Economic Growth in Costa Rica: 1950 – 2000

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March 2002

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Section I: Introduction

Costa Rica seems like a strong candidate for high economic growth. In contrast with other Latin American countries, Costa Rica has maintained peace and democracy over more than fifty years, and has made huge investments in education, health and a high coverage of basic infrastructure. It attracted an important number of migrants, had a positive change in its demographic structure, benefits from a relatively fluid and efficient labor market, and it has carried out several reforms since the mid 80s. Among these reforms, current and capital accounts liberalization have played an important role, allowing for a strong increase in exports and foreign direct investment. By the 1990's, Costa Rica was already exporting goods and services significantly more sophisticated than those that supported the economy during all previous decades (de Ferranti et. al 2001).

Despite such favorable conditions, Costa Rican GDP per capita growth rate during the last fifty years has been disappointing with a 2.4% annual growth rate during 1950-2000. There have been episodes of higher growth, but its performance is mediocre in comparison to that of other countries with less favorable conditions. As shown in table 1.1, the Costa Rican growth rate is lower than that of developed countries, and even more so than that of East Asian countries. It is higher than that of Latin America as a whole, but this was one of the regions with worst economic performance (only outperforming Africa).

The period of higher growth during this half-century was 1963-1973, with a 4.3% annual growth rate, comparable to that of East Asian countries. However, growth rates decreased over the periods that followed. As shown in table 1.1, over the last period (1984-2000) the annual growth rate was only 2.1%.

The purpose of this research is to analyze the economic performance of the Costa Rican economy over the last 50 years, focusing on two questions: Why has Costa Rican average growth rate been so low over the last 50 year despite many of the favorable conditions described above? Why has growth during the last 16 years been mediocre even in comparison to that on previous decades, despite the fact that important reforms such as current and capital account liberalization took place precisely during this last sub-period?

In the preparation of this study, we made two accidental findings. First, international data bases, such as Summers and Heston (Penn World Tables) and Barro and Lee (about schooling) are not adequate for specific-country studies, since data differ significantly from that of primary sources at country level. These data bases are highly valuable for studies that require consistent data from a large number of countries, but should not be used to analyze the case of a particular country. Second, at least in the case of Costa Rica, consistent series over long periods of some of the main variables are not readily available. This is even the case of widely used variables such as real GDP, investment and employment. One of our major efforts in this study was the construction of these data series based on different sources. We hope that this effort will not only stimulate other researchers to study the case of Costa Rica, but will also call on the attention of local authorities on the need to construct and maintain long data series with consistent data.

The paper is structured as follows. Section II describes the economic policy implemented during the period as well as the most relevant aspects of the international economic environment. In section III, we decompose GDP per capita growth, into two components: growth in GDP per worker, and changes in participation rates. In section IV, we analyze growth in GDP per worker through a careful growth accounting exercise. This procedure measures the contribution of physical and human capital, as well as that of total factor productivity (TFP) to observed growth in GDP per worker. Surprisingly, we find that TFP has deteriorated over the period 1963-2000. In section V, we attempt to explain this phenomenon as well as the economic slowdown observed after the 70's, by looking at the distribution of factors of production across economic sectors as well as the evolution of productivity in each sector. Section VI presents a statistical analysis aimed at understanding the influence of international variables on the Costa Rican slowdown in the post-crisis period. We also include VAR model, that helps us explain, in particular, the slowdown observed during the second half of the 90's as a function of international and domestic variables. In section VII, we present our main conclusions and suggestions for future research.

Section II: Economic Policy in Costa Rica and Evolution of the International Environment

This section starts with a description of the evolution of GDP in Costa Rica during the whole period of study (1950-2000). Then we briefly describe the evolution of economic policy and international conditions that the country has faced. We split the period in different sub-periods characterized by different economic policies and international conditions.

II.a – Evolution of GDP in Costa Rica during the period 1950 – 2000

The first problem we encountered was the nature of the GDP series. For almost the entire study period, the available GDP series is based on prices and basket of goods both from 1966. This series was not updated or corrected until 1997. This is troublesome not only because of the obvious reasons dealing with the considerable change in circumstances over a 30 year period, but also because internal price distortions were very big in the mid 60's, given strict government price controls and extreme isolation from international trade. Moreover, certain economic activities not relevant in 1966, such as tourism and non-traditional agriculture, were estimated indirectly from remote sources, rather than being directly measured, an instance that generated important errors. Likewise, other sectors such as pharmaceuticals or computer parts were not measured at all back then. By the mid 90's, a time when the old 1966-based series was still being used, all of these industries had become a sizeable portion of the economy but were being left out either partially or wholly.

The new GDP series, which starts out in 1991, directly measures all relevant sectors and uses prices that are more suitable to the present circumstances. It was published in 1998 and it revealed that the 1991 GDP calculation underestimated the true GDP value in as much as 27%. That 27% corresponds to a growth that necessarily occurred between 1966 and 1991 and that therefore was not considered in the 1966 series. In order to generate a consistent GDP series that would cover the entire period, we had to make assumptions that would allow us to distribute said growth in time and that would consequently enable us to merge both series into one. Those assumptions are explained in Appendix A.1.

Another problem of importance in recent years with production data, and even in the case of the new GDP series, is the measurement of value added coming from those companies in the Export Processing Zone regime, which to date represent more than half the country's exports. This is particularly important in the case of the electronic company INTEL, which is, by far, Costa Rica's biggest company. Both value added and productivity measurements for companies such as this one are difficult to obtain for at least two reasons. First, an important portion of the value added of these companies results from the specific know how of a foreign owner and it is very difficult, though necessary, to determine the portion of it that should be valued as a production input. The second reason is that many of these companies are part of a vertically integrated value chain of a multinational operation that owns them. Thus, they are not involved with trade in at least one side of their transactions: either raw materials are imported from company plants elsewhere or production is meant to be exported to other company plants elsewhere which will use it as an input in their own operation. Therefore there are no market prices to value inputs or products (since there are no transactions with a third party in which said prices should be negotiated or registered), and the value added is consequently obtained from the internal transfer prices that the own company estimates and reports. These prices are in turn influenced by the way in which the multinational company wants to handle profits allocation along its value chain, given fiscal considerations in the various countries it works in. Thus, the red between 1966 and 1991 and that therefore was not considered in the 1966 series. In order to generate a consistent GDP series that would cover the entire period, we had to make assumptions that would allow us to distribute said growth in time and that would consequently enable us to merge both series into one. Those assumptions are explained in Appendix A.1.

Graph 2.1 shows both growth series, the one from the original GDP and the adjusted one, which is the series we use throughout the rest of this study. We find that the adjusted series shows a greater growth rate for the 1966-1991 period, and then a lesser one for years '98 and '99 , which are in turn the years in which INTEL contributes more to the GDP growth. Finally, in the year 2000 INTEL decreases, and thus the adjusted series shows a smaller growth rate than the original series.

For a better idea of the evolution of the GDP's growth rate, it is convenient to break down the growth series into two components: its growth trend component and its business cycle component. The standard tool to accomplish this exercise is the filter proposed by Hodrik and Prescott. Graph 2.2 shows the GDP series and the growth component.

The graph shows a gradual decrease in the growth trend along the time period, going from approximately 9% in 1951 to less than 5% in the year 2000. This is one of the phenomena we want to explore in this study. It is also evident the high volatility characterizing the growth rate during the 50's, where this rate fluctuated from levels of 10% in one year to cero or even negative levels the next year. Even when part of this high volatility could be accounted for by the high concentrations of the country's exports in coffee and banana, the truth is that national accounts data from those years are not so reliable. This is one of the reasons for which we will focus, for the most part of this study, on the 1963 – 2000 period, as we will explain in the next sub-section.

