamic Rep. of	353.33	5.41	4.87	5567.99
31	Venezuela	125.70	2.56	6.89	5461.71
32	Belize	1.26	5.30	3.80	5406.67
33	Algeria	157.96	2.59	2.58	5375.26
34	Panama	15.11	5.01	2.65	5283.16
35	Maldives	1.48	6.79	2.41	5281.18
36	Dominican Republic	42.60	4.21	3.86	5276.54
37	Dominica	0.38	1.39	2.39	5259.70
38	Ukraine	260.60	-1.90	10.55	5195.61
39	St. Vincent	0.55	3.36	2.33	5093.43
40	Kazakhstan	76.61	2.01	8.43	4945.58
41	Lebanon	16.34	4.95	10.16	4880.62

Middle Income Countries (3,000-15,000 GDP US$ per capita)

	COUNTRY	GDP PPP US$ (Billions)	GDP Growth	GDP Growth Volatility	GDP per capita PPP US$
42	Fiji	3.75	3.06	3.40	4704.17
43	Belarus	46.90	1.89	8.25	4681.36
44	St. Lucia	0.78	2.43	2.58	4672.37
45	Turkmenistan	20.78	4.57	13.49	4659.59
46	Samoa	0.79	2.97	3.61	4652.65
47	Suriname	2.02	1.84	3.25	4439.14
48	Peru	111.28	3.41	4.17	4411.81
49	Paraguay	22.65	2.14	2.31	4360.25
50	Yugoslavia, former	32.14	2.74	6.60	4328.94
51	Swaziland	4.13	3.14	1.68	4210.35
52	Cape Verde	1.74	6.02	2.96	4110.27
53	Jamaica	9.83	1.09	1.50	3874.77
54	Philippines	274.75	3.34	2.15	3712.54
55	Guyana	2.72	3.02	4.13	3682.86
56	El Salvador	22.56	3.76	2.11	3664.23
57	Jordan	17.32	5.29	3.32	3641.97
58	Guatemala	39.70	3.54	0.95	3441.32
59	Morocco	95.04	3.03	5.15	3436.71
60	Ecuador	40.48	2.88	2.82	3380.42
61	Albania	11.31	2.51	10.86	3347.18
62	China	4191.44	9.31	2.55	3336.21
63	Egypt	200.12	3.78	2.58	3230.03
64	Vanuatu	0.57	2.74	4.31	3142.25
65	Bosnia and Herzegovina	12.16	11.91	16.99	3131.69
66	Syrian Arab Rep.	48.84	5.00	4.21	3128.24
67	Indonesia	596.37	4.55	5.08	2949.32
68	Azerbaijan	22.70	0.81	13.97	2893.53
69	Sri Lanka	55.11	4.84	1.92	2877.54
70	Armenia	8.20	1.87	17.02	2383.04
71	Bhutan	1.65	6.75	1.51	2190.51
72	India	2132.10	5.78	1.57	2179.11
73	Georgia	11.21	-1.29	16.36	2124.99
74	Angola	24.01	3.82	9.34	1879.32
	Average	**205.98**	**3.37**	**4.98**	**5448.41**

Note: (1) Average Growth over the Period. * Per capita income data available from 1997
Source: IMF WEO database, IMF IFS database and Levy-Yeyati.

Table A1.2

Rankings for Average GDP growth and growth volatility (1990-2005)

Ranking GDP Growth

	COUNTRY	GDP Growth
1	Bosnia and Herzegovina	11.91
2	China	9.31
3	Maldives	6.79
4	Bhutan	6.75
5	Malaysia	6.49
6	Cape Verde	6.02
7	India	5.78
8	Chile	5.59
9	Mauritius	5.53
10	Iran, Islamic Rep. of	5.41
11	Belize	5.30
12	Jordan	5.29
13	Botswana	5.24
14	Thailand	5.09
15	Panama	5.01
16	Syrian Arab Rep.	5.00
17	Lebanon	4.95
18	Tunisia	4.86
19	Sri Lanka	4.84
20	**COSTA RICA**	**4.65**
21	Turkmenistan	4.57
22	Indonesia	4.55
23	Dominican Republic	4.21
24	Turkey	4.14
25	Angola	3.82
26	Egypt	3.78
27	El Salvador	3.76
28	Namibia	3.65
29	Guatemala	3.54
30	Peru	3.41
31	St. Vincent	3.36
32	Philippines	3.34
33	Saudi Arabia	3.32
34	Antigua and Barbuda	3.26
35	Argentina	3.25
36	Swaziland	3.14
37	Mexico	3.11
38	Fiji	3.06
39	Morocco	3.03
40	Guyana	3.02
41	Colombia	2.97
42	Samoa	2.97
43	Ecuador	2.88

Ranking Growth Volatility

	COUNTRY	Growth Volatility
1	Guatemala	0.95
2	Jamaica	1.50
3	Bhutan	1.51
4	India	1.57
5	Botswana	1.61
6	Swaziland	1.68
7	Tunisia	1.80
8	Mauritius	1.92
9	Sri Lanka	1.92
10	South Africa	1.98
11	El Salvador	2.11
12	Philippines	2.15
13	Paraguay	2.31
14	St. Vincent	2.33
15	Namibia	2.38
16	Dominica	2.39
17	Colombia	2.39
18	Maldives	2.41
19	China	2.55
20	Egypt	2.58
21	Algeria	2.58
22	Brazil	2.58
23	St. Lucia	2.58
24	Panama	2.65
25	**COSTA RICA**	**2.65**
26	Antigua and Barbuda	2.72
27	Ecuador	2.82
28	Tonga	2.82
29	Cape Verde	2.96
30	Saudi Arabia	3.04
31	Mexico	3.16
32	Chile	3.20
33	Suriname	3.25
34	Jordan	3.32
35	Fiji	3.40
36	Grenada	3.60
37	Samoa	3.61
38	Belize	3.80
39	Dominican Republic	3.86
40	Gabon	3.88
41	Macedonia, FYR	4.03
42	Guyana	4.13
43	Peru	4.17

Ranking GDP Growth

	COUNTRY	GDP Growth
44	Grenada	2.79
45	Poland	2.78
46	Vanuatu	2.74
47	Yugoslavia, FMR	2.74
48	Seychelles	2.61
49	Algeria	2.59
50	Venezuela	2.56
51	Albania	2.51
52	St. Lucia	2.43
53	Uruguay	2.33
54	Tonga	2.23
55	Croatia	2.22
56	South Africa	2.20
57	Brazil	2.16
58	Paraguay	2.14
59	Kazakhstan	2.01
60	Gabon	1.93
61	Belarus	1.89
62	Armenia	1.87
63	Suriname	1.84
64	Libya	1.75
65	Latvia	1.64
66	Dominica	1.39
67	Jamaica	1.09
68	Azerbaijan	0.81
69	Romania	0.53
70	Macedonia, FYR	0.29
71	Russia	-0.10
72	Georgia	-1.29
73	Bulgaria	-1.42
74	Ukraine	-1.90
	Average	**3.37**

Ranking Growth Volatility

	COUNTRY	Growth Volatility
44	Syrian Arab Rep.	4.21
45	Poland	4.22
46	Vanuatu	4.31
47	Malaysia	4.53
48	Iran, Islamic Rep.of	4.87
49	Indonesia	5.08
50	Morocco	5.15
51	Seychelles	5.17
52	Thailand	5.19
53	Turkey	5.45
54	Croatia	5.53
55	Uruguay	5.55
56	Romania	6.32
57	Argentina	6.35
58	Yugoslavia, FMR	6.60
59	Bulgaria	6.61
60	Venezuela	6.89
61	Libya	6.96
62	Russia	7.99
63	Belarus	8.25
64	Kazakhstan	8.43
65	Angola	9.34
66	Lebanon	10.16
67	Ukraine	10.55
68	Albania	10.86
69	Latvia	11.05
70	Turkmenistan	13.49
71	Azerbaijan	13.97
72	Georgia	16.36
73	Bosnia and Herzegovina	16.99
74	Armenia	17.02
	Average	**4.98**

Source: IMF WEO database, IMF IFS database and Levy-Yeyati.

Table A1.3

Rankings for Average Inflation and inflation volatility
(Average 1990-2005)

Middle Income Countries (3000-15000 GDP US$ per capita) excluding outliers with annual average inflation exceeding 50%

COUNTRY	Inflation Average
Saudi Arabia	0.58
Panama	1.26
Vanuatu	1.37
Bosnia and Herzegovina**	1.82
Dominica	1.94
Belize	2.07
Antigua and Barbuda	2.16
Grenada	2.21
Seychelles	2.26
St. Vincent	2.48
St. Lucia	2.63
Jordan	2.77
Libya	2.94
Malaysia	2.96
Morocco	3.41
Fiji	3.71
Gabon	3.83
Thailand	3.91
Samoa	3.95
Tunisia	4.09
Cape Verde	4.73
China	5.38
Syrian Arab Rep.	5.80
Maldives	6.00
Tonga	6.29
Mauritius	6.82
India	7.45
Bhutan	7.61
Philippines	7.75
El Salvador	7.81
South Africa	8.15
Chile	8.38
Egypt	8.55
Swaziland	8.64
Namibia	9.34
Botswana	9.72
Sri Lanka	10.65
Indonesia	12.04
Algeria	12.11
Guatemala	12.18
Paraguay	13.45

Middle Income Countries (3000-15000 GDP US$ per capita) excluding outliers with annual average inflation exceeding 50%

	COUNTRY	Inflation Volatility
1	Panama	0.61
2	Grenada	0.83
3	Malaysia	1.28
4	Dominica	1.58
5	Tunisia	1.66
6	Belize	1.79
7	Saudi Arabia	1.79
8	Seychelles	1.89
9	St. Lucia	1.94
10	St. Vincent	2.12
11	Thailand	2.27
12	Fiji	2.30
13	Antigua and Barbuda	2.45
14	Morocco	2.47
15	Mauritius	2.53
16	Jordan	2.53
17	Botswana	2.91
18	Swaziland	3.03
19	Namibia	3.14
20	India	3.62
21	South Africa	3.86
22	Bhutan	3.90
23	Philippines	4.10
24	Samoa	4.13
25	Tonga	4.19
26	Sri Lanka	4.28
27	Cape Verde	4.40
28	**COSTA RICA**	**5.76**
29	Bosnia and Herzegovina**	5.82
30	Syrian Arab Rep.	5.92
31	Egypt	6.18
32	Maldives	6.41
33	Libya	6.53
34	Vanuatu	6.57
35	El Salvador	6.79
36	China	7.28
37	Chile	7.32
38	Paraguay	8.70
39	Colombia	8.84
40	Gabon	9.59
41	Iran, Islamic Republic of	9.82

COSTA RICA	**14.64**	42	Guatemala	10.42
Mexico	14.91	43	Mexico	10.44
Dominican Republic	16.09	44	Algeria	11.63
Colombia	16.45	45	Indonesia	12.81
Guyana	17.73	46	Dominican Republic	17.60
Lebanon	19.41	47	Jamaica	18.36
Iran, Islamic Rep. of	20.61	48	Venezuela	22.18
Jamaica	20.97	49	Ecuador	23.90
Albania	28.56	50	Guyana	26.92
Uruguay	34.10	51	Yugoslavia FMR***	29.81
Ecuador	34.25	52	Lebanon	31.94
Yugoslavia FMR***	36.25	53	Uruguay	34.57
Venezuela	37.18	54	Albania	57.02
Average	**10.04**		**Average**	**8.90**

Note: Some countries available information is more restricted: * 1992-2005; ** 1995-2005; *** 1998-2005.

Source: IMF WEO database, IMF IFS database and Levy-Yeyati.