II.b Evolution of the International Environment, Economic Policy and Macroeconomic Aggregates in Costa Rica

In general terms, the country went from an agricultural exporting model in the 1950's, to and imports substitution policy in by the end of that decade which was later complemented by the incorporation of Costa Rica to the Central American Common Market (CACM) in 1963. In the 70's, the country followed a strategy of high investment in state-owned firms (entrepreneurial state) that, together with other policies that expanded government expenditure, led to high fiscal deficits and a strong increase in public debt. Together with the coffee boom in the 1975-1979 period, and a fixed exchange rate policy, this generated a high but unsustainable growth rate by the end of the 70's, and a debt crisis in the years 1980-1982. In 1982, stabilization policies began, and in 1984 new measures were implemented to adopt a new model base on exports promotion. This model, which included international capital and trade liberalization policies as well as fiscal incentives on exports, consolidated itself at the same time that other reforms in the fiscal and financial sectors were implemented. This situation continues up until the end of the period.

The above description of the period suggests the following 5 sub-periods:

1. Transition from the agricultural exporting model to the imports substitution model (1950-1963)
2. Incorporation to the Central American Common Market (CACM): 1963-1973.
3. Entrepreneurial state and unsustainable macroeconomic policy: 1973-1980
4. Crisis and stabilization: 1980-1984
5. Exports promotion model and initial structural reforms: 1984-2000.

In choosing the exact years that mark the different sub-periods, one of the main criteria were the years in which censuses took place. This is because these censuses, which took place in 1950, 1963, 1973, 1984, and 2000, provide a significant part of the information used in the analyses presented in the sections ahead. Fortunately the dates in which the censuses took place coincide with key events in recent economic history: in 1963, Costa Rica joins CACM; 1973 is the year right before the oil crisis with which a period of high international volatility gets started; in 1984, Costa Rica signs the first Structural Adjustment Program with the World Bank, which includes several reforms that characterize this sub-period.

In this study we focus mainly on the 1963-2000 period, paying less attention to the 1950-1963 period. This is mainly because a large fraction of the data that we need for the analysis are either not available or are highly inaccurate during this period. First, National Accounts data for this period are provided by a punctual study by the Ministerio de Planificación and not provided by the Central Bank Second, the World Bank database that we use for international comparisons only starts in 1960. Third, for our growth decomposition exercise, data on real investment is needed for several years before the beginning of the period of study in order to obtain capital stock data that are less vulnerable to errors in initial capital stock estimates.

A few stylized facts and trends are useful in describing the period of study. First, as shown on graph 2.3, there is a clear reduction in the economy´s dependence on four traditional export products (coffee, banana, sugar and meat), which represented 90% of total exports in 1950, and constitute only 14.1% of total exports in 2001.

Two main factors explain this evolution: first, the import substitution policies and the incorporation of Costa Rica to the CACM, since the exports to this market were mainly industrial. Graph 2.4 clearly shows the impact of this commercial agreement on the Costa Rican exports profile. The second factor that explains the diversification is exports is the exports promotion model which was implemented starting in 1984. A key element in this model is the Export Processing Zones (EPZ), which has represented a growing proportion during the last years, as shown on graph 2.5.

Export diversification has been accompanied by increasing commercial opening of the economy. Graph 2.6 shows the evolution of the openness index (exports plus imports of goods as a proportion of GDP) which has increased from less than 40% in 1950 to more than 70% in 2000. Note that the openness index stagnates during the import substitution and CACM period. This implies that, as a fraction of GDP, the increase in trade with Central America was compensated by a decrease in trade with the rest of the world during this period.

A second feature worth noting for the period of study has to do with the behavior of international capital flows to Costa Rica and their composition. As shown on graph 2.7, there was a progressive increase in the current account deficit from beginning of 1950´s to to the end of the 70's. With the debt crisis, the current account deficit falls drastically, but has maintained relatively high levels (near 4%) in the 80's and 90's. As stated by Gonzalez-Vega and Céspedes (1993), Costa Rica has been highly dependent on foreign savings for its development during the last decades. Foreign direct investment (FDI) has been an important financial source in covering the current account deficit, with levels around 2% of GDP for the whole period, and levels of 4% by the end of the 90's.

A third element is the behavior of the real exchange rate. As shown on graph 2.8, real exchange rate was relatively stable durin 1966-1980. With the debt crisis in 1981, there is a strong real devaluation and a subsequent strong appreciation. From 1984 on, the real exchange rate has displayed a gradual appreciation, but still maintains levels more depreciated than those observed during the import substitution period as expected from economic theory.

Fourth, the behavior of inflation is also relevant for the period of study. This variable is an indicator of economic stability and predictability, and therefore has a significant effect on investment. As shown on graph 2.9, inflation was low during the 50's and 60's, then peaked during the first oil crisis, to decrease and peak again during the debt crisis. During the years that followed, inflations has maintained moderate levels and has leveled around 10% during the last years. There is no clear tendency of a reduction in inflation, because the Central Bank must pay for a significant fraction of the public debt in Costa Rica, and therefore must rely on revenues from the inflationary tax to finance itself. Despite the fact that this inflation rate is moderate, Costa Rica is today one of the three most inflationary countries in Latin America.

Terms of trade faced by Costa Rica show no clear trend during the period as a whole, except for the last three years with a clear deterioration (graph 2.10). However, volatility in this variable has decreased significantly since the end of the 80's, when the growing exports diversification reduced Costa Rica's exposure to international price fluctuations in a few traditional products. Nonetheless, given the high degree of openness of the Costa Rican economy, short run international price fluctuations constitute an important explanatory variable in the economic cycles, as explained later in the paper.

The behavior of international interest rates is also worth noting in this period. Graph 2.11 presents the evolution of the prime rate. There is an increasing trend during the first three decades of the period, and then a reduction during the 80's. During the 90's the level is relatively stable. It should be noted that, despite the reduction in rates during the 80's, the level maintained in the 90's is still significantly higher than that in the 50's and 60's.

Finally, as shown in table 2.1, income distribution improved during the 60's (with a decrease from 0.5 to 0.43 in the Gini coefficient), but then maintains its level until 1992, which is the last year for which we have this series (extracted from Trejos (1995)).

Section III: Evolution of Participation Rate and Its Contribution to Growth

The main purpose of this research is to explain the evolution of GDP per capita in Costa Rica over the last forty years. Part of this explanation lies in understanding the behavior of the participation rate during this period. Growth in the number of workers per person has been particularly fast in developing countries experiencing rapid economic growth, and it might be a good indicator of growth potential for other countries. In the case of Costa Rica, employment has increased on average at an annual rate 3.6%. Graph 3-1 presents the evolution of the participation rate, which is characterized by a rapid and sustained increase over the period.

GDP per capita can be expressed as the product of GDP per worker and the net participation rate: $Y/N = (Y/L)*(L/N)$, where Y is GDP, N is population, and L is number of workers. Hence, the rapid growth in the participation rate may constitute an important component of income expansion. Table 3-1 shows GDP per capita growth rates for each sub-period, decomposing it into the effects of changes in participation rate and growth in labor productivity (i.e. GDP per worker). Observe that GDP per worker has increased by a modest 1.57% annual rate over the whole period, and by only 1.41% during the 1984-2000 period when most reforms and liberalization of current and capital accounts took place. GDP per worker grows by less than 0.8% annual during the last two decades of the period, and, therefore, GDP per capita grows very slowly despite the fact that the participation rate increases considerably.

Despite the mediocre growth in GDP per worker, the economy has had a surprising capacity to absorb an important increase in labor supply without significant changes in the unemployment rate and other labor market indicators. In particular, unemployment duration, flows across employment conditions, and creation and destruction of labor display healthy levels. More importantly, real wages have increased, and have done so even faster than product per worker, which is reflected by the fact that the fraction of income absorbed by the labor factor has increased progressively, as documented in the next section.

It is interesting to compare the growth pattern followed by Costa Rica with that of other countries. Table 3-2 presents annual GDP per capita growth rates decomposed into its participation rate and product per worker components, for a relevant sample of countries. In general, participation rates increase is very strong in high growth East Asian countries, and relatively high in Latin America, when compared with developed countries. For Costa Rica, the increase in participation represented an economic expansion of 0.7 percentage points, consistent with what is observed in bigger Latin American countries. This represents a third of its total growth, which is even a larger fraction than that observed in East Asian countries. Given its contribution to the evolution of per capita GDP, we will devote the rest of this section to understanding the origin of the expansion in the participation rate. We study three main sources for participation rate increases: a drop in the fertility rate, which lowers the gross participation rate; higher female participation; and migration. Sections V and VI present a thorough analysis of the sources of growth in GDP per worker.

For several reasons, but particularly because of schooling improvements that we refer to below, Costa Rica presented a considerable drop in fertility rates over the past decades. In 1962, gross fertility rate in Costa Rica was 6.92%. Then it dropped to 4.34 in 1972, 3.51 in 1982, and 2.83 in 1997. As time has gone by, this strong decrease in the fertility rate has contributed to an increase in the fraction of the population in working age. The Costa Rican fertility rate not only falls faster than the Latin American and World averages (during the period 1962-1982, Costa Rican fertility rate halved, while the other cases only decrease by a third); it also took place earlier. The fastest drop in Costa Rican fertility rate took place in the 1960's, ten years earlier than in the World average, and 20 years earlier than in Latin America.

As shown in table 3-3, the population in working age increases from 53% of total population in1963 to 63.3% in 2000. Almost two thirds of the accumulated growth in L/N is associated with changes in the age structure, although the net participation rate (labor force as a fraction of population in working age) also grows rapidly between 1963 and 1980, and then remains more or less constant during the rest of the period.

Table 3-4 decomposes the annual growth in L/N, into the effects of change in age structure and change in net participation rate. Again, and specially during the 70's and 80's, the effects of an early fertility drop contribute with almost one percentage point in the growth of workers as a fraction of total population. The net participation rate contributes significantly more during the first twenty years, but not during or after the debt crisis in 1981.

What explains the increase in the number of workers as a fraction of the population in working age (i.e. net participation rate)? An important part of this increase is explained by a growing female labor participation, which is consistent with various trends observed at national and international levels. On the one hand, schooling levels have increased considerably, specially for females, during previous decades. Even though increased schooling reduces the participation rate of younger people (this explains the fall in participation rate in the male population between 15 and 65 that is shown on the next table), participation rates among female population are much more sensitive to increases in schooling than among males. In particular, Fernández y Trejos (1997) show that the difference between Central American and developed nations in female participation can be explained almost completely by differences in schooling. Controling for schooling years and age, the employment behavior of the female population in Central America is very similar to that of more developed countries. This means that schooling improvement efforts not only have the potential of increasing productivity per worker, but also lead to an expansion in the number of available workers in the economy. The drop in fertility also shares this source. We present a more detailed description of the evolution of schooling and its effect on female participation in the next section. As shown in table 3-5, the increase in the general participation rate is strong, and is due to the fact that female participation has more than doubled since 1963, from 18.2% in that year to 39.1% in 2000. This has more than compensated the fall in participation rate among the male population, mostly due to the increased school enrollment rate among young males.

In addition to the above change in age structures and participation rates among Costa Ricans, part of the increase in the number of workers as a fraction of total population is due to a significant migration process. Costa Rica has received and important number of immigrants (mainly from Nicaragua) since the mid 80's. Approximately one fifth of the new jobs created after since 1984, have been occupied by non-citizen residents (126641 persons or 19.1% according to the Household Survey). Since the migrant population has significantly higher participation rates than Costa Ricans (most migrants are already in working age, leaving the other members of the family at home), the total participation rate is increased by these migrations.[1]

Looking into the future, it is worth asking ourselves whether this rapid growth in employment will persist in the medium and long run. Given that an increase in participation rate is a common factor in many successful growth experiences, will this opportunity stay open for much longer in the future?

One of the factors mentioned above, that is, the increase in female participation, is likely to persist in time, since it responds not only to cultural and legal trends that are non-reversible, but also to increasing female schooling. Secondary and tertiary education enrollment rates have increased considerably over the last five years (primary levels are already high enough that they are not likely to increase significantly), and some legal reforms make it likely that this trend will continue for several years. This implies that female schooling (to which female participation is highly sensitive), is likely to keep on growing. Economic asymmetries between Costa Rica and its neighbors are not likely to disappear in the near future and this is the main factor that drives migration. It is to be expected that migration will keep its pace or even increase as a result of recent immigrations from other, non-neighboring countries. In spite of the above, the growth in L/N over the medium run will hardly

[1] The migration data for non-working population reported by census do not seem accurate, and therefore we don´t have comparable participation rate data for this population.

be as high as the one experience in the past four decades, since the drop in fertility has stopped. Several decades have gone by since the steepest drop in fertility, which means that the age structure in the future will be a lot less variable.

Section IV: Growth per Worker Decomposition

The general picture that emerges from the previous section is one of an economy that has been able to absorb a great amount of labor but has not been able to take off due to a mediocre growth in productivity per worker (despite a few deep reforms implemented in the 80's). Why has product per worker grown so slowly during the past four decades? This the main question that this paper intends to answer. Several hypotheses come up:

a) Is the stagnation of GDP per worker the result of a decrease in the quality of the labor force? This would be consistent with the fact that young workers, immigrants, and female workers have less experience or fewer school years on average, and would imply a lower productivity of workers.
b) Is this stagnation the result of poor rates of accumulation of physical capital? This is also possible since, particularly in the last years, investment has been subject to important financial restrictions, while the labor force has grown at a high rate. This might have led to an excessively slow growth in the capital-labor ratio (slow capital deepening).
c) Is it simply that total factor productivity (TFP) has stagnated? Should it be this way? Why?
d) Is it that the production composition of the economy has changed with lower productivity sectors absorbing more labor than high productivity sectors? This is also possible since the sector composition of the economy has changed a lot (agriculture used to represent 49.7% of total employment in 1963, and only 20.4% in 2000; it has lost its share to all types of services, that now represent 58.4% of total employment instead of 30% in 1963).

In this section we make several growth decomposition exercises to evaluate the contribution of each of the first three hypotheses above as explanations for the slow growth in product per worker. In the next section, we present a sectoral analysis to evaluate whether the shift of factors across sectors or the growth within sectors can explain part of the slowdown in product per worker that we observe during the last two decades.

There are several growth accounting studies, some of them using international databases that include Costa Rica, and others specifically about Costa Rica. Why make one more exercise of this type? There are at least three reasons why we should do this. Fist, the international databases for multiple countries in comparative studies of growth decomposition have proved fairly inadequate in the case of Costa Rica. It is necessary to adjust the data since the most commonly used series present important flaws. In section II we discussed the corrections that are necessary in the case of the GDP series. Other data must also be adjusted, as is the case of the capital series, which we derive by more conventional methods than the ones used by Summers and Heston. We will also work to reconcile important differences between the data obtained from the Census and data obtained from the official Household Survey. This is necessary because the census contains better data on demographics and population, while the Household Survey contains data with higher frequency and better quality in employment variables.

Second, given the nature of our hypotheses, we need a decomposition exercise that includes the most recent past (not included in existing studies), in order to understand what happened during the last period, with an opening economy and export-based economic growth.

Third, it is convenient to perform a more detailed study on some of the determinants of Costa Rican TFP. This includes the possibility of changes in factor shares along the period, measures of human capital that take in account the whole distribution of schooling among workers (instead of just the average), or imperfect substitutability between different types of capital.