Table A1.4

Rankings for Monetization and Dollarization for Middle Income Countries (1990-2005)

COUNTRY	Foreign Deposits/Total Deposits			Money/GDP Average
Uruguay	82.4%	1	Morocco	54.6%
Angola	68.6%	2	China	52.2%
Armenia	68.1%	3	Libya	46.6%
Croatia	66.9%	4	Syrian Arab Rep.	42.4%
Bosnia and Herzegovina	65.6%	5	Jordan	38.3%
Peru	65.6%	6	Cape Verde	32.4%
Vanuatu	64.1%	7	Saudi Arabia	26.2%
Georgia	63.9%	8	Vanuatu	25.9%
Lebanon	61.8%	9	South Africa	25.9%
Azerbaijan	61.6%	10	Malaysia	25.2%
Maldives	49.2%	11	Albania	23.3%
Paraguay	48.9%	12	Egypt	21.3%
Belarus	48.8%	13	Maldives	20.6%
Kazakhstan	48.6%	14	Grenada	19.9%
Argentina	45.8%	15	Bulgaria	19.7%
Turkey	45.1%	16	Bosnia and Herzegovina	18.2%
Suriname	44.9%	17	Antigua and Barbuda	17.8%
Bulgaria	44.8%	18	Bhutan	17.4%
Latvia	43.6%	19	St. Lucia	17.1%
Macedonia, FYR	40.7%	20	Latvia	16.7%
COSTA RICA	**38.7%**	21	Ukraine	16.2%
Russia	34.0%	22	Dominica	16.1%
Ukraine	32.7%	23	Fiji	15.6%
Romania	32.5%	24	Belize	15.4%
Egypt	31.7%	25	Mauritius	13.6%
Albania	30.2%	26	Tonga	13.4%
Philippines	28.5%	27	Jamaica	13.4%
Poland	25.4%	28	Poland	13.3%
Jamaica	23.1%	29	Russia	12.9%
Jordan	22.4%	30	Dominican Republic	12.2%
Saudi Arabia	21.8%	31	Croatia	11.9%
Sri Lanka	20.0%	32	Azerbaijan	11.7%
Indonesia	19.7%	33	Kazakhstan	11.6%
Dominican Republic	16.0%	34	Samoa	11.3%
Chile	9.5%	35	Armenia	11.1%
Fiji	9.4%	36	Thailand	11.1%
Syrian Arab Rep.	7.4%	37	**COSTA RICA**	**11.1%**
Mauritius	7.3%	38	Romania	10.9%
Mexico	7.3%	39	Philippines	10.7%
China	7.2%	40	Guatemala	10.6%
El Salvador	6.4%	41	Lebanon	10.6%
Antigua and Barbuda	5.5%	42	Venezuela	10.5%
Grenada	5.0%	43	Sri Lanka	10.4%
Samoa	5.0%	44	Indonesia	10.1%

Cape Verde	4.9%	45	Paraguay	10.0%
Bhutan	3.7%	46	Colombia	9.8%
Malaysia	2.7%	47	Mexico	9.2%
Tonga	2.7%	48	Angola	9.2%
Dominica	2.6%	49	Peru	9.2%
South Africa	2.4%	50	El Salvador	8.9%
Belize	2.1%	51	Chile	8.7%
St. Lucia	1.0%	52	Belarus	8.1%
Venezuela	0.8%	53	Macedonia, FYR	8.0%
Guatemala	0.8%	54	Argentina	7.2%
Thailand	0.7%	55	Turkey	6.0%
Libya	0.5%	56	Georgia	6.0%
Morocco	0.5%	57	Uruguay	5.9%
Colombia	0.3%	58	Suriname	0.0%
Average	**27.6%**		**Average**	**16.6%**

Source: IMF WEO database, IMF IFS database and Levy-Yeyati.

Table A1.5

Rankings for Central Government Debt and Fiscal Balance - (1990-2005)

Fiscal Indicators – Int. Comparison –MIC (3000-15000 GDP US$ per capita)

COUNTRY	Years		Public Debt/GDP Average		COUNTRY	Fiscal Balance/GDP Average	Fiscal Balance/GDP Volatility
Guatemala	1994	2004	7.0%	1	Botswana	4.1%	5.9%
Botswana	1990	2003	10.4%	2	Panama	1.5%	2.1%
Thailand	1990	2003	15.1%	3	Chile	1.2%	1.1%
Swaziland	1990	2003	20.5%	4	Thailand	0.6%	2.7%
Chile	1990	2000	23.3%	5	Indonesia	0.1%	1.3%
Belarus	1994	1998	27.3%	6	Mexico	-0.4%	1.8%
Croatia	1995	1997	27.4%	7	Malaysia	-0.4%	2.0%
Mexico	1990	2004	29.1%	8	Croatia	-0.6%	0.4%
COSTA RICA	**1990**	**2004**	**34.2%**	9	Swaziland	-0.7%	3.7%
Mauritius	1990	2003	37.1%	10	Jordan	-0.8%	3.1%
Indonesia	1990	1999	38.2%	11	Mauritius	-1.4%	1.9%
Fiji	1990	1998	39.0%	12	Guatemala	-1.5%	0.8%
Maldives	1990	2003	41.9%	13	Poland	-1.6%	1.3%
South Africa	1990	2004	43.8%	14	Belarus	-1.8%	0.6%
Albania	1995	1998	44.4%	15	Georgia	-2.4%	0.8%
Turkey	1990	2001	44.8%	16	St. Vincent	-2.8%	2.7%
Poland	1994	2001	45.3%	17	Morocco	-2.8%	1.6%
St. Vincent	1990	2001	49.8%	18	**COSTA RICA**	**-3.1%**	**1.0%**
Malaysia	1990	1999	50.2%	19	Tunisia	-3.3%	1.6%
India	1990	2001	53.2%	20	South Africa	-3.7%	2.2%
Tunisia	1990	1999	57.7%	21	Fiji	-5.0%	2.2%
Georgia	1998	2004	61.1%	22	India	-5.7%	0.9%
Panama	1990	2003	63.2%	23	Maldives	-5.8%	3.4%
Russia	1995	1998	77.7%	24	Russia	-5.9%	1.3%
Morocco	1990	2003	78.8%	25	Sri Lanka	-7.7%	1.6%
Lebanon	1993	1999	91.1%	26	Turkey	-8.0%	4.8%
Sri Lanka	1990	2001	95.1%	27	Albania	-10.3%	2.0%
Jordan	1990	2001	122.4%	28	Guyana	-11.2%	8.5%
El Salvador	1990	2000	294.8%	29	El Salvador	-15.2%	8.9%
Guyana	1990	1997	446.6%	30	Lebanon	-17.1%	5.2%
Average			**69.0%**		**Average**	**-3.7%**	**2.6%**

Source: IMF WEO database, IMF IFS database and Levy

ANNEX 2: EXCHANGE RATE CHANGES UNDER DIFFERENT REGIMES

The relevance of exchange rate risk depends on the future volatility of the real exchange rate which may not be well represented by its historical volatility. Movements in the equilibrium real exchange rate may have been followed by movements in the actual real exchange rate with some lag. In this case, the change in international reserves or the rate of growth of output may have provided the adjustment necessary to compensate the imbalances or to keep the external accounts in balance while the real exchange rate failed to adjust immediately to changing external conditions. The real depreciation ρ is defined as the nominal depreciation rate ΔE/E, adjusted by the inflation differential[1]

$$\rho_t = \Delta E_t / E_{t-1} + \pi^*_t - \pi_t \tag{1}$$

In general the shocks that affect the external position of the economy are accommodated through changes in international reserves ΔNIR and by the real depreciation rate ρ. Under a floating exchange rate regime the NIR would stay constant and all the adjustment would be performed by the real depreciation rate (ρ). Of course, the opposite applies to a fixed exchange rate regime in which all the adjustments are carried through changes in net international reserves. The shocks that affect the change in reserves or the exchange rate are represented by deviations from trend of real GDP (y), inflation (π), terms of trade (τ) and the interest rate differential (i-i*). The bar over a variable is used to denote its trend or equilibrium value. In addition, the difference between existing and desired NIR also affect the external adjustment function.

$$\begin{aligned} &\rho_t + \eta_0 \Delta NIR = -\eta_1 (y_t - \bar{y}_t) - \eta_2 (\pi_t - \bar{\pi}_t) + \eta_3 (\tau_t - \bar{\tau}_t) + \\ &\eta_4 (i - \bar{i} - i^* - \bar{i^*}) - \eta_5 (NIR_{t-1} - NIR_t^{\,d}) \end{aligned} \tag{2}$$

The behavior and volatility of the real depreciation rate, ρ, is in part the result of policy decisions determined by the selection of the exchange rate regime, and in part the response to adjustments of the real exchange rate to its equilibrium value.

Crawling peg regime

The crawling peg regime used in Costa Rica to set the exchange rate implies that changes in the nominal exchange rate follow the lagged inflation differential and the desired adjustment in the real exchange rate. Equation (3) presents the rate of exchange rate depreciation, nominal and real, in the context of a crawling peg exchange regime, where p* is international inflation, RER the real exchange rate and RER the equilibrium real exchange rate.

$$\begin{aligned} &\Delta E_t / E_{t-1} = (\pi_{t-1} - \pi^*_{t-1}) + \alpha_1 (RER_{t-1} - \bar{RER})]; \\ &\rho_t = \Delta(\pi - \pi^*) - \alpha_1 (RER_{t-1} - \bar{RER}) \end{aligned} \tag{3}$$

[1]The nominal and real exchange rate is represented as the bilateral rate vis-à-vis the US (E).

Given the crawling peg system, the adjustment to external shocks is mostly carried out through changes in ΔNIR. Replacing (3) in (2) and rearranging terms an expression for the change in NIR can be obtained.

$$\Delta NIR = (1/\eta_0)\{-\eta_1(y_t - \bar{y}_t) - \eta_2(\pi_t - \bar{\pi}_t) + \eta_3(\tau_t - \bar{\tau}_t) + \eta_4[i_t - \bar{i}_t - (i_t^* - \bar{i}_t^*)] - \eta_5(NIR_{t-1} - NIR_t^d) + \alpha_1(RER_{t-1} - R\bar{E}R) - \Delta(\pi - \pi^*)\} \quad (4)$$

The desired level of the net international Reserves will be identified with a desired coverage of NIR of foreign currency deposits. The reserve coverage of foreign currency deposits acts as a deterrent against a run in foreign currency deposits, with υ representing the desired coverage ratio. Assuming that deposits are a fraction μ of money balance M, and considering that foreign currency deposits are a fraction "dd" of total deposits, we can present desired NIR as a function of the degrees of Dollarization (dd) and monetization (m). Where m is the ratio of nominal money balances to nominal GDP (Y).

$$NIR^d{}_t = \upsilon DU\$_t = \upsilon \times dd_t \times D_t = \upsilon \times \mu \times dd_t \times M_t \quad (5)$$

The change in NIR can be presented as a gradual adjustment towards its desired level plus the effect of a collection of random shocks. All the shocks can be represented by a single variable (ζ) with a null expected value, furthermore replacing in (6) the definition of shocks and the value of desired reserves (7).

$$\zeta_t = (1/\eta_0)\{-\eta_1(Y_t - \bar{Y}_t) - \eta_2(\pi_t - \bar{\pi}_t) + \eta_3(\tau_t - \bar{\tau}_t) + \eta_4[i_t - \bar{i}_t - (i_t^* - \bar{i}_t^*)])\} \quad (6)$$

$$\Delta NIR_t = \zeta_t + \alpha_1(RER - R\bar{E}R) - \Delta(\pi - \pi^*) - \eta_5(NIR_{t-1} - \upsilon \times \mu \times dd_t \times M_t) \quad (7)$$

The change in NIR also responds to deviation of the real exchange rate from its equilibrium value, to changes in the inflation differential and to the desired adjustment in reserves. The use of currency intervention to sustain a RER level that deviates from equilibrium by being overly appreciated would represent the loss of important amounts of international reserves. In such an event, reserves would increasingly fall short from the desired level that provides coverage to foreign currency deposits. The change in the net international reserves to GDP ratio is presented in (8). Replacing equation (7) into (8) we can obtain the change in the NIR to GDP ratio (nir) as a function of several shocks, of the past level of NIR and of the desired NIR level. Rearranging terms, we obtain the change in nir under the existing policy regime of crawling peg.

$$\Delta nir_t = \frac{\Delta NIR}{Y_{t-1}} - nir_{t-1}\lambda_t \quad (8)$$

$$\Delta nir_t = \frac{\zeta_t}{Y_{t-1}} + \alpha_1(RER - R\bar{E}R) - \Delta(\pi - \pi^*) + \upsilon \times \mu \times dd_t \times m_t - nir_{t-1}(\eta_5 + \lambda_t) \quad (9)$$

Under the existing policy regime Δnir is subject to significant volatility following the realization of the external shocks, but the trend change in nir over the medium- and long-term continues to be stable

responding to desired reserves. For the trend value of Δnir, the shocks represented by ζ converge to zero as the individual variables go to their trend values. In the long run $\eta_5$converges to one, the real exchange rate to its equilibrium value and domestic and foreign inflation to their trends, consequently the trend change in nir will be associated to the desired level of international reserves.

$$\Delta nir_t = \upsilon \times \mu \times dd_t \times m_t - nir_{t-1}(1+\lambda_t) \tag{10}$$

In this policy regime, the volatility of the rate of real depreciation is a function of the volatility of domestic and foreign inflation and of the volatility of the equilibrium Real Exchange Rate. However the other macroeconomic shocks do not affect the volatility of the rate of real depreciation under the crawling peg. They only affect the changes in net international reserves.

$$Var(\rho_t) = f[Var\Delta(\pi - \pi^*), Var(\bar{RER})] \tag{11}$$

Floating exchange rate regime

Under a floating exchange regime the change in NIR will be zero and the changes in the real exchange rate ρ the variable that will adjust in response to the shocks. Considering once again the different shocks and imposing the condition of null change in reserves, the external adjustment can be written as.

$$\begin{aligned} \rho_t = &-\eta_1(y_t - \bar{y_t}) - \eta_2(\pi_t - \bar{\pi}_t) + \eta_3(\tau_t - \bar{\tau}_t) + \eta_4[i_t - \bar{i} - (i_t^* - \bar{i}^*)] \\ &- \alpha_1(RER_{t-1} - \bar{RER}) \end{aligned} \tag{12}$$

Alternative exchange rate regime

The short-term volatility of the rate of real depreciation has been dampened through the monetary-cum-exchange rate arrangement prevailing in Costa Rica, but under an alternative exchange rate regime the volatility of the real depreciation rate would be enhanced. The level of the net international reserves would not play any significant role, and in addition, no coverage of NIR of foreign currency deposits would be considered. Further considering that all the shocks in (13) can be represented by a single variable ζ with a null expected value, the increased volatility of ρ should help to contain dollarization.

$$\xi_t = -\eta_1(y_t - \bar{y_t}) - \eta_2(\pi_t - \bar{\pi}_t) + \eta_3(\tau_t - \bar{\tau}_t) + \eta_4[i_t - \bar{i} - (i_t^* - \bar{i}^*)] \tag{13}$$

$$\rho_t = \xi_t - \alpha_1(RER_{t-1} - \bar{RER}) \tag{14}$$

The containment of Dollarization is important not only because of the associated currency mismatches in loan portfolios, but also because of liquidity risk. The NIR coverage of foreign currency deposits has been declining because of the rapid dollarization in private banks. Additional international reserve accumulation to increase the reserve coverage of foreign currency deposits would have important implications for the quasi-fiscal losses of the Central Bank.