IV.a Data

Table 4-1 shows the main data used in the growth accounting exercise. The data don't match official series because they have been corrected in multiple ways, which are explained in detail in Appendix A. Some of the most general aspects of the statistical correction, particularly in the schooling data series, are derived in the following. It should be noted that there is significant difference between these data and those used in comparative exercises, including De Gregorio and Lee.

The GDP series is corrected as explained in section II, by geometrically distributing over the 1966-1991 period the difference in GDP value that arises from the transition from the 1966 base year basket to the 1991 basket. We also correct the distortions created by INTEL due to transfer prices and abnormal profits attributable to non-measurable know how.

The physical capital series is generated from investment data, segregating infrastructure and machinery since depreciation rates differ a lot between both types of capital and the composition of accumulation fluctuates a lot in time. Given and initial capital stock, we assume that capital accumulates according the equation $K_{t+1} = (1-\delta) K_t + I_t$, where K_t, δ, e I_t denote capital stock, rate of depreciation, and real investment respectively. Depreciation rates used for machinery and infrastructure respectively were 8.5% and 2.5% respectively (these values were taken from Harberger (1998). We take the capital stock of 1950 as the initial stock. This initial capital is obtained by assuming that the growth rate of real investment and GDP have been fairly stable over a long period before 1950. We assume that these growth rates are equal to their observed average during 1950-1960.

The schooling data do not correspond to the average years of schooling of the working population, because the effect of schooling on productivity is not assumed to be linear. In particular, we assume that the relation between human capital (H) and schooling (s) is given by $H = \sum_{i=1}^{L} e^{\phi s_i}$, where s_i is the number of years of schooling of individual i, and ϕ is the coefficient of a Mincer regression that relates the log of the wage and the number of years of schooling. We define the effective schooling level of the working population as the value $\tilde{s}$ such that $Le^{\phi\tilde{s}} = \sum_{i=1}^{L} e^{\phi s_i}$.[2]

The employment data are based on the population data from Programa Centroamericano de Población after 1976 and census data before that year, and the data on employment rates estimated from the Household Survey. We use information on average hours of work per week to correct the employment growth rate for changes in number of hours worked.

IV.b Physical and Human Capital Accumulation

The growth in factors of production presented on table 4-1 seems particularly low over the whole period, and even more so after 1980. Why does the accumulation of factors of production follow such a disappointing dynamic?

We start with the physical capital, which obviously reflects the value of investment. Two aspects call on our attention and stand out in graphs 4-1 and 4-2. First, investment of all types fell steeply during the debt crisis and took several years to recover its previous trend. Second, public and state investment (the latter includes the first one plus investment by public firms) fell during the debt crisis and took a lot longer to recover its previous trend in comparison to private investment. Graph 4-1 shows that, in real terms, public and state investment barely recovered its pre-crisis levels by 2000 despite the fact that the economy and population are now much larger. Measured as a fraction of GDP, public and state investment is now nearly half its level before the debt crisis.

It is easy to explain the reduction in public and state investment during the debt crisis and its slow recovery thereafter. After the non-payment declaration in 1980, and the subsequent consequences of the financial breakdown, the Costa Rican government had a very limited access to internal and external financial resources. Since then, the access to financial markets by the Costa Rican government has recovered, but a profound fiscal adjustment has not been achieved, and Costa Rica now has a relatively low tax burden. Given its limited tax income, its huge pressures associated to expenditures in debt service, wages, pensions and judicial obligations, and a fragile macroeconomic balance in general, the government postponed important investments. Today, transportation infrastructure is saturated, and there are long waiting lists for services provided by state firms, especially in the case of the state controlled monopoly on electricity and communications.

In the case of private investment, recovery eventually occurred, and the end-of-1990's level is consistent with what could be projected from the years before the debt crisis. Even though private investment gained some strength in recent years (with INTEL and other transnational firms starting operations in Costa Rica), it is still the case that private investment has been relatively low on average during the period.

[2] Note that $\tilde{s}$ is equal to the average schooling level only if all workers have the same degree of schooling.

Even excluding the debt crisis period, private investment averaged 15% of GDP, a much lower level than that of high growth countries all around the world. For example, in 1995, private investment rates were above 30% in South Korea and Malaysia, 22% in East Asia and Pacific and 20% in Chile.

There are several explanations for Costa Rica's low private investment rate. First, the domestic relative price of capital goods with respect to consumption goods is much higher than its international counterpart (this characteristic is common to many developing countries), and this lowers the return on investment. Graph 4-3 shows the evolution of the relative price of investment and the real exchange rate. The relative price of investment is highly correlated with the real exchange rate because capital goods have a larger imported component than consumption goods. Note that in 1963-1980, the relative price of investment was rather high despite a very appreciated real exchange rate. This is consistent with the protectionist policies that prevailed during the period. The huge real exchange depreciation that occurred during the debt crisis also boosted the relative price of investment, which only decreased gradually as the real exchange rate appreciated during the post-crisis period. Although the relative price of investment has decreased, its level is still high by international standards as shown on table 4-2.

Second, financial intermediation in Costa Rica is inefficient and real interest rates are comparatively high. Even in the 1990's, the deposit rates in the banking system average 5.55% and 14.85% in real and nominal terms respectively, with an intermediation margin of nearly 10 percentage points. State-owned financial institutions, which by nature are less efficient than their private counterparts, still represent more than half the financial system in the country. State-owned banks were a much larger fraction of the system a few years ago, and a gradual (but slow) financial reform has taken place since 1984, that has increased efficiency and improved supervision, but the efficiency levels are still low. Today's financial operator is too small, and legislation isolates the country from the international financial market.

Third, saving rates have been low during the period. The government saving rate has been negative for most of a good part of the 1963-2000 period, and the financial sector has failed to stimulate private savings. Until 2000, pensions worked under a pay-as-you-go system, with a low net contribution to total saving. On that year, a reform was made for a switch towards a capitalization system in pensions, that is likely to boost savings and investment rates in the future, but will not have noticeable effects for several years until enough accumulation takes place.

As a compensating factor, Costa Rica has implemented relatively effective policies for the attraction of foreign direct investment (FDI), especially in tourism and manufacturing in "Zonas Francas". Costa Rica was the larger attractor of FDI per capita in Latin America during the 1990's, which is the main reason why private investment recovered after the debt crisis.

Summing up, there are several reasons why Costa Rica has not accumulated physical capital at the necessary speed for this to be a more effective source of growth especially in the 80's and 90's: persistent fiscal deficits that have restricted public investment, high relative price of investment goods, an inefficient financial system and high real interest rates, and low savings. The above is only partially compensated by high rate of FDI.

What explains the evolution of human capital? Back at table 4-1, schooling grows at a healthy annual rate of 10% during 1963-2000. The biggest investments in education were made early in the period and it is before 1984 that most of the increase in schooling takes place. Expansion rates fell to much lower levels thereafter only partially recovering during the last five years.

Table 4-3 shows average schooling years for the population in working age. There is a dramatic growth in schooling, but most of it takes place before the debt crisis. While average schooling grew a total of 2.37 years in the 17 years comprised in 1963-1980, it only grew by 0.9 years over the next 15 years. Neither the dramatic education effort in the pre-crisis period, nor the slowdown after that, are captured by Barro and Lee international data set.

From the above table, one can also note the fact that schooling levels do not differ significantly across genders, in contrast with other developing countries. However, this may be misleading. In table 4-4 we present the schooling data for the working population, where schooling among females is at least one and at some point even two years higher than that among males.