The change of the exchange regime towards a more flexible one would help contain dollarization and would reduce the need for holding high levels of international reserves. Lower NIR would alleviate the pressure on the quasi-fiscal losses of the Central Bank, and, more importantly, it would result in lower secondary currency mismatches in the banking system through a lower level of foreign currency lending. As is being shown in the report, dollarization in Costa Rica responds not only to the volatility of the exchange rate, but also primarily to the volatility of inflation. Exchange rate flexibility in Costa Rica would be supported by the lower inflation that would be possible in a currency regime that allows the Central Bank to focus its energies and capabilities on price stabilization rather than exchange rate stabilization. The pay-offs of such a shift in regime could be very important in reducing dollarization and the vulnerabilities associated with the financial system.

ANNEX 3: METHODOLOGY USED IN THE ECONOMETRIC CALCULATIONS FOR PUBLIC DEBT DYNAMICS, REQUIRED PRIMARY SURPLUS UNDER UNCERTAINTY, MACROECONOMIC VAR AND MONTE CARLO SIMULATION

The subsequent sections of this annex presents the methodology used in econometric estimates of money demand; public debt dynamics in Costa Rica; the required primary surplus in conditions of uncertainty; the calculation of the macroeconomic vector auto-regression (VAR) for Costa Rica; and the Monte Carlo Simulation.

1. Money Demand

Table A3.1: Unit Root Test for Money Demand Variables

Serie	Augmented Dickey Fuller	Phillips Perron	Test Equation include
LOG M1	I(1)	I(0)	Trend-Constant
LOG M2	I(1)	I(1)	Trend-Constant
LOG GDP	I(1)	I(1)	Trend-Constant
Inflation	I(1)	I(1)	Constant
Dollarization	I(1)	I(1)	Trend-Constant
Primary Nominal Interest Rate on Deposits	I(1)	I(1)	Constant
Primary Real Interest Rate on Deposits	I(1)	I(1)	Constant
30 Days Deposit Interest Rate (C$), Privates Banks	I(1)	I(1)	Constant
30 Days Deposit Interest Rate (C$), Public Banks	I(0)	I(0)	Constant

Source: Staff calculations

The search for co-integration vectors was carried out using Johansen's test, correspondingly one vector at 1% significance was found for M1 and one at 5% significance for M2. The normalized co integration vectors are presented with the Standard errors between brackets. They represent the long-run relationship for money demand. Once again financial Dollarization exerts a significant effect only in the demand for M1 and the elasticity of money demand with respect to GDP is not different from one. To represent money demand a simplified version of the equation for M1 will be used imposing unitary income elasticity.

$$Log\ M1 = -1.5728 + 1.1287\ Log\ PIB - 1.6150\ Dollar\ Fin. - 0.0486\ TPCE\_30$$
$$(0.9893)\ (0.0842) \qquad (0.6307) \qquad (0.0078)$$

2. Public Debt Dynamics in Costa Rica

For the purpose of this report Public Debt is defined as comprising the debt of the Central Government and of the Central Bank. The Central Government and the Central Bank debt represent more almost 90 percent of total public debt and the dynamics and risk to debt sustainability can be well represented by this definition of total public debt. In equation (1) BG(t), BC(t) and BP(t) represent the nominal stocks of debt of the Central Government, Central Bank and the addition of both defined as public sector, at the end of period (t), respectively.

$$BP_t = BC_t + BG_t \tag{1}$$

In equations (2) and (3) BGC$ and BCC$ represent the debt denominated in domestic currency (Colones) of the Central Government and Central Bank, respectively. Similarly, BGU$ and BCU$ represent the debt denominated in foreign currency (US dollars) of the Central Government and Central Bank. E represents the nominal exchange rate measured in Colones per US dollar.

$$BG_t = BGC\$_t + E_t \times BGU\$_t \tag{2}$$

$$BC_t = BCC\$_t + E_t \times BCU\$_t \tag{3}$$

It is assumed that the Central Bank does not provide any financing to the government nor accumulates other forms of domestic credit, using all monetary financing available to cover its quasi-fiscal losses or repay debt. Then, as presented in (4) the change in Central Bank debt is defined by the difference between the accumulation of international reserves (Δ NIR), and the expanded quasi-fiscal balance (QF) and the monetary financing (MF). If the Central Bank were to provide any financing to the government or accumulate other forms of domestic credit, there would be a discrete increase in Central Bank debt, additional to that represented in (4).

$$\Delta BC_t = -QF_t + E_t \times \Delta NIR_t - MF_t \tag{4}$$

The expanded quasi-fiscal balance includes in addition to interest earnings from the reserves and interest payments for the debt, the central bank primary surplus and the capital gains and losses owing to the depreciation of the currency. The latter term is not included in the official accounting for the quasi-fiscal balance, however is needed in order to have an adequate track of debt dynamics for the Central Bank. Equation (5) presents the expanded quasi-fiscal balance where δ is the sovereign premium on foreign currency debt, i the domestic currency nominal interest rate and i* the foreign currency interest rate. Changes in the nominal exchange rate are represented by ΔE, from which capital gains and losses are derived. Finally, PSC represents the primary surplus of the Central Bank that includes earnings other than interest on central bank reserves minus expenses other than interest payments on central bank debt, mostly operational expenses of the Central Bank. Monetary financing includes the seignorage and the inflation tax. It is a function of money demand in a dollarized environment, and the inflation rate that is tolerated by the policy makers.

$$\begin{aligned} QF_t = & -BCC\$_{t-1}[i_t] - E_t \times BCU_{t-1}\$[i^*_t + \delta_t + \Delta E_t / E_t] \\ & + E_t \times NIR_{t-1}[i^*_t + \Delta E_t / E_t] - PSC_t \end{aligned} \tag{5}$$

The dynamics of Central Bank debt is a function of nominal interest rates in domestic and foreign currency, the sovereign spread, the nominal depreciation rate, existing reserves and reserve accumulation,

monetary financing and the bank's primary surplus. The current level of Central Bank debt increases above the previous period debt due to the interest payments and valuation changes associated to debt plus any increase of net international reserves. The debt level is reduced by the interest receipts and valuation changes generated by the existing NIR by monetary financing and by the primary surplus of the Central Bank (PSC). The debt dynamics of the Central Bank could be represented by ratios to GDP of the different variables involved. Representing ratios to GDP by lower cases, the Central Bank debt as a ratio to GDP (bc) can be described as a function of last period ratios to GDP of domestic and foreign currency debt (bcc$ and bcu$), net international reserves (nir), the change in the net international reserve ratio (Δnir), the domestic currency and foreign currency real interest rate (r and r*), the sovereign premium (δ), the rate of real depreciation (ρ) and the rate of real GDP growth (λ). In addition the debt ratio depends on the current GDP ratios of the central bank primary surplus and monetary financing (psc and mf). The actual dynamics of Central Bank debt over the last few years can be reasonable represented by equation (6).

$$BC_t = BCC\$_{t-1}[1+i_t] + E_t \times BCU\$_{t-1}[1+i^*_t + \delta_t + \Delta E_t / E_t] - E_t \times NIR_{t-1}[1+i^*_t + \Delta E_t / E_t] + E_t \times \Delta NIR_t - MF_t - PSC_t \quad (6)$$

$$bc_t = bcc\$_{t-1}\frac{[1+r_t]}{(1+\lambda_t)} + bcu\$_{t-1}[\frac{1+r^*_t+\delta_t+\rho_t}{(1+\lambda_t)}] - \frac{nir_{t-1}[-\lambda_t + r^*_t + \rho_t]}{(1+\lambda_t)} + \Delta nir_t - mf_t - psc_t \quad (7)$$

Similarly to the Central Bank Debt, the change in Central Government debt is defined by the fiscal balance (FB) and the valuation changes of the foreign currency debt, which is not included in the fiscal balance. The fiscal balance includes the primary surplus PSG minus the interest payments for the debt, where δ, i and i* are the sovereign premium the domestic and the foreign currency nominal interest rates, which are assumed equal to the equivalent Central Bank variables.

$$\Delta BG_t = \Delta E_t \times BGU\$_{t-1} - FB_t \quad (8)$$

$$FB_t = -BGC\$_{t-1}[i_t] - E_t \times BGU\$_{t-1}[i^*_t + \delta_t] + PS_t \quad (9)$$

$$BG_t = BGC\$_{t-1}[1+i_t] + E_t \times BGU\$_{t-1}[1+i^*_t + \delta_t + \Delta E_t / E_{t-1}] - PSG_t \quad (10)$$

The dynamics of the government debt can be represented by an expression associated to debt in the previous period, the relevant interest rates, the depreciation rate and the primary surplus. The debt dynamics can be represented for the debt to GDP ratio. The Central Government debt ratio can be described as a function of last period ratios to GDP of domestic and foreign currency debt (bgc$(t-1) and bgu$(t-1)), the domestic and foreign real interest rate (r and r*), the rate of real depreciation (□), the sovereign premium, and the rate of real GDP growth (□). In addition the debt ratio depends on the current primary surplus as a percent of GDP

$$bg_t = bgc\$_{t-1}\frac{[1+r_t]}{(1+\lambda_t)} + bgu\$_{t-1}[\frac{1+r^*_t+\delta_t+\rho_t}{(1+\lambda_t)}] - psg_t \quad (11)$$

An expression for the dynamics of aggregate public Sector debt can be derived by adding up the expressions for the debt ratio of the central bank and of the central government. The dynamics of public debt is a function of policy variables under the control of the authorities, and of variables subject to macroeconomic uncertainty.

$$bp_t = bpc\$_{t-1}\frac{[1+r_t]}{(1+\lambda_t)} + bpu\$_{t-1}[\frac{1+r^*_t+\delta_t+\rho_t}{(1+\lambda_t)}]$$

$$-\frac{nir_{t-1}[-\lambda_t+r^*_t+\rho_t]}{(1+\lambda_t)} + \Delta nir_t - mf_t - psg_t - psc_t \quad (12)$$

Among the policy variables are the level of international reserves, the primary surplus of the Central Government and Central Bank and monetary financing. These variables have some endogenous responses to macroeconomic conditions; however they can be controlled or targeted to a significant extent through policy actions. Now, the aggregate primary surplus for the adopted definition of the public sector is mostly the result of the Central government efforts, with the Central Bank generating a small primary deficit.

Variables out of the control of the authorities and subject to macroeconomic uncertainty are the domestic and foreign real interest rates, the rate of real depreciation, the sovereign premium, and the rate of real economic growth. The annual values of the macroeconomic variables are subject to significant uncertainty, real economic growth (λ) over the last five years has been as high as 6 percent and as low as 1 percent; the sovereign spread (δ) fluctuates between 200 and 400 basis points; the rate of real depreciation has varied between a positive 4 percent and negative 2 percent. Finally, the implicit real interest cost of public debt (γ) has reached above 10 percent, but also has been as low as 5 percent.

The implicit real cost of public debt is a weighted average between the implicit real cost of domestic currency and foreign currency denominated public debt. The real interest rates presented are all ex-post, that is are computed using actual inflation rather than expected inflation as in the case of the ex ante real interest rates. The implicit cost of public debt denominated in domestic currency of period t is obtained by dividing the interest payments in domestic currency during period t by the end of period debt level in t-1. The nominal interest rate is transformed into real rates using the actual inflation rate of period t. The implicit real rate for debt denominated in foreign currency is obtained in a similar fashion; the implicit nominal rate is transformed into real rate using the actual inflation rate. The implicit real cost in foreign currency denominated debt is equivalent to the market real interest rate in foreign currency (r*) plus the sovereign spread of Costa Rica (δ) and plus the effective rate of real depreciation (ρ).

The expression can be further simplified by assuming that foreign currency debt represents a constant fraction ϕ of total debt and defining the public sector primary surplus (pps) including the primary surpluses of the central bank psc and the central government psg.

$$bp_t = bp_{t-1}\{(1-\phi)\frac{[1+r_t]}{(1+\lambda_t)} + \phi[\frac{1+r^*_t+\delta_t+\rho_t}{(1+\lambda_t)}]\}$$

$$-\frac{nir_{t-1}[-\lambda_t+r^*_t+\rho_t]}{(1+\lambda_t)} + \Delta nir_t - mf_t - pps_t \quad (13)$$

It can be solved for the primary surplus consistent with debt sustainability, as derived in section 3 of this annex.

$$pps_t = \frac{bp\{-\lambda_t + (1-\phi)r_t + \phi[r^*_t + \delta_t + \rho_t]\}}{(1+\lambda_t)} - \frac{nir_{t-1}[-\lambda_t + r^*_t + \rho_t]}{(1+\lambda_t)} + [\Delta nir_t - mf_t] \quad (14)$$

The intent is to find trend policy targets that will deliver stability. Consequently, the primary surplus, the change in international reserves and monetary financing will be expressed in their trend or permanent values. Furthermore, the average real cost of public debt is the weighted average of the real interest rate paid for the debt in domestic currency and the real rate paid by the debt in foreign currency. The average real cost of debt will be designed γ.

$$\gamma_t = +(1-\phi)r_t + \phi[r^*_t + \delta_t + \rho_t] \quad (15)$$

Substituting the average real cost of debt in the expression for the required primary surplus.

$$pps = \frac{bp_{t-1}(-\lambda_t + \gamma_t)}{(1+\lambda_t)} - \frac{nir_{t-1}[-\lambda_t + r^*_t + \rho_t]}{(1+\lambda_t)} + \Delta nir_t - mf_t \quad (16)$$

The required primary surplus is an increasing function of the level of public debt, of the average cost of real debt in excess of economic growth, and of reserve accumulation. The required primary surplus is a decreasing function of the net international reserves, of the rate of return of reserves in excess of the growth of the economy, and of monetary financing. Accordingly the required primary surplus varies over time, depending on the value taken by the different variables.

In order to define a policy target for the primary surplus that could be followed permanently the different variables will be replaced by their trend values. This will include the variables subject to macroeconomic uncertainty out of the control of the authorities (λ, γ, r*, ρ) and those variables that can be targeted through policies (Δnir and mf). We will assume that the trend monetary financing (mf) will be defined basically through the selection of a target for the inflation rate, and that the change in the ratio of international reserves to GDP will be equal to zero[2].

$$pps = \frac{bp_{t-1}(-\lambda + \gamma)}{(1+\lambda)} - \frac{nir_{t-1}[-\lambda + r^* + \rho]}{(1+\lambda)} - mf \quad (17)$$

Under each level of initial debt and under each policy strategy that defines the level of monetary financing, mf, the required primary surplus is different. Given the policy strategy the required primary surplus varies with the average cost of debt, the growth rate of the economy, the external real interest rate and the rate of currency depreciation. A probability function can be defined for the required primary surplus on the basis of the probability distributions of defining macroeconomic variables (γ,r*,ρ,λ).

[2] The trend changes in the reserves to GDP ratio could not be very different from zero so that it would not imply mayor changes in the result. However, considering them would add unnecessary complications to the computation of the required primary surplus.

The required primary surplus and the debt dynamics can also be simulated using the historical trajectories of the policy and macroeconomic variables. Given that the different variables are subject to uncertainty, the required primary surplus will be calculated with an associated probability that with such a surplus, the level of debt will be stable. The underlying macroeconomic uncertainty may result in debt becoming unsustainable even at those levels of the primary surplus. The outcomes form that results could be either another adjustment that would then produce debt sustainability or, alternatively, a debt crisis and default.

3. The Required Primary Surplus for Debt Sustainability

We can define the discount factor for public sector debt (1+β(t)), which depends on the domestic and foreign real interest rates, the sovereign premium, the growth rate and the rate of real depreciation. For the existence of a stable solution the discount factor β has to be positive implying that the real cost of debt has to exceed the real growth rate of the economy.

$$(1) \qquad [1+\beta_t] = \{(1-\phi_t)\frac{[1+r_t]}{(1+\lambda_t)} + \phi_t[\frac{1+r^*_t+\delta_t+\rho_t}{(1+\lambda_t)}]\} > 1$$

Replacing the discount factor in the debt dynamics equation presented in section IV.

$$(2) \qquad bp_t = bp_{t-1}[1+\beta_t] - \frac{nir_{t-1}[-\lambda_t + r^*_t + \rho_t]}{(1+\lambda_t)} + \Delta nir_t - mf_t - pps_t$$

Whether the debt dynamics are unstable or not is difficult to discuss in this setting where all macroeconomic variables are changing period by period. Under the assumption of a constant discount factor–that is constant interest rates, a constant real depreciation rate, and a constant growth rate–it is possible to write the debt dynamics equation as follows.

$$(3) \qquad bp_t = bp_{t-1}[1+\beta] - \frac{nir_{t-1}[-\lambda + r^* + \rho]}{(1+\lambda)} + \Delta nir_t - mf_t - pps_t$$

Lagging the equation once

$$(4) \qquad bp_{t-1} = bp_{t-2}[1+\beta] - \frac{nir_{t-2}[-\lambda + r^* + \rho]}{(1+\lambda)} + \Delta nir_{t-1} - mf_{t-1} - pps_{t-1}$$

Replacing the expression for lagged debt ratio:

$$(5) \qquad \begin{aligned} bp_t = {} & bp_{t-2}[1+\beta]^2 - \frac{[nir_{t-1} + (1+\beta)nir_{t-2}][-\lambda + r^* + \rho]}{(1+\lambda)} \\ & + \Delta nir_t + (1+\beta)\Delta nir_{t-1} - mf_t - (1+\beta)mf_{t-1} - pps_t - (1+\beta)pps_{t-1} \end{aligned}$$

Further replacing lagged values of the debt expression until the nth one.

$$bp_t = bp_{t-N}[1+\beta]^N - \frac{[-\lambda + r^* + \rho]}{(1+\lambda)} \sum_{i=0}^{N} (1+\beta)^i nir_{t-i-1}$$

(6)
$$+ \sum_{i=0}^{N} (1+\beta)^i \Delta nir_{t-i} - \sum_{i=0}^{N} (1+\beta)^i mf_{t-i} - \sum_{i=0}^{N} (1+\beta)^i pps_{t-i}$$

Multiplying the whole expression by $[1+\beta]^{-N}$ we obtain the present value of future debt as a function of the original value of debt minus the discounted value of the stream of debt payments**.** The sources for debt payments include the stream of primary surpluses, the earnings of international reserves net of reserve accumulation, and monetary financing.

$$bp_t[1+\beta]^{-N} = bp_{t-N} - \frac{[-\lambda + r^* + \rho]}{(1+\lambda)} \sum_{i=0}^{N} (1+\beta)^{i-N} nir_{t-i-1}$$

(7)
$$+ \sum_{i=0}^{N} (1+\beta)^{i-N} \Delta nir_{t-i} - \sum_{i=0}^{N} (1+\beta)^{i-N} mf_{t-i} - \sum_{i=0}^{N} (1+\beta)^{i-N} pps_{t-i}$$

The same expression is easier to understand if we consider that period t is the Nth period.

$$bp_N[1+\beta]^{-N} = bp_0 - \frac{[-\lambda + r^* + \rho]}{(1+\lambda)} \sum_{i=0}^{N} (1+\beta)^{i-N} nir_{N-i-1}$$

(8)
$$+ \sum_{i=0}^{N} (1+\beta)^{i-N} \Delta nir_{N-i} - \sum_{i=0}^{N} (1+\beta)^{i-N} mf_{N-i} - \sum_{i=0}^{N} (1+\beta)^{i-N} pps_{N-i}$$

The transversality condition requires that the present value of debt at period N should converge to zero as N goes to infinite. Given the transversality condition, the value of the initial debt bp (0) is equal to the discounted value of the stream of net debt payments taking place from period 0 to period N. Net debt payments are defined by the primary surplus plus the interest receipts on reserves plus monetary financing, net of the increase in the international reserves ratio.

$$\lim_{n->\infty} bp_N[1+\beta]^{-N} = 0 \Rightarrow$$

(9)
$$bp_0 = \lim_{n->\infty} \sum_{i=0}^{N} (1+\beta)^{i-N} \{ \frac{[-\lambda + r^* + \rho]}{(1+\lambda)} nir_{N-i-1} - \Delta nir_{N-i} + mf_{N-i} + pps_{N-i} \}$$

For the transversality condition to hold, the discounted value of the primary surplus stream should be equal or greater than the minimum or required stream of primary surplus, properly discounted. The required discounted value of the stream of primary surplus depends on the initial level of debt, and the discounted income stream of interest earning and valuation changes on reserves, the discounted value of reserve accumulation and the discounted value of monetary financing.

$$bp_0 - \lim_{n->\infty} \sum_{i=0}^{N} (1+\beta)^{i-N} \{ \frac{[-\lambda + r^* + \rho]}{(1+\lambda)} nir_{N-i-1} - \Delta nir_{N-i} + mf_{N-i} \} \leq$$

(10)

$$\lim_{n->\infty} \sum_{i=0}^{N} (1+\beta)^{i-N} pps_{N-i}$$

A discounted value of a stream of payments can be a complex concept. Much clearer is a level of the primary surplus as a percent of GDP that has to be maintained permanently. The Required Primary Surplus is the trend value of the primary surplus that will stabilize the debt to GDP ratio. It is conditional on the value of other policies and of macroeconomic variables, which are subject to uncertainty. Imposing that the debt ratio stays constant or falls from period t-1 to period t and using equation (42).

$$bp_{t-1} = bp_{t-1} \{ (1-\phi) \frac{[1+r_t]}{(1+\lambda_t)} + \phi [\frac{1+r^*_t + \delta_t + \rho_t}{(1+\lambda_t)}] \}$$

(11)

$$- \frac{nir_{t-1}[-\lambda_t + r^*_t + \rho_t]}{(1+\lambda_t)} + \Delta nir_t - mf_t - pps_t$$

Solving for the constant debt level

$$bp_{t-1} \{ 1 - [(1-\phi) \frac{[1+r_t]}{(1+\lambda_t)}] - \phi [\frac{1+r^*_t + \delta_t + \rho_t}{(1+\lambda_t)}] \} =$$

(12)

$$- \frac{nir_{t-1}[-\lambda_t + r^*_t + \rho_t]}{(1+\lambda_t)} + \Delta nir_t - mf_t - pps_t$$

Multiplying both sides of by $(1+\lambda_t)$ and rearranging terms

$$bp\{\lambda_t - (1-\phi) r_t - \phi [r^*_t + \delta_t + \rho_t]\} =$$

(13)

$$- nir_{t-1}[-\lambda_t + r^*_t + \rho_t] + (1+\lambda_t)[\Delta nir_t - mf_t - pps_t]$$

Multiplying by -1 and solving for the primary balance

$$- bp\{\lambda_t - (1-\phi) r_t - \phi [r^*_t + \delta_t + \rho_t]\} - nir_{t-1}[-\lambda_t + r^*_t + \rho_t]$$

(14)

$$+ (1+\lambda_t)[\Delta nir_t - mf_t] = (1+\lambda_t) pps_t$$

Rearranging terms

$$pps_t = \frac{bp\{-\lambda_t + (1-\phi) r_t + \phi [r^*_t + \delta_t + \rho_t]\}}{(1+\lambda_t)} - \frac{nir_{t-1}[-\lambda_t + r^*_t + \rho_t]}{(1+\lambda_t)}$$

(15)

$$+ [\Delta nir_t - mf_t]$$

4. Estimate of the Macroeconomic VAR

The vector auto-regression is commonly used in forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The VAR approach sidesteps the need for structural modeling by treating every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system.