The existence of this difference in schooling levels across genders in the working population (despite their similitude in the general population), can be explained by the fact that the decision to participate in the labor market is much more sensitive to schooling in the female than in the male population. As shown in table 4-5 from household survey 94 and 95 data reported in Fernandez y Trejos (1997), schooling has no significant effect on male participation rates. In contrast, the participation rates of females with post-secondary education are two times as high as those of females who finished primary school, and six times those of females who did not complete primary education. Since the opportunity cost for women is higher at their peak (because work competes with raising their children), only those with more profitable and attractive opportunities work.

What explains the evolution of average schooling of workers in the different sub-periods?
Part of this evolution is explained by an increase in the participation rate of females (and their associated higher education level). By decomposing growth in schooling, we find that, for the period 1963-2000, 78.1% of total growth comes from investment in male education (because male workers constitute a much larger fraction of the labor force), although this contribution drops significantly towards the 90's. The increase in female education explains 15.3% of the total growth in schooling, and 6.6% is explained by the increase in female labor participation. However, by the end of the 90's (95-2000), 41.9% of schooling growth is explained by the last two factors (32.4% by an increase in female schooling, and 9.5% by higher female participation).

What explains the rapid growth in schooling in Costa Rica, and why does it slowdown by mid 1980's? Investment in public education has been an important characteristic of the Costa Rican government for more than a century. En the 60's and 70's, large investments were made to extend the education quality standards in the Central region to the rest of the country, and this explains a good fraction of the accelerated increase in schooling during this period.

The steep schooling slowdown after the debt crisis is mainly caused by financial factors. Investment in education was much more sensitive to social investment contractions associated with fiscal problems, than, for example, health expenditure. The reason is that expenditures in education depend completely on the general fiscal budget, while health expenditure is financed with an independent tax on wages that funds a state-owned institution that does not depend on the Central Government. In particular, as shown on graph 4-4, secondary education was the most affected. Primary education had priority for the government; public university education was financed with an independent source of funds that even allowed for increased investment; and private universities increased their number, quality and size. It took major efforts in the second half of the 90's for secondary education to return to its historic trend. However, the reduction in education immediately after the crisis still weighs on the average schooling of the working population of today.

A second explanation for the post-crisis slowdown in schooling lies on the nature and volume of immigration. During this period, the country has absorbed foreign workers, most of them with low income and coming from nations with lower public education investments. This migration produces a significant increase in the number of workers as well as a reduction in the average schooling level. The data do not allow us to quantify this effect, but it is potentially large given that today 10% or more of the Costa Rican labor force is from Nicaragua, where schooling levels in 1990, according to Barro and Lee, were 3.68 years in comparison to 5.55 years in Costa Rica.

We generate our effective schooling data following the procedure mentioned before and explained in detail in Appendix A. This procedure takes in account the fact that marginal returns to education are not constant, and takes in account the whole distribution of schooling among workers. The comparison between average schooling levels and this effective schooling index is presented on table 4-6.

IV-c Growth Decomposition

Having discussed the evolution of factors of production during the period, we now proceed to apply several growth decomposition procedures in order to understand these factors' contribution to GDP growth, and the evolution of total factor productivity (TFP).

As a starting point, we consider an exercise in which all capital is considered homogeneous, and where all improvements in labor quality attributable to schooling are taken as part of TFP growth. In other words, we reproduce De Gregorio and Lee's exercise, using (as they did) a Cobb Douglas production function assuming a 0.4 capital share and report the results on table 4-7.[3] The difference between their

[3] As shown below, the capital share in Costa Rica takes an average value significantly lower than 0.4. It also fluctuates significantly during this period, which suggests using a function that allows for variable shares instead of a Cobb-Douglas function. For now, we use these assumptions in order to be able to compare our results with those of De Gregorio and Lee. The difference in results can only be

results and ours reflects, exclusively, the corrections that we made to the data. The differences are notorious. In particular, with our corrected data, the growth rate in TFP is considerably higher (0.8% instead of 0.2%), although its level is still disappointing. There are important differences in all variables, including a faster growth in labor, and a slower capital growth than in the international database used by those authors. Differences are most notorious in the 80's, especially in GDP growth, which is 1.2% higher in our data than in De Gregorio and Lee's.

The use of a Cobb-Douglas with a 0.4 capital share makes sense in a multi-country study like De Gregorio and Lee's. However, since we focus exclusively in Costa Rica, we can use a specification that is more consistent with our labor and capital share data. As mentioned before, real wages have grown faster in than labor productivity over the whole period, and this reflects the fact that factor shares in income are variable over time. As shown in table 4-8, these shares fluctuate significantly during the debt crisis. We describe the methodology by which we estimate factor shares in Appendix A. Labor share fluctuates between 59% and 75% during the period, with an average value of 66%, similar to the values reported for other countries by Gollin (2000).[4] In line with our corrections to the data, our estimates of factor income shares in 2000 exclude, from GDP, those INTEL's profits in excess of "normal profits" expected from the average capital unit in Costa Rica.

We now allow for variable factor shares by using a translogarithmic production function (developed independently by Christensen, Jorgenson, and Lau (1971, 1973), Griliches and Ringstad (1971), and Sargan (1971)). Assuming constant returns to scale in a translog production function, and taking first differences, one obtains the following expression for growth decomposition in discrete time:

$$\ln\left(\frac{y_t}{y_{t-1}}\right) = \bar{\alpha}\ln\left(\frac{K_t}{K_{t-1}}\right) + \left(1-\bar{\alpha}\right)\ln\left(\frac{L_t}{L_{t-1}}\right) + PTF_{t-1,t} \qquad (1)$$

where

$$\bar{\alpha} = \left(\alpha_t + \alpha_{t-1}\right)/2 \qquad (2)$$

and α_t is the capital share at time t.

We will take this formulation as a basis for all decomposition exercises from here on. Table 4-9 shows the growth decomposition of GDP per worker into its capital deepening component and TFP growth. Observe that there are slight differences between these results and the ones obtained with the Cobb-Douglas production function.

Up to now, the pictured describe is one of a country where TFP has increased, although not dramatically, for a long time. The former decompositions, take the improvements in labor quality as part of TFP growth. However, in a country like Costa Rica, where investment in education fluctuates drastically during the period of

attributed to differences between our data and those in international databases like Summers and Heston's.

[4] Bernanke et al report 0.74 for labor participation in Costa Rica, using the same methodoloy that we use here for average data in the period 1980-1995.

study, it is important to single out the contribution of schooling to growth. The first step is to repeat the above analysis using our information on human capital to define employment in terms of quality units. In this way, the contributions of capital and employment are the same as before, but now we know how much of the growth in productivity can be attributed to human capital. Results are presented on table 4-10.

The outcome is interesting and disappointing. All the sources of growth for GDP per worker grow at a much lower pace in the post-crisis period (1984-2000), than during the Central American Common Market period 1963-1973. Capital and schooling accumulation, that contributed 2.24% and 2.76% to annual growth in 63-73 and 73-80 respectively, fall to 1.22%. Total factor productivity increases by only 0.23% annual since 1984, despite the positive changes experienced by this economy, which should have had a stronger effect on productivity. Once we extract the effect of schooling increases, the Costa Rican TFP has remained practically constant for almost 40 years. In fact, TFP has fallen by almost 14% in 27 years since 1973. Productivity increased rapidly during the imports substitution period in the context of the Central American Common Market, but started to fall by mid 70's.

The fact that TFP falls so dramatically is surprising, especially given that the data have already been corrected for important flaws that produce a downward bias on productivity. In particular, as explained before (and detailed in Appendix A), the GDP growth series was corrected to reflect a gradual development of the new sectors that accounted for 27% of total production in 1991, but were almost inexistent in 1966 (the base year used for GDP measurement until 1991). Similarly, we avoid usual measures of human capital that use investment in education instead of schooling stock, and that would over-estimate human capital growth by leaving out the effect of immigration on average schooling.