The mathematical representation of a VAR is:

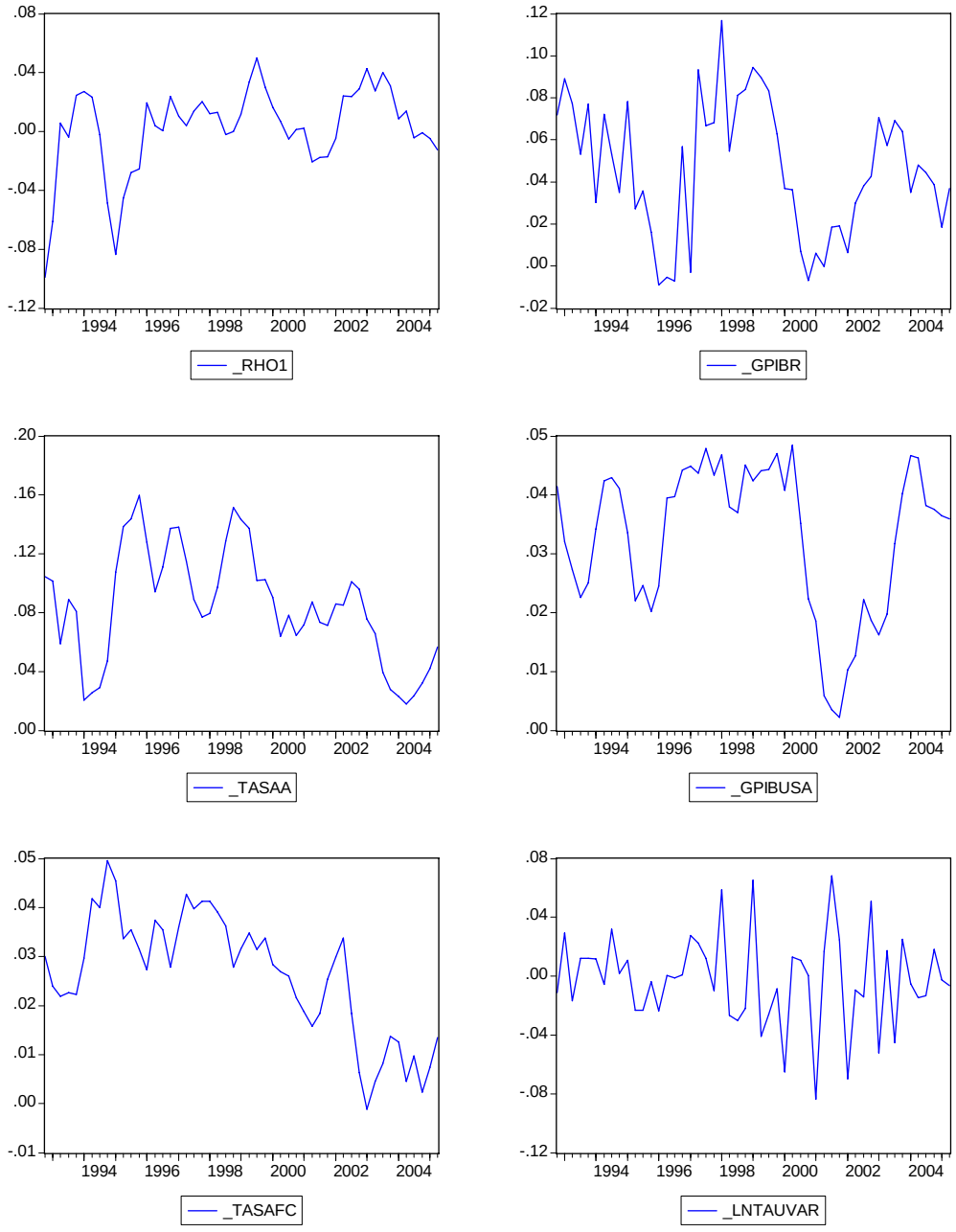
$$(1) \qquad y_t = B_1 y_{t-1} + \ldots + B_p y_{t-p} + Ax_t + u_t$$

where Y_t is a k_1 vector of endogenous variables, X_t is a k_2 vector of exogenous variables, B_i and A are matrices of coefficients to be estimated and u_t is a vector of innovations.

In order to capture the macroeconomics dynamics of Costa Rica a Vector Auto Regression model (VAR) was estimated for the rate of growth of real GDP, the real interest rate and the rate of real depreciation as endogenous variables. Exogenous variables included in the VAR were the rate of growth of real GDP in the US, the real rate of interest of 5-year US Treasury Bonds, and the log difference of the Costa Rican terms of trade. A first approach also considered using the sovereign risk (δ) as the fourth endogenous variable. However, data limitations (lack of EMBI series for Costa Rica) and limitations of the model (public debt is not included to explain the premium) yielded unsatisfactory results. Finally, it was chosen not to include δ in the VAR and to present scenarios based in different values of this variable

The real interest rate in domestic currency was represented by the Basic Liability Rate in Colones, calculated by the Central Bank of Costa Rica, and deflated using the inflation rate of the following month. Since the model required a representative rate of the implicit cost of the public debt in domestic currency, the calculated real rate was adjusted by adding a constant 2% to the series used in the estimation of the VAR. This adjustment represents the difference between the implicit interest rate cost of the domestic currency debt and the basic rate.

Figure A 3.1 Variables used in the Macroeconomic VAR for Costa Rica



The inclusion of non-stationary series can be the origin of complexities in the estimation of a VAR of finite order, due to the existence of a stable relationship between the variables which would then depend exclusively on the existence of a co integration relation. Tests of unitary root were carried out for each one of the variables that were included in the VAR, both endogenous and exogenous. The test considered were Phillips-Perron and Elliot-Rothenberg Stock DF - GLS, both reportedly more powerful in the detection of unitary roots than the traditional augmented Dickey Fuller (ADF). All the tests considered the inclusion of a constant. The results indicated that with the exception of the terms of trade, all variables are integrated of order zero.

Figure A 3.2

Costa Rica VAR Unit Root Tests
Orthogonalization: Residual Covariance
Sample: 1992Q4 2005Q2
H_o: Serie has a unit root

Serie	ADF (P-Value)	PP (P-Value)
_GPIBR	0.0078	0.0011
_TASAA	0.3581	0.1649
_RHO1	0.0756	0.0125
_GPIBUSA	0.3405	0.1960
_TASAF	0.7418	0.5558
_LNTAU	0.5836	0.6432

Costa Rica VAR Unit Root Tests
Elliott-Rothenberg-Stock DF-GLS test statistic
Sample: 1992Q4 2005Q2
H_o: Serie has a unit root

Serie	t-statistic	5% Critical	10% Critical
_TASAA	-1.6838	-1.9474	-1.6127
_GPIBUSA	-1.6423	-19474	-1.6127
_TASAF	-1.8887	-1.9474	-1.6127
_LNTAU	-1.4304	-1.9474	-1.6127

In order to select the order of lags in the VAR, various criteria as well as diagnostic checking and normality test were considered. The different model specifications were compared using information criteria. In addition, a sequential likelihood ratio test, that contrasts if the coefficients over and above the lag considered are jointly different of zero, was also applied. This last test indicated that the optimum VAR lag was of order 2.

Figure A 3.3 Likelihood Ratio Test

Lag	LogL	LR
1	433.9303	83.45964
2	450.0265	19.31550*
3	465.4119	16.61619
4	472.8666	7.156533

The estimated VAR(2) also included third lags for the growth of US GDP and fourth lags for the international real interest rate and for the change in the terms of trade. It was considered that growth in the United States and international interest rate had a slow effect on the real variables of Costa Rica - or with a lag of two quarters to a year. In addition, a dummy variable was included to capture the large real appreciation of the domestic currency in 1994.

The presence of residual autocorrelation and heteroskedasticity were analyzed together with the normality of the VAR residuals. In the heteroskedasticity analysis the test of White (without crossed terms) was applied, which did not reject the null hypothesis of no heteroskedasticity. To test for possible autocorrelation of the residuals of LM, Breusch-Godfrey was applied, which indicated possible autocorrelation of order one and three.

Figure A 3.4

Costa Rican VAR Residual Heteroskedasticity
No Cross Terms
Sample: 1992Q4 2005Q2
H_0: no heteroskedasticity

	Chi-square	Prob.
Joint test:	6.1547	0.7243

Costa Rican VAR Residual Serial Correlation LM Test
Sample: 1992Q4 2005Q2
H_0: no serial Correlation al lag order h

Lags	LM-Statistic	P-value
1	29.8642	0.0005
2	6.4087	0.6984
3	17.4484	0.0421
4	12.2208	0.2011
5	3.6520	0.9328
6	3.6682	0.9319
7	6.4403	0.6952

In the normality tests the third and fourth moment of the residuals were analyzed separately, as well as jointly by means of the Jarque-Bera statistics. The analysis indicated that the residuals do not have a coefficient of asymmetry (skewness) statistically different from a normal distribution, but they have narrower tails. This is reflected in a coefficient of kurtosis smaller to three as much for each equation of the system and for the system. This last one is reflected in the rejection of normality of the residuals by means of the Jarque-Bera test. It must be noted that in the simulations carried out, it is not recommended to use normal errors, but rather to use the empirical distributions and to construct the shocks of the simulations by means of some method of re sampling like bootstrap.

Figure A 3.5

Costa Rican VAR Normality Tests
Orthogonalization: Residual Covariance
Sample: 1992Q4 2005Q2
H_0: Residuals are multivariate normal

Component	Skewness	P-value
1	-0.0800	0.8048
2	-0.1046	0.7466
3	-0.1079	0.7389
Joint		0.9644

Figure A 3.6

Costa Rican VAR Normality Tests
Orthogonalization: Residual Covariance
Sample: 1992Q4 2005Q2
H_0: Residuals are multivariate normal

Component	Kurtosis	P-value
1	1.2764	0.0067
2	0.8485	0.0006
3	1.4238	0.0138
Joint		0.0000

Costa Rican VAR Normality Tests
Orthogonalization: Residual Covariance
Sample: 1992Q4 2005Q2
H_0: Residuals are multivariate normal

Component	Jarque-Bera	P-value
1	7.4075	0.0246
2	11.8796	0.0026
3	6.1725	0.0457
Joint		0.0167

Figure A 3.7

Costa Rican Pairwise Granger Causality / Block Exogenity Wald test
Sample: 1992Q4 2005Q2
H_0: Serie Precede Staticaly

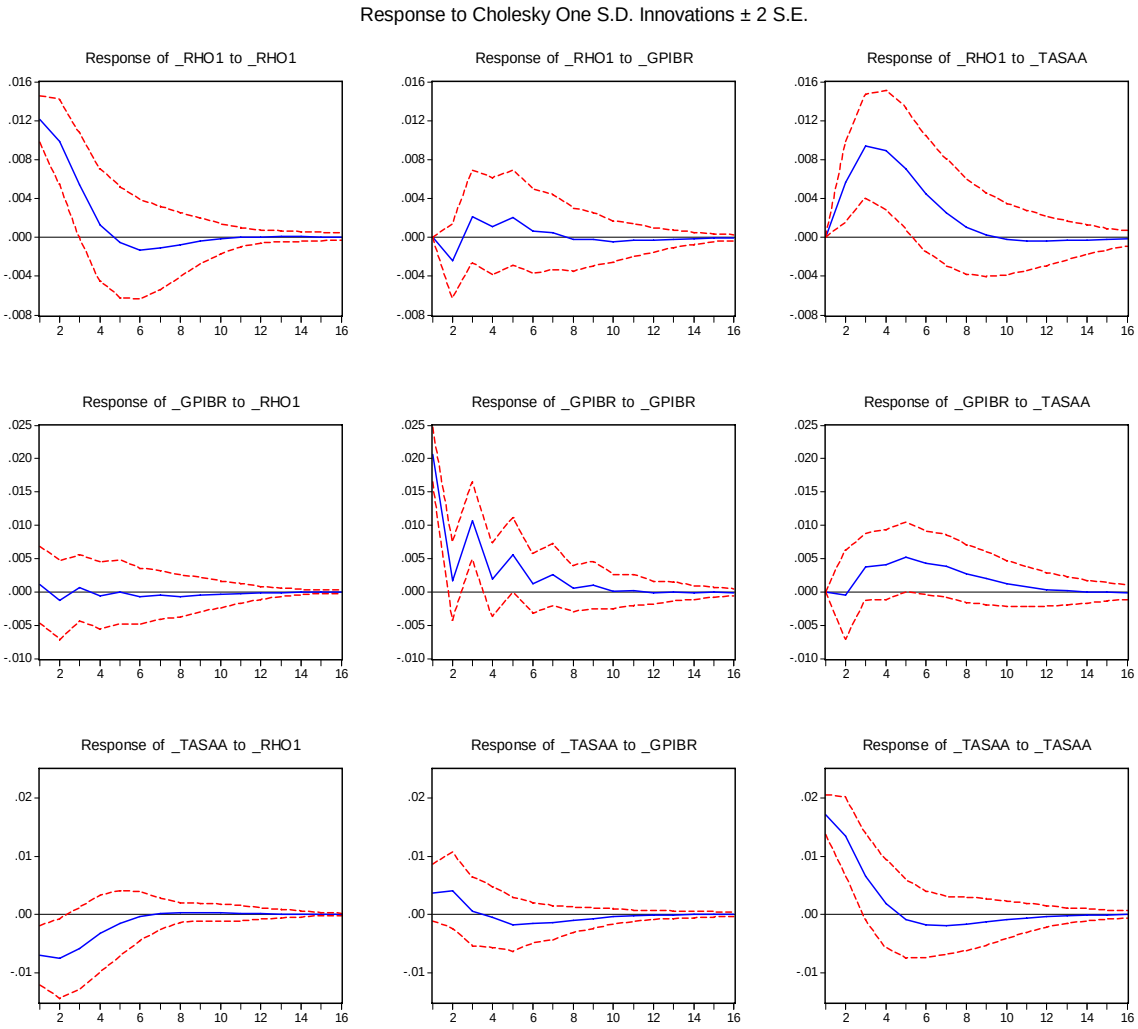
Serie	Chi-Square	P-Value
_RHO1		
_GPIBR	7.3475	0.0254
_TASAA	12.7362	0.0017
All	20.3363	0.0004
_GPIBR		
_RHO1	3.1514	0.2069
_TASAA	2.4597	0.2923
All	5.9693	0.2015
_TASAA		
_RHO1	1.0592	0.5888
_GPIBR	1.1481	0.5632
All	1.9620	0.7428

The effects of a time shock on current and futures values of the endogenous variables are traced by impulse response functions. To calculate the impulse responses Cholesky decomposition was used. The order of the endogenous variables in the response impulse calculation is relevant because it determines the way that specific shocks affect the other entire endogenous variables thorough dynamic.