One explanation for low productivity growth is related to the composition of investment in physical capital. Conventional production functions used in growth accounting group all types of investment in physical capital as if these goods were perfect substitutes for one another. In reality, there are important complementarities between certain types of public capital and private capital (infrastructure and vehicles; telecommunications and computers; electricity and industrial equipment; etc.). This is relevant to our growth accounting exercise because investment composition has changed a lot during the last twenty years as a result of the financial constraints that affect the public sector after the debt crisis. While public investment increased steeply before 1980, reaching levels higher than 50% of total investment, the period after 1984 saw a rapid drop in this ratio. Today, the ratio of public to private investment is only half its 1980 level as shown on graph 4-5.

Table 4-11 shows the growth rates for public and private capital. Part of what we call public capital corresponds to investments made by state-owned firms that operate independently, and include electricity, telecommunications, alcohol, insurance, and half the banking sector. The nature of these investments is similar to that of private firms, in the sense that these capital goods do not constitute a *public* good. They are different from other public investments such as transportation infrastructure. Fortunately, the data allow us to distinguish between these two types of public capital. We generate two more capital series, one that includes private firms capital plus capital from state-owned firms, and another one that includes mainly transportation infrastructure. Graph 4-6 shows the evolution of both series.

How can we take in account the change in investment composition in a growth accounting exercise? We first use a specification in which public capital is a public good that externally affects the productivity residual using parameters estimated by Cavalcanti and Issler (). The specification used for growth decomposition is given by:

$$\ln\left(\frac{y_t}{y_{t-1}}\right)=\bar{\alpha}\ln\left(\frac{K_t^{empresa}}{K_{t-1}^{empresa}}\right)+\left(1-\bar{\alpha}\right)\ln\left(\frac{H_t}{H_{t-1}}\right)+0.05\ln\left(K_{pub}\right) \tag{3}$$

where the "entrepreneurial" capital stock is: $K^{empresa}=K_{pri}+K_{ee}$, and K_{pri} is private capital while K_{ee} is the capital stock of state-owned firms. K_{pub} is the stock of public capital (mainly transportation infrastructure) that has a public good nature. The growth decomposition results are presented on table 4-12. The second column shows the contribution of $K^{empresa}$, and the last column is the contribution of K_{pub}. The TFP column contains the contribution of total factor productivity, while the residual component is the part of TFP that corresponds to the external effect of public capital.

This exercise clarifies some of the previous results. Due to the accelerated public investment effort in 63-73, TFP seems to grow at a fast rate during this period, which is no longer true once we account for the external effect of public capital. Moreover, the drop in TFP during 1973-1980 is now a lot deeper than in our previous calculations because of the significant effect of public investment during that period. The contribution of private investment after 1984 is now slightly bigger than in previous exercises.

Finally, consider the above exercise allowing for the possibility that the capital stock in state-owned firms is complementary to that of private firms. In this case, we define entrepreneurial capital as the following composite good: $K^{empresa}=K_{pri}^{\theta}K_{ee}^{1-\theta}$. We calibrate the value of θ so as to get similar implied rates of return on capital belonging to private and to state-owned firms. Table 4-13 presents the main results.

The main effect of allowing for this complementarity is a slight increase in the contribution of entrepreneurial capital in the 63-80 period. This reflects the change in capital composition that occurs in this period. Table 4-14 shows the evolution of both types of entrepreneurial capital, and the significant increase in the ratio of K_{ee} to K_{pri} during 1963-1980. The value with which theta was calibrated implies that the optimal ratio of K_{ee} to K_{pri} is 0.17, which is the observed average over the period. During the 63-80 period the ratio of capitals approaches this value. Hence, the growth rate in the composite entrepreneurial stock is higher than the one obtained when both types of capital are assumed perfect substitutes for each other. This causes our productivity to grow less during the first 17 years of the study.

Table 4-15 sums up our results on total factor productivity. First, as soon as we take in account the effect of schooling, the productivity growth rate turns negative for the whole period. The only sub-period with an acceptable TFP growth is 1963-1973. Second, as we introduce more complex (and, in principle, more adequate) specifications, the reduction in TFP growth between 63-73 and 84-2000 becomes less significant. In this way, we go from a 1.1% reduction according to De Gregorio and Lee's methodology to 0.9% when schooling is introduced, and 0.67% when the independent contribution of public investment is taken in account. (This last number does not change significantly when we allow for complementarities between capital in private and state-owned firms).

The following sections explore two possible explanations for the low productivity growth in Costa Rica. Section V studies the change in sectoral composition of the economy. In section VI, we present a statistical analysis that illustrates the sensitivity of the Costa Rican economy to eh evolution of the international economy, and the deterioration of external conditions, especially at the end of the period.

Section V: Analysis by Sectors

Up until now, we have noted that GDP per worker growth rate is low for al sub-periods except for 1963-1973 when the growth rate was 3.8%. The growth rate of GDP per worker for the whole period was 1.5%, which is low in comparison with developed and East Asian countries.

This low growth rate has been accompanied, and is probably the result of, a negative growth rate in TFP (-0.17%) for the entire period. The productivity growth rate was relatively high during 63-73, but then dropped considerably during the following years. The key question is, why has TFP remained stagnant or has even dropped during the last three decades in Costa Rica?

Several approaches can be used to tackle this hard question. In this section we make a sector analysis in order to find out whether low TFP growth rate is common across sectors or whether the problem is localized in a particular sector or sectors. This analysis will also allow us to measure the extent to which factor shifts across sectors have contributed to TFP growth, and to the slowdown observed during the periods following the 1963-1973 sub-period.

V.a Sector Analysis of Labor Productivity

We begin by focusing on labor productivity in the different sectors. Because we lack the necessary data to estimate labor shares by sector, and because sector investment data are not trustworthy, we only comment on some of the conclusions suggested by a more complete but less trustworthy analysis of total factor productivity.

In the first place, it is important to formally specify the methodology followed in this analysis, which is common among long run growth studies. The first step is to estimate the fraction of total GDP growth that is associated with growth in different sectors -- given the initial employment distribution across sectors—and the fractions associated with labor reallocation from low to high productivity sectors. Formally,

$$y = \sum_i l_i y_i \tag{4}$$

where y represents GDP per worker, y_i is value added per worker in sector i, and l_i is the fraction of workers in sector i. Hence, the absolute change in y can be written as:

$$\Delta y = \sum_i \left[(\Delta l_i)\, y_i + l_i (\Delta y_i) + (\Delta l_i)(\Delta y_i) \right] \tag{5}$$

Dividing both sides of (5) by y, we obtain the following expression in terms of growth rates:

$$\frac{\Delta y}{y} = \sum_i \left[(\Delta l_i) \frac{y_i}{y} + l_i \frac{y_i}{y} \left(\frac{\Delta y_i}{y_i} \right) + (\Delta l_i) \frac{y_i}{y} \left(\frac{\Delta y_i}{y_i} \right) \right] \tag{6}$$

The first term in (6) is the growth component associated with labor reallocation across sectors, known in the literature as "shift share". The second term is associated with productivity growth in each sector given the initial fraction of labor allocated to each sector, and given the initial ratio of sector productivity to general productivity of labor. The third term is a cross-product of these two effects.

Several issues should be considered prior to this analysis. First, the analysis assumes that the reallocation of labor does not generate changes in average product of labor. Otherwise, the change in y_i that appears in the second and third terms of equation (6) would partly be the result of labor reallocation, and the first term could no longer be interpreted as gathering the full shift share effect on growth. To the extent that labor is not the only factor whose allocation shifts across sectors, the interpretation of the first term in (6) as the shift share term becomes turns out to be more accurate. This is because, assuming constant returns to scale, it is possible to shift all factors across sectors without affecting average products as long as the ratios of labor to capital are kept constant.