The ordering of variables consisted in placing those considered more exogenous in the first places, leaving to the last places those that could be considered closer to be endogenous variables. The ordering,

presented below, was decided on the basis of Granger causality tests to check the statistical precedence of the variables. Accordingly the variables were aligned in the following order:

Figure A 3.8 Impulse Responses of the Macroeconomic VAR for Costa Rica



The impulse response functions derived from the estimated VAR show that the endogenous variables do not in general respond to innovations in other endogenous variables, with the exception of ρ**.** The rate of real depreciation ρ presents a positive and significant response to innovations in the real interest rate.

Table A3.2 Costa Rica: Estimation Results of the Macroeconomic Vector Auto-Regression (VAR) Model

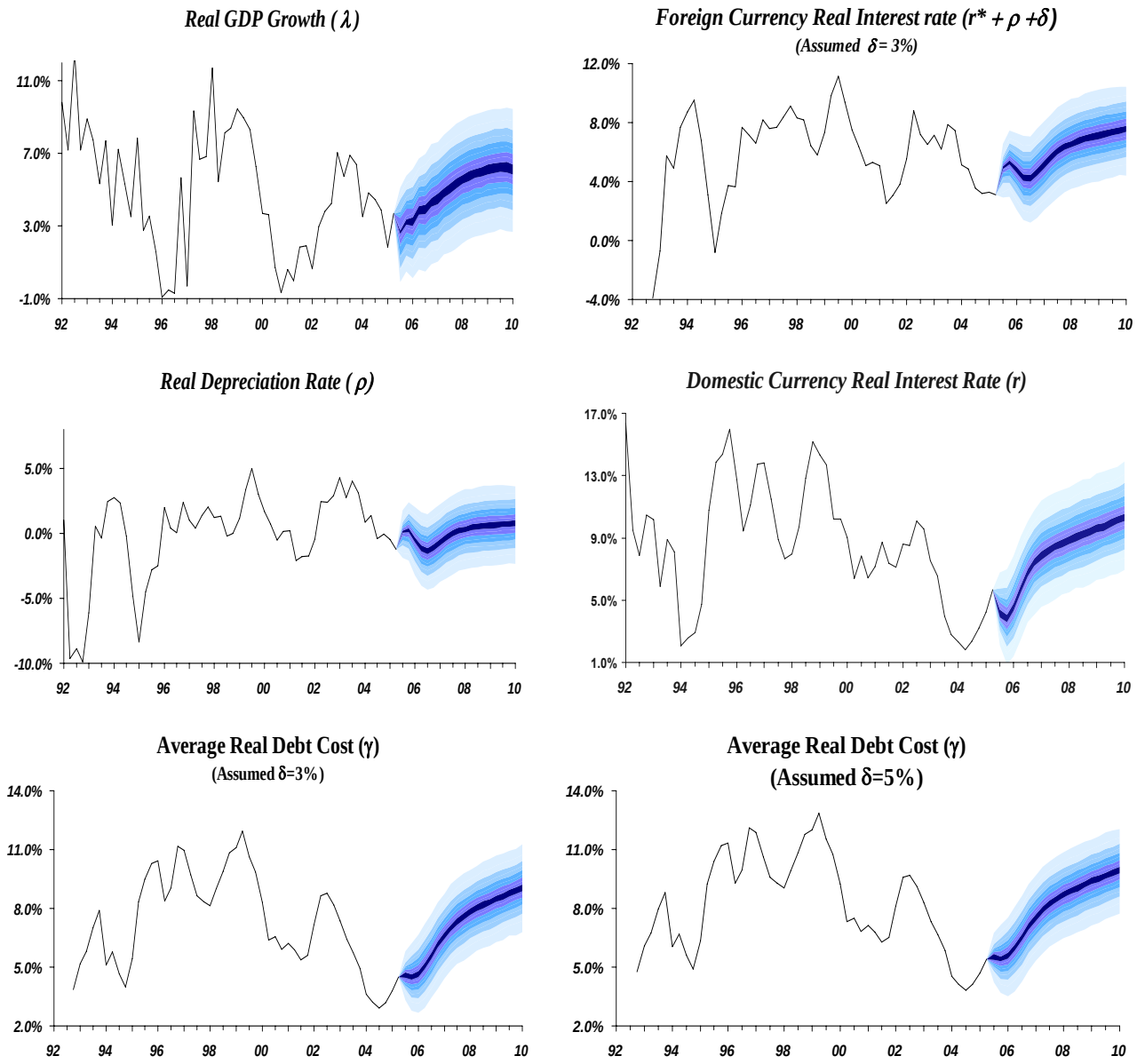
Costa Rican Macroeconomics VAR Sample: 1992Q4 2005Q2 Endogenous Variable Effects	ρ	λ	r
constant	0.000 [-0.07198]	0.012 [1.08366]	0.011 [1.02337]
ρ(–1)	1.014 [6.89378]	-0.127 [-0.50848]	-0.176 [-0.77087]
ρ(–2)	-0.236 [-1.84902]	0.269 [1.23714]	0.073 [0.36836]
λ(–1)	-0.177 [-2.24959]	0.086 [0.64173]	0.057 [0.47095]
λ(–2)	0.180 [2.37433]	0.449 [3.48502]	-0.126 [-1.07127]
r(-1)	0.330 [2.87758]	-0.027 [-0.13718]	0.786 [4.42572]
r(-2)	-0.050 [-0.37610]	0.283 [1.24767]	-0.174 [-0.84236]

Costa Rican Macroeconomics VAR Sample: 1992Q4 2005Q2 Enxogenous Variable Effects	ρ	λ	r
λ*(–2)	0.232 [0.67809]	1.155 [1.98862]	-0.372 [-0.70236]
λ*(–3)	-0.271 [-0.83964]	-1.028 [-1.87095]	0.278 [0.55445]
r*	-1.124 [-2.61993]	-1.166 [-1.59855]	-0.287 [-0.43191]
r*(-1)	0.729 [1.33178]	0.542 [0.58257]	0.749 [0.88304]
r*(-2)	0.713 [1.46619]	-0.506 [-0.61224]	-0.547 [-0.72593]
r*(-3)	-2.096 [-4.57963]	0.478 [0.61435]	1.788 [2.51915]
r*(-4)	1.043 [2.52592]	0.085 [0.12071]	-0.653 [-1.01980]
Δτ	0.026 [0.35059]	0.362 [2.88978]	-0.062 [-0.54504]
Δτ(–1)	0.249 [3.14650]	0.334 [2.48556]	-0.096 [-0.78310]
Δτ(–2)	0.089 [1.10128]	0.470 [3.40458]	0.019 [0.15130]
Δτ(–3)	0.150 [1.77276]	0.502 [3.49360]	0.034 [0.25566]
Δτ(–4)	0.048 [0.57909]	0.235 [1.67438]	-0.032 [-0.25203]
Dummy(1994	-0.027 [-1.70960]	-0.017 [-0.65569]	0.000 [0.01577]
R-squared t-statistics in [ ]	0.895	0.736	0.850

5. Monte Carlo Simulation

The simulation of the trajectory of the macroeconomic variables that will impact the future value of debt was carried out using as a base the estimated VAR already presented. In order to solve for the required primary surplus displayed in equation, it is necessary to have a projection of future values for real growth, the real interest rate and the real depreciation rate. The equations for the endogenous variables of the VAR were then solved recursively and simulated for 40 quarters (10 years) starting off in the second trimester of 2005.

Figure A 3.9 Fan charts for Simulated Macroeconomic Variables.



The iterative projection of the VAR equations also required a projected evolution of the exogenous variables. The rate of growth of US GDP was projected considering a gradual convergence from 3.6% in the second quarter of 2005 to 2.8% in the second quarter of 2010. The convergence of the external real interest was considered from 1% currently up to 3.8% by 2010. Finally, for the change in the terms of trade the convergence was calculated for the level of the terms of trade to reach in 2010 a value equal to the average of last the 17 years.

The inclusion of macroeconomic uncertainty in the resolution of the projected equations considered two alternative approaches. First the use of a modified impulse response methodology, allowing successive random shocks in every moment of time, unlike the traditional impulse-response that applies initially to a shock of one standard deviation, and shows how the effect decays over time. To use this particular methodology that considers contemporary shocks, it is necessary to make some orthogonal decomposition. The most used and easy to compute is the Cholesky decomposition. Nevertheless, this decomposition has serious short-comings questioning the dependency of the results to the order in which the equations are considered (Hamilton 1994).

The second alternative considered was to use the contemporary shocks (residuals) of the estimation. For every projected moment "t" the value of the variable was computed using the estimations of the VAR. A random selection of a moment in time was performed, and then the shocks of the endogenous variables for the selected moment were added to the estimation of the period at issue. This exercise for every moment "t" was repeated five times, and the future forecast was made for 40 periods. In this form, the evolution of each forecasted variable will depend not only of the present random shocks but that of the trajectory until that moment. This methodology has the advantage to maintain the empirical relationship considered by the VAR between the shocks and of not imposing a functional form to the individual distribution of the shocks.

Although the results of the projection using both forms of simulation did not differ greatly, the second methodology was preferred for its relative clarity and for demanding fewer assumptions. The VAR was estimated using the program EVIEWS 5.1, and with the estimated coefficients, the forecasting equations subject to uncertainty were programmed and recursively resolved using the program GAUSS 6.0.

ANNEX 4: BACKGROUND INFORMATION ON LOGISTICS SURVEY

For this current study, a Logistics Survey was conducted with the objectives of: (i) identifying logistics problems which raise the price of national production and which diminish company competitiveness, in order to present suggested changes in the corresponding public policies; (ii) assessing the relative importance of the logistics costs in company production costs; (iii) identifying the current or potential production lines so as to be able to create mechanisms to strengthen them. The survey, which allows these objectives to be assessed, is directed at Costa Rica's business sector and investigates the following elements:

- Logistics costs structure in exporting
- Infrastructure impact on logistics services
- Logistics chain cost structuring (transportation, stocks, warehousing and so forth. Transportation will be classified by type: maritime, air and so forth)
- Quality perception and access to logistics services

1. Choosing Studied Supply Chains and the Companies Surveyed

The study is focused on the perception of infrastructure and logistics demand. Thus, the objective of this study is the opinion of those requesting logistics and shipping services of the three most representative export supply chains and the ones with the greatest prospects in Costa Rica's international trade. These three chains are:

- Flowers and vegetable products, such as plants
- Medical supplies
- Processed food, such as flour by-products.

The study refers to the opinions of firms pertaining to the three aforementioned supply chains. These chains are sufficiently representative of the Costa Rican economy. Determining these chains is based on their predominance in the national economy and in international transactions. Selection criteria was as follows

- Participation in total national exports
- Participation in total national imports
- GDP participation

Given these three selection criteria for the supply chains, the empirical evidence showed the following results:

Processed food

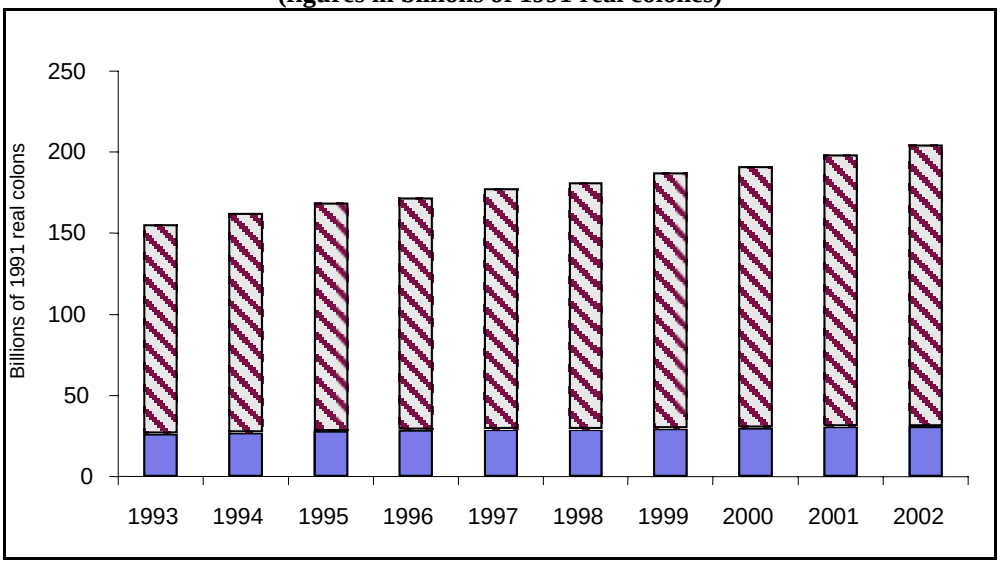
Over the past decade, the food, beverage and tobacco sector is the second most important sector in Costa Rica's total industrial production, surpassed only by the tax-free zone and active improvement industry. Such is its importance that, between 1993 and 2003, the added value of the food, beverage and tobacco

sector grew at an average annual pace of 2 percent, climbing from 65.53 billion colones in 1993 to 77.97 billion colones in 2002. In 1997, its GDP participation was 7.2 percent, and in 2002, it was 5.8 percent.

Within the sector, the most important is food production, followed by beverages. In the 1993-2002 period, the two most important products for the food industry were the slaughtering of livestock and meat preparation and producing dairy products. Even though it is true that in 2001 and 2002 the food industry registered a reduction of its gross added value by 2 billion colones, this was mainly due to reductions in fruit bottling and preservation and the cacao, chocolate and candy production. And one cannot overlook the fact that, between 1993 and 2000, the gross added value of the food industry displayed an upward trend and production increased to an annual average rate of 3.7 percent (Figure A 4.1).

The upward trend presented over the past 10 years by food consumption (presenting an annual average variation of over 3 percent), has mainly presented itself in the consumption of produced foods, which haves been rising at an average annual pace of 3.4 percent.

Figure A 4.1
Final household consumption expenses in farming and livestock food and manufactured items, 1993- 2002
(figures in billions of 1991 real colones)



Source: World Bank Investment Climate Survey (2005).

The inclusion of the food sector in the study is ratified by proving that, although food industry exports diminished in 2001, in 2002 and 2003 they displayed important growth levels, ranging from $381 million in 2001 to $485 million in 2003. This increase of over 27 percent in two years is due to foreign sales of prepared food and palm oil, two subgroups which each increased their exports by 89 percent. In 2003, prepared food is the food industry's main export group, with 27 percent, followed by the sales of fruit juices and concentrates, with 11 percent (Table A 4.1).

Table A 4.1
Breakdown of food sector exports, 2000- 2003 (US$ m)

Product	2000	2001	2002	2003
TOTAL INDUSTRIAL	**4497.63**	**3732.3**	**3999.95**	**4641.43**
Food Industry	389.93	381.29	444.05	484.73
Sugar	34.11	30.03	27.03	21.89
Palm Oil	35.86	22.85	34.48	43.32
Fruit Sauces and Pastes	37.47	43.38	39.90	41.89
Other food products	63.58	70.56	111.08	133.06
Fish products and canned fish	15.33	20.22	28.75	32.49
Fruit juice and concentrates	62.35	46.47	55.87	54.42
Ethyl alcohol	18.57	14.16	10.82	13.25
Hearts of Palm	24.88	23.57	22.25	20.89
Other	97.80	110.05	113.85	123.52

Source: World Bank Staff Calculations

Flowers and vegetable products as decorative plants

The European market is the main destination for Costa Rican flower and vegetable product exports. Currently, Costa Rica is one of the five main exporters of decorative plants, flowers, and bulbs to that area. Costa Rica is the main supplier of ferns and live plants to the European Union, with 30 percent and 55 percent of the market, respectively. Additionally, it supplies 10 percent of the imports of cuttings and stakes. The United States is the second most important market for Costa Rica, for which it supplies 8 percent of the orchids, 37 percent of the cuttings, stakes and grafts, 11 percent of the chrysanthemums and 35 percent of the live trees and bushes which the United States imports. Furthermore, Costa Rica is Japan's main supplier of green plants, Indian cane and yucca. It possesses 34 percent of the cuttings and stakes market (Indian cane and yucca) and 15 percent of the plants market.

In 1996, exports of decorative plants, flowers, and plants represented 33.6 percent of agricultural exports, 8.2 percent of non-traditional exports, and 3.3 percent of total exports. In 1989, it accounted for $43.26 million of total exports. In 1995, exports totaled $112.79 million, which means that these exports rose 160 percent over these seven years (PROCOMER – *Promotora del Comercio Exterior* – Costa Rica's Foreign Trade Promotion Office). In 1995, daily exports totaled: 91,000 fern branches, 70,000 kg. of cuttings and stakes, 20,000 kg. of tropical flowers and approximately 19,000 rose stems, not counting the exports of other flower varieties, such as carnations, or other plants, such as orchids, marginatas and bromeliads (PROCOMER). Additionally, over 10,000 people are involved in this activity and the payroll totals close to 5 billion colones annually, proving that this is an interesting economic activity for the study of logistics and competitiveness.

The destination for Costa Rican decorative plants, flowers and plants is varied: 63 percent of exports head to the European Union, 30 percent to North America, 5 percent to Asia, and 1 percent to Latin America and 1 percent to other countries.

Medical supplies

The recently signed Central American Free Trade Agreement (CAFTA) will provide a definitive boost to the sales of medical items and equipment. Latin America's economic recovery and the government's plans to improve health services will also boost sales of medical supplies in the region. According to the U.S. Department of Commerce (DOC), the lowering of tariffs because of the CAFTA will ensure that over 80 percent of U.S. medical supply imports will come from Central America. In this regard, the DOC

expects that medical equipment trade between the United States and Central America flows in both directions, particularly the more that U.S. producers resort to subcontracting, in an attempt to lower production costs. Latin America, and especially Costa Rica and Mexico, are important countries for U.S. manufacturers of medical items and equipment despite the growing interest in China and other parts of Asia where salaries are lower. This is due to the fact that the difference in salaries is offset by lower transportation and logistics costs, swifter delivery times and tax breaks.

According to business statistics, the tendencies of the U.S. manufacturers is to continue launching new products in the United States and then send production southward, as their products mature. Mexico is the most important exporter and importer of medical items. In 2002, the sector represented $2.3 billion of the bilateral commerce, according to the U.S. International Trade Commission. Costa Rica is the second most important importer of medial merchandise, with sales rising over 257 percent, from $185 million in 2000 to $476 million in 2004.

2. Company Selection Criteria

Once the supply chains for study were selected and the usefulness of the ICA study was re-evaluated, the companies to be surveyed were then selected. This selection was performed between May 1 and June 20 and performed in collaboration with ECOANÁLISIS and THE WORLD BANK.

Data availability determined a universal sampling comprised of the companies most complete information registered in the four databases: the PROCOMER directory of exporters, Chamber of Food Industry (CACIA – *Cámara de la Industria Alimentaria*) member list, the list of members of the Association of Producers of Plants and Ferns and the list of producers in the Costa Rican Coalition of Development Initiatives (CINDE – *Coalición Costarricense de Iniciativas de Desarrollo*) tax free areas. In total, 283 companies (83 food, 150 plant, 50 medical) were surveyed (see Annex 2). Bearing in mind this number, it was determined that a representative number of companies would be 100.

The selection of the 100 companies to be surveyed was performed under criteria of relation, pertinence, location, size, and ICA.

- **Relation:** Activities performed by companies must belong to the selected supply chains.

- **Pertinence:** It refers to two sub-criteria: being an exporter and using transportation infrastructure services.

- **Location:** The geographical distribution of the companies must encompass Costa Rica.

- **Size:** The study of the opinions of the firms includes businesses which could be classified as being: large, medium and small-medium according to the number of employees hired in the last quarter, according to what is registered by the available database.

- **ICA:** A criteria which grants preference in the selection of businesses and which means the company has been selected for The World Bank's ICA study[3].

[3] The Salvadorean Foundation for Economic and Social Development (FUSADES – *Fundación Salvadoreña para el Desarrollo Económico y Social*) has placed a list of companies it will attempt to survey for the Costa Rica ICA study at the disposal of the Logistics and Competitiveness Study.

3. How the Survey Process Was Conducted

The survey is 79 questions (the total number of variables of the databases is 245). A field stage was begun on June 28, with a previous stage of survey-taker training. The companies were visited and, from the 121 businesses originally selected, 65 firms were surveyed. The other 56 companies did not wish to provide the information or were businesses that merged into companies, which were already in the survey, or they simply disappeared. From August on, companies that did not collaborate with the study started to be substituted by others with similar characteristics (same activity and size). Then, a problem arose–some sectors were too small and there were no other businesses to visit.

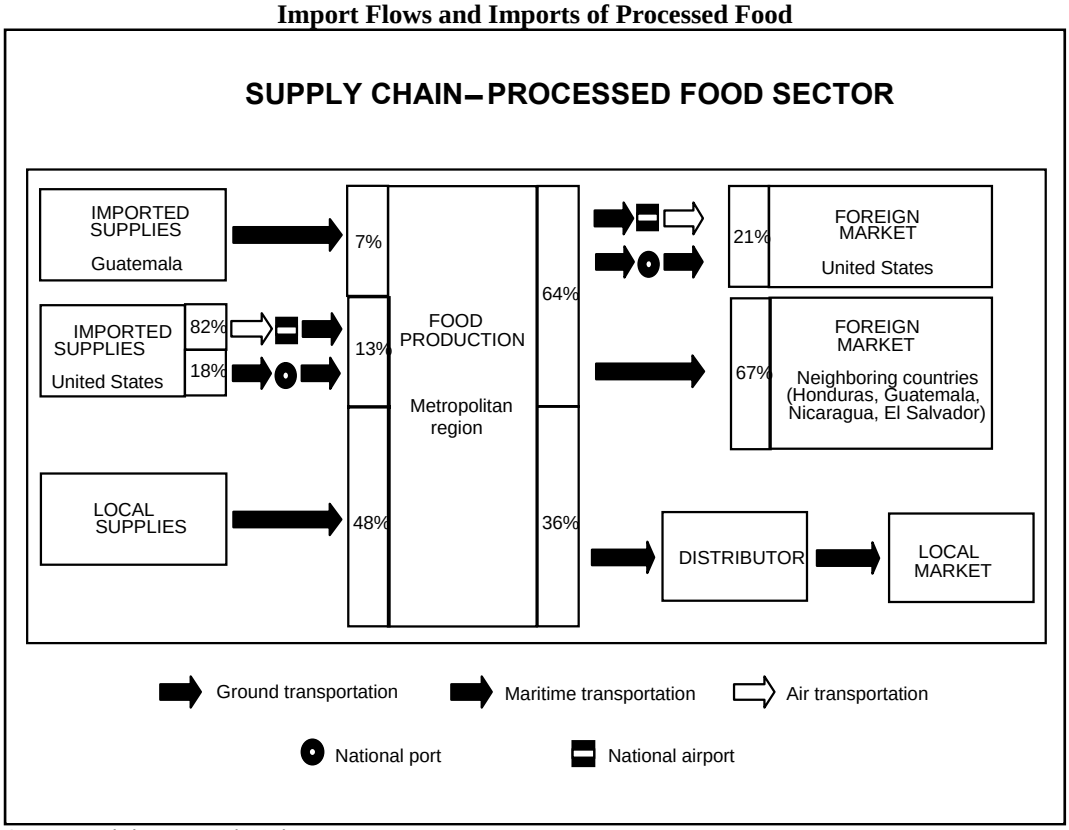
Below, import and export flows in each of the three sectors are described. In the three cases, important demand in land, maritime and intermodal transportation are displayed, illustrating the preponderance and impact of these services on the competitiveness of Costa Rican companies.

Processed food

Figure A 4.2 below summarizes the import flows and imports of processed food in Costa Rica, the means of transportation used in each stage of the chain, in addition to the origins and destinations of supplies and products:

- Supplies used are 52 percent imported and 48 percent of national origin.
- Most imported supplies come from the United States (13 percent) and Guatemala (7 percent)
- Guatemalan supplies are imported via ground transportation and, without having to make any transshipment, they continue their journey to processing plants via ground transportation.
- 18 percent of the supplies imported from the United States are done so by maritime transportation and, then, are taken to the plants by ground transportation. The other 82 percent is imported by air transportation and from there, transported to the plants by ground transportation.
- Processed food production plants are mainly located in the major metropolitan areas.
- National supplies come from the central region and are ground transported to the processing plants.
- Production is sold to local and foreign market distributors (64 percent of the production is exported)
- Only 50 percent hire outsource shipping services in order to get the products to the markets.
- Orders are ground shipped to local purchasers.
- Regarding exports, orders are ground shipped to purchasers in neighboring countries or to Puerto Limón where they are finally shipped abroad.
- The main destinations for exports are the United States, which receives 21 percent of the exports, and Honduras, Guatemala, El Salvador and Nicaragua, which get 67 percent of the exports.