Another implicit assumption in this analysis is that labor is homogeneous. Otherwise, one could think of the case in which labor productivity is higher in one sector than another just because workers in the first sector are more educated. In this case, an increase in workers' schooling that causes them to move towards more human capital-intensive sectors would be wrongly interpreted as a shift share effect.

Finally, in this section we don't assume that the economy starts in a general equilibrium situation, where real wage is equal to marginal product of labor, and that marginal product is equal across sectors. One of the models that gives birth to this analysis is in Lewis (1954), where there is surplus labor in the agricultural sector. This model assumes that marginal product of labor is lower in agriculture than in the industrial sector, but labor may not flow out of agriculture because workers are paid their average instead of their marginal product in agriculture. As long as the average product is equal or higher than wages in the rest of the economy (where real wage is assumed to be equal to marginal product), labor will not flow out of agriculture. In this case, when labor flows from agriculture to the rest of the economy, an increase in productivity takes place.

Summing up, the following shift-share analysis identifies an element that affects total factor productivity, but the results depend on the above assumptions. Alternative interpretations must be admitted if the assumptions above do not hold. Having made these qualifications, we present the a shift share analysis for the case of Costa Rica.

First, we run the analysis using the national accounts data with 1966 as the base year. This series ends in 1998. Then we use the 1991-base year series from national accounts to analyze the period 1991-2000.

One must be careful when interpreting the results obtained with the 1966 base year series, because production is measured at 1966 relative prices, which were highly distorted by import substitution policies. Tables 5.1 and 5.2 show respectively the allocation structure of labor across sectors, and the average product of labor per sector along the period of study. As is typical in the development process of many countries (Maddison, 1982), there is an important reallocation of labor from agriculture to industry and services, with an accelerated increase of employment in the two latter sectors. Also notice that the average product of labor is significantly lower in agriculture than in the other sectors especially at the beginning of the period. Therefore, our expectation is that the shift of resources across sectors will be an important explanatory factor for growth during the period.

Table 5.2 shows the growth rate in labor productivity in each of the different sectors. In general, the productivity growth rate is significantly higher in the agricultural and industrial sectors than in the service sector, where commerce, restaurants and hotels grow at –1.5%, and the other services grow at –0.02% for the rest of the period. We also observe a slowdown in the agricultural and industrial sectors after the first sub-period.

Table 5.3 show the analysis results. The conclusion is that the slowdown is explained by both, a lower productivity growth rate in each of the sectors, and a smaller contribution of factor shifts across sectors. What is the cause of this behaviour?

The slowdown in productivity growth within sectors is explained partly by a slower growth in agriculture and industry, but especially by an increase in relative size of the services sector where productivity growth has been negative over the whole period. The reduction in "shift share" is explained by two factors: first, a reduction in labor reallocation across sectors, and smaller differences in productivity levels between sectors.

Now we turn to the analysis based on 1991-base-year series from national accounts. To save space, we do not present all the data here (Appendix B contains a complete analysis). Instead, we highlight two results. First, the annual growth rate in labor productivity for 1991-2000 is higher than the one observed for the 84-98 period with the 1966 based series. This suggests that the slowdown in agriculture and industry as growth engines is not as strong as suggested above. Second, the observation that shift-share was very small during these years still remains.

Summing up, the slowdown in labor productivity observed in the last period is responds two three different factors: the "engine" sectors for growth (agriculture and manufactures) grew at a lower pace. Second, the relative size of the service sector increased, and therefore augmented the effect of its typically low productivity growth on the economy wide productivity estimate. Third, the "shift share" contribution almost disappeared due to smaller labor shifts from sector to sector and smaller differences in productivity across sectors.

V.b Sector Analysis of Total Factor Productivity

In this section we repeat the above analysis, but now include physical capital in addition to labor. To save space, we omit the description of this exercise and the corresponding tables, and just focus on the main results:[5]

- TFP in agriculture is lower than in the rest of the economy at the beginning of the period, but this difference decreases in time.
- Just as with labor, the proportion of capital absorbed by agriculture decreases over time. This reallocation is such that the capital to labor ratio increases in industry and decreases in the service sector. Taking a composite of labor and capital (based on a Cobb-Douglas with capital share equal to 0.3) as a measure of total inputs used in each sector, we obtain that factors of production were mainly reallocated towards services. The relative allocation in industry increased (although less than in services), and construction kept its participation constant.
- The higher TFP growth sectors were agriculture and manufacture, although there is a slowdown in the post-crisis period with respect to the Central American Common Market period (1963-1973).
- The productivity growth rate in services is negative, although this trend is reverted in the post-crisis period with a 0.7% growth rate during 1984-1994.
- The shift-share has an important contribution to TFP growth during 1963-1973, but it almost disappeared in the subsequent periods.

What do we learn from including capital in the analysis? First, we obtain information on the extent to which the evolution of labor productivity is the result of changes in the capital-labor endowment in each sector. This endowment increases significantly in agriculture and manufacture, but only increases slowly in services and construction sectors. This explains, albeit only partially, the faster growth of labor productivity in agriculture and manufacture in relation to services.

Second, the high growth in labor productivity in the industrial sector during the CACM period is not only due to an increased capital to labor ratio: although the investment rate was high, TFP displays significant growth too in this sector. The same is true for agriculture although this is less surprising since, in contrast with manufacture, this sector did not benefit from protection schemes.

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[5] In this análisis, we asume an identical Cobb-Douglas production function for all sectors of the economy, with a capital income share equal to 0.3. We generate a capital stock series for each sector following the same methodology applied to the whole economy in the previous section. We lack deflators for sector specific investment and therefore use the general investment deflator instead. The initial capital stock in each sector is calculated assuming that the investment rate is stationary during a long period previous to 1963, and equal to the average investment rate observed in 1966-1973. We do this exercise using the 1966-base year series only, because the sector investment series are not available with 1991 as a base year. The last year for which we have the necessary data is 1994, and therefore, the period of analysis is 1963-1994.

Third, this analysis suggests that part of the slow growth in labor productivity in services responds to a stagnant capital to labor ratio in this sector. This is relevant because it is an indicator that not all of the difference in labor productivity performance with respect to other sectors is due to measurement problems. Instead, it seems like technological or regulation factors may be generating low returns that not only produce slow TFP growth but also low investment rates.

V.c Some on the sector analysis results

From the above analysis, several questions follow:

- Why is there a slowdown in labor productivity and TFP in the agricultural and industrial sectors from the CACM period (1963-1973) to the post-crisis period?
- Why is growth in labor productivity and TFP so low in the services sector?
- Why have the agricultural and industrial sectors come to represent a relatively small fraction of the economy.
- If the low productivity growth in services and the increasing relative size of this sector are typical trends in developing countries, what have East Asian countries done to maintain high growth rates in product per worker?

A rigorous answer to these questions is out of the scope of this paper. Here we will limit ourselves to discuss some possible answers.

Why is there a slowdown in labor productivity and TFP in the agricultural and industrial sectors from the CACM period (1963-1973) to the post-crisis period?

The deceleration in the agricultural sector is probably due to the end of the green revolution. However, it should be noted that the labor productivity growth rate in 1991-2000 (with 91 as the base year) was 3.3%, which is not very low. Also, this growth is associated to an increase in non-traditional exports, which include a wide range of products, in contrast with a high concentration in coffee and bananas in 63-73. This diversification is important because it reduces the vulnerability of the economy to fluctuations in the prices of a few products.