Figure A 4.2
Import Flows and Imports of Processed Food



Source: Logistics Survey (2006).

Medical Equipment

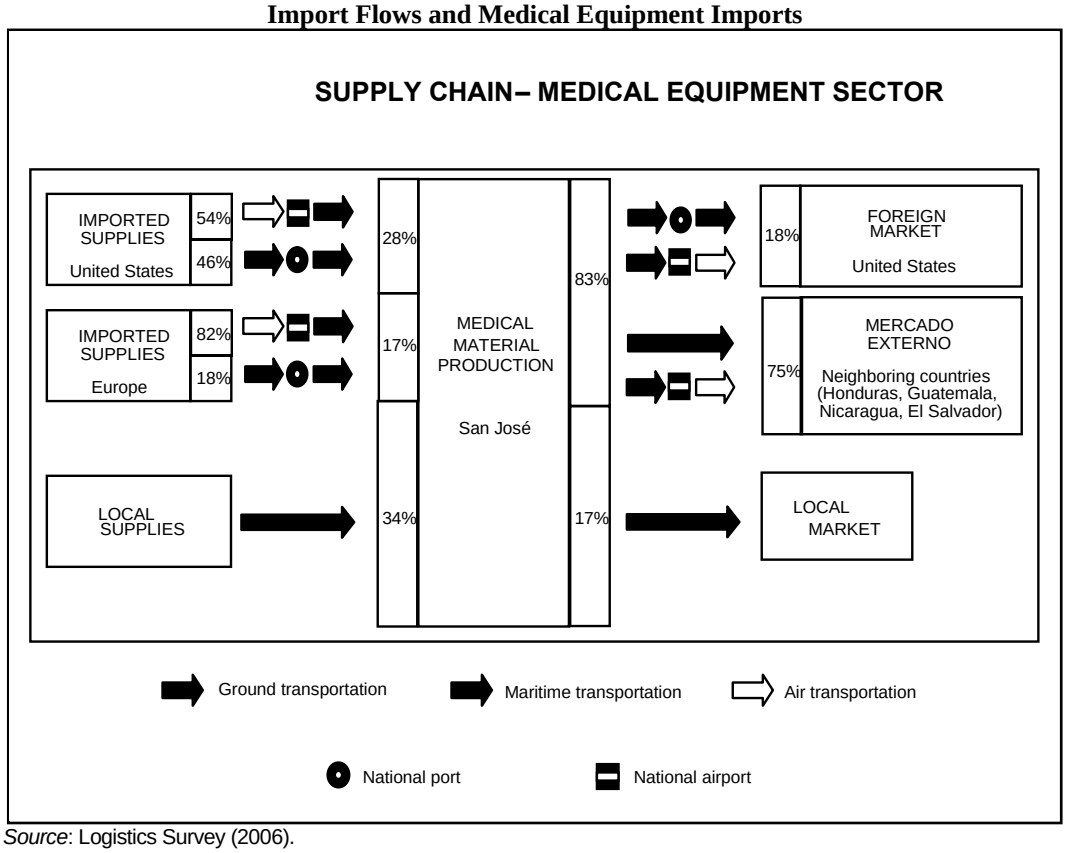
Figure A 4.3 summarizes Costa Rican import flows and medical equipment imports, the means of transportation used in each stage and the origins and destinations of supplies and products.

- The production of Medical supplies is centered in San José.
- Demanded supplies in this chain are 34% of national origin and 66% foreign.
- Most supplies originate from the metropolitan area and are ground shipped.
- Imported supplies mostly come from the United States (28%), Europe (17%) and South America (6 %).
- Imported supplies are mainly air transported.
- This chain's production is mainly sold to end consumers who transform or assemble them.
- The chain exports 83% of its production.

- The main export destinations are the United States (purchasing 18 % of the exports), and Honduras, Guatemala, El Salvador and Nicaragua (these four countries account for 75 % of the exports).

- Orders are transported via ground shipment to local purchasers and, in the case of orders for international markets, these are mainly done via air transportation.

Figure A 4.3
Import Flows and Medical Equipment Imports



Source: Logistics Survey (2006).

Flowers and plants

The scheme of Costa Rican import flows and flower and plant imports, the means of transportation used at each stage and the origins and destinations of supplies and products are shown in Figure A 4.4:

- The flower and plant supply chain focuses its production center in areas close to the metropolitan central region.

- It uses 75 percent national supplies and 25 percent imported supplies.

- National supplies are ground shipped.

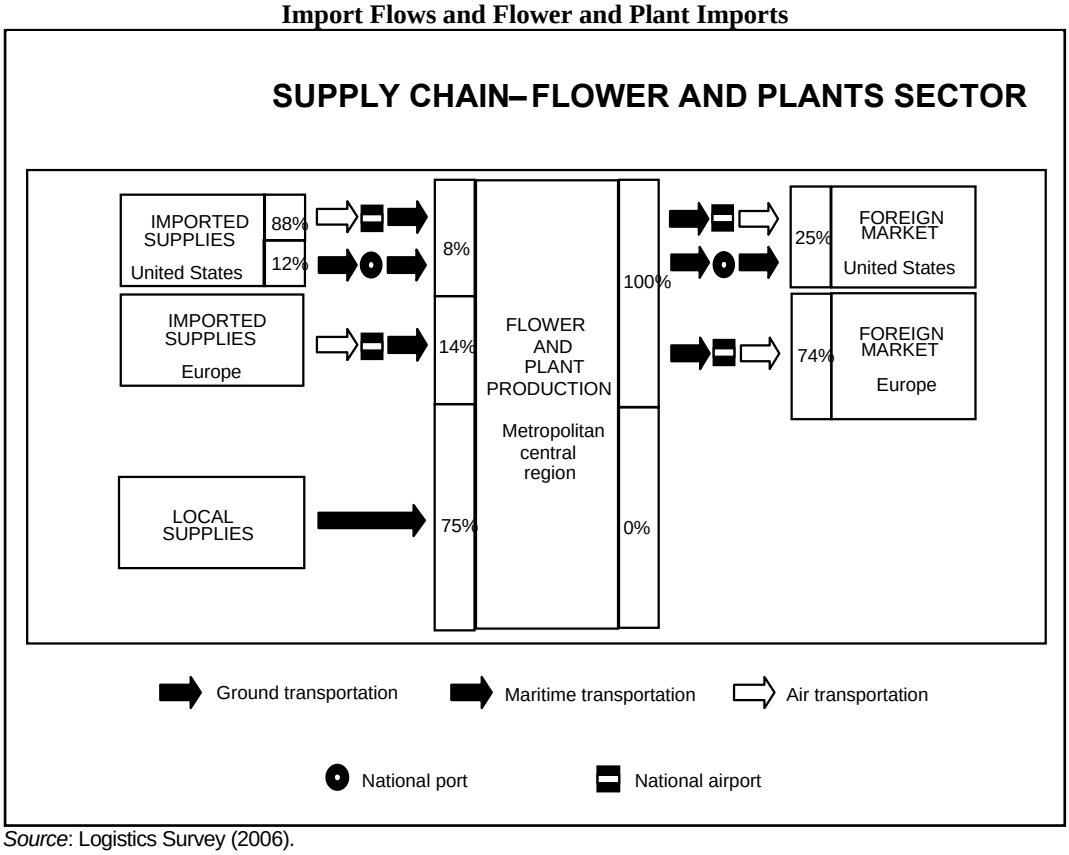
- Imported supplies mostly come from the United States (8 percent) and Europe (14 percent).

- Supplies are shipped either by air or maritime transportation.

- 88 percent of the supplies from the United States are shipped by air transportation as are almost all European supplies.

- Almost the entire chain production is exported (100 percent according to those surveyed) and distributors are their main purchasers.

Figure A 4.4
Import Flows and Flower and Plant Imports



Source: Logistics Survey (2006).

ANNEX 5: DESCRIPTION OF COSTA RICA'S PUBLICLY FUNDED ROAD PROJECTS

The project to construct the South Costa Rican Road Complex (*Complejo Vial Costanera Sur*) is aimed at encouraging tourism development in the Southern Pacifica area and contributing to the integration of the Central American logistics network. The project has undergone lengthy delays, mainly due to appeals filed to the bidding documents and to work stoppage by the construction companies. Despite this, construction on several of the bridges that connect different stretches of the road has advanced with public investment. Likewise, the process to obtain the right of way is currently 40 percent completed.

The Costa Rican Government and the Central American Bank for Economic Integration (BCIE – *Banco Centroamericano de Integración Económica*) have provided US$22.98 million (from the national budget) and US$60 million (loan), respectively. The projects to be financed by the BCIE funds are:

- Renovation of the Inter-American Highway-Caldera (12 km.)
- Renovation of the bridge over the Tárcoles River (340 m.)
- Road construction, Quepos-Savegre section (20 km.)
- Road construction, Savegre-Dominical section (23 km.)
- Bridges over the Parrita River (160 m.), Paquita River (120 m.) and Naranjo River (180 m.)
- Bridge construction over the Portalón River (90 m.), Matapalo River (60 m), Hatillo Nuevo River (120 m.), Hatillo Viejo River (120 m.) and expansion of the bridge over the Savegre River. (128 m.)

As part of the activities being performed on the road network, the following projects are in the bidding process or pre-bidding phase:

- International Public Bid LPI 2004-001 – Tárcoles Bridge renovation
- International Public Bid LPI 2004-002 – Inter-American Highway-Caldera renovation
- International Public Bid LPI 2004-003 – Construction, Quepos-Savegre section
- International Public Bid LPI 2005-000 – Construction and design of bridges over the Parrita River, Paquita River and Naranjo River
- Design and Construction of the bridges over the Portalón River, Matapalo River, Hatillo Nuevo River, Hatillo Viejo River, and the expansion of the bridge over the Savegre River
- Road construction, Savegre-Dominical section

For 2006, the Ministry of Public Works and Transportation (MOPT–*Ministerio de Obras Públicas y Transporte*) estimates that all of the projects will be adjudicated and some will be in execution, as long as the bids are not subject to any appeals in the adjudication process. Projects that have been financed by the Costa Rican Government through the National Road Council (CONAVI–*Consejo Nacional de Vialidad*) are almost totally concluded.

Tables No. A 5.1 and No. A 5.2 present the condition of the infrastructure investments made with funds from the Central American Bank for Economic Integration (BCIE–*Banco Centroamericano de Integración Económica*) and the National Road Council (CONAVI–*Consejo Nacional de Vialidad*), respectively. As stated below, the CONAVI funds projects are slightly further ahead.

Table A 5.1:
Current Condition of Projects Financed by Central American Bank for Economic Integration (BCIE) Loan Funds

Project	*Preliminary Preparation*	*Bidding Process*	*Construction Process*
Renovation, Inter-American Highway-Caldera (12 km.)	100%	75%	
Renovation, bridge over the Tárcoles River (340 m.)	100%	100%	0%
Road construction, Quepos-Savegre section (20 km.)	100%	60%	0%
Road construction, Savegre-Dominical section (23 km.)	100%	70%	0%
Bridges over the Parrita River (160 m.), Paquita River (120 m.) and Naranjo River (180 m.)	98%	0%	0%
Expansion of the bridge of the Savegre River	85%	0%	0%
Bridge construction over the Portalón River (90 m.), Matapalo River (60 m.), Hatillo Nuevo River (120 m.), Hatillo Viejo River (120 m.) and expansion of the bridge over the Savegre River. (128 m)	85%	0%	0%

Source: Ministry of Public Works and Transportation, Boletín Informativo Costa Rica. Mayo 2005, Edición Nº 1

Table A 5.2
Current Condition of Projects Financed with CONAVY Funds

Project	*Preliminary Preparation*	*Bidding Process*	*Construction Process*
Mata de Limón estuary bridge renovation	100%	100%	100%
Jacó-Esterillos road section renovation	100%	100%	100%
Esterillos-Lomas road renovation	100%	15%	0%
Bridge construction, Parrita-Quepos section	97%	93%	84%
Construction and access, Parrita-Quepos minor bridges	100%	100%	100%
Drainage construction, Quepos-Savegre section	100%	100%	100%
Final works, Barú-Piñuela	100%	100%	100%
Final works, Piñuela-Palmar Norte	100%	100%	100%

Source: Ministry of Public Works and Transportation, Boletín Informativo Costa Rica. Mayo 2005, Edición Nº 1

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