In the industrial sector, labor productivity growth decreased from 5.5% annual in the CACM period to 4.2% in 91-2000 (using the 1991 base year series and adjusting for INTEL). This seems to be an indicator that circumstances were not as favorable in the post-crisis period as they were in the CACM period. However, several observations are relevant on this matter. First, the growth reduction is not very significant, and the 4.2% growth rate is relatively high in comparison with the world average, although it is still lower than those in Taiwan, Korea, and Singapore (7.8%, 4.9%, and 4% respectively for the 66-90 period). Second, one could argue that the growth rate in the industrial sector during the imports substitution period was unsustainable because the economy would have to open to trade eventually, and some firms would fail to compete in the new environment. The recent growth has taken place in liberalized trade environment, and one could assume that such growth is sustainable and does not impose a heavy burden on the rest of the economy. Third, the most dynamic growth has taken place with firms installed in Export Processing

Zones (EPZ), which belong mostly to the industrial sector. Table 5.4 shows the value added (adjusted for INTEL) in EPZ's, at constant 91 prices, and the number of workers in this regime. Growth rate per worker has been 10.9% annual during the 91-2000 period, which is very high, and explains part of the dynamism of industry as a whole. However it should be noted that EPZ's account for only 2.6% of total employment, and therefore this sector cannot produce a huge impact on the global economy.

- Why is growth in labor productivity and TFP so low in the services sector?

One possibility is that this is a universal phenomenon, probably due to methodological problems with measurement of value added in this sector. However, according to Maddison (1982), the labor productivity annual growth rates in 1950-1963 in services were 3% in France and Germany, 3.6% in Japan, 2.4% in Holland, 1.6% in UK, and 1.8% in US.

The evolution of capital to labor ratio does not support the measurement problem hypothesis either. The annual growth in the capital to labor ratio during 63-94 was 4.3% and 3.1% in agriculture and manufacture respectively. Instead, in the services sector, this ration increased at only 0.5% per annum, which is consistent with a genuinely low growth in labor productivity in this sector.

An interesting exercise, which will be left for further research, would be to compare the labor productivity in Costa Rica and the US by sectors. Is it true that Costa Rican services sector is lagging farther behind, than the industrial and agricultural sectors, with respect to those same sectors in the US?

Finally, we explore which sub-sectors in the services sector may be responsible for this slow growth in productivity. Table 5.5 presents the annual growth rate in labor productivity during 1991-2000 for those sub-sectors on which we have the necessary data. "Electricity and water", and "transportation, storage and communications" are the only two sub-sectors with positive growth rates in productivity. "Commerce, restaurants and hotels", and "communal, social and personal services" (which include public administration) absorb 80% of total employment in services. The low growth rates in labor productivity in these two sectores (-0.3% and –0.7%) explain most of the bad performance of the services sector during this period. The low productivity growth in "commerce, restaurants and hotels" is most puzzling since tourism has grown dynamically during the 90's, and is closely related to these services. Future research should address this issue.

Why have the agricultural and industrial sectors come to represent a relatively small fraction of the economy?

Table 5.6 compares the relative size of the agricultural and industrial sectors in Costa Rica with that of other developing countries. Taking agriculture and industry together, the relative size of these sectors is smaller than that of Brazil, and significantly smaller than that of South Korea, Chile and Malaysia. The relative size of these sectors is smaller in Mexico and Singapore than in Costa Rica, but Singapore is not a fair comparison since this country lacks agriculture almost completely. The relative size of the services sector in Costa Rica is not to far from that of developed countries. It would be interesting here to obtain the expected size of agriculture and services in Costa Rica given its per capita income. This is also left for future research.

Back to table 5.6, observe that Costa Rica has the smallest industrial sector of the group of countries included in the table. In fact, the relatively small size of agriculture and industry taken together reflects completely the small size of the industrial sector, since its agricultural sector is one of the biggest presented in this table (only surpassed by Malaysia).

What explains the small relative size of the Costa Rican industrial sector? For now, we can only offer hypothesis without an adequate empirical backing. Notice that, with exception of Singapore, all the countries that we used for comparison are substantially bigger than Costa Rica. Our first hypothesis is that small economies can only develop a relatively big industrial sector if they are well integrated with the international economy. Costa Rica only began to follow this strategy in 1984, and more time may be needed for the development of a strong industrial.

A second hypothesis is that the real exchange rate in Costa Rica has been over valued for a long time, damaging the production of tradables such as agriculture and manufactures. A third hypothesis is that there are several elements that reduce competitiveness in the industrial sectors, such as infrastructures deficiencies, high real interest rates, lagging telecommunication services, and different regulations that increase the costs of business in the country.

If the low productivity growth in services and the increasing relative size of this sector are typical trends in developing countries, what have East Asian countries done to maintain high growth rates in product per worker?

From Young (1994), we conclude that these countries were able to maintain high growth rates in labor productivity, thanks to a combination of the following elements:

- High productivity growth rates in services
- A service sector whose relative participation in GDP does not grow too much
- A progressive increase in productivity growth in manufactures and agriculture, compensating for the tendency of these two sectors to reduce their relative weight in factor employment

VI. Statistical Analysis

The goal of this section is to explore the empirical relation between Costa Rican GDP growth rate, and some internal and external variables that may have an influence on it. In particular, we aim to explain clear differences in GDP growth rates observed in 63-73, and 84-2000, and, within this last period, the slowdown observed during the second half of the 90's. How much of this deceleration can be explained by external shocks? What fraction of the forecast error variance can be explained by external shocks in the 90's?

We split our analysis in two parts. First, we do a regression analysis using annual data in which we use external as well as internal (but exogenous) variables to explain the evolution of GDP growth rate. The results of this analysis point towards the great influence of terms of trade, international real interest rates and US GDP growth, on the Costa Rican GDP growth rates. Using this results, we infer how much of the deceleration observed from 63-73 to the post-crisis period is explained by these external factors.

In contrast with external variables, the domestic variables used in this analysis were not statistically significant or showed up with the wrong sign (not consistent with the theory or with other studies). A good part of the problem is that there are very few exogenous domestic variables to choose from.

The second part of this analysis estimates a VAR model to describe the relation between domestic growth and the evolution of external and internal variables. This allows us to include endogenous domestic variables that may help explain GDP growth rates. In general, the relation between the variables included and their lagged values respond to short run dynamics. For this reason we use quarterly data in this exercise, and limit ourselves to the 1991-2000 period because quarterly data are not available before 1991. We use this methodology to explain the slowdown in Costa Rican production observed between the first and second half of the 90's, and estimate the fraction of GDP forecast error variance that is explained by internal and external shocks.

We use three main references for this section. The first one is Perry et al (1999), the second is Monge et. Al (1999), and the third one is Hoffmaister and Roldos (2001). This last one uses a structural VAR with long run restrictions to explore the importance of external and internal shocks as determinants of GDP growth in Brazil and Korea. In our VAR analysis we use a model very similar to this one.

VI.a Annual data regressions for 1961-2000 period

In the first regression analysis, we use US GDP growth rate, terms of trade, and real interest rate as external explanatory variables, denoted by DLYUS, RSTAR, AND DLTOT respectively. In addition, we include the following as domestic, exogenous variables: government consumption (CGOB), public investment (IGOB), and dummies for election years and pre-election years (CICLO 1 and CICLO2).

Table 6.1 shows the results. In general, the external variables are significant and have the expected sign: faster US growth, terms of trade improvements, and low international real interest rates stimulate domestic growth. Domestic variables, however, were not significant (this happened with CICLO1, CICLO2, and CGOB) or had the "wrong sign" as is the case on public investment which has a negative sign.

On table 6.2 we present the results obtained when we only include external variables (this time we include terms of trade with one lag). Just like in the previous regression, all these variables have coefficients that are significant and have the expected sign. It is surprising that these three variables explain almost 60% of the total variance in domestic GDP growth ($R2 = 0.595$).

As explained before, there is an important difference in growth rates between periods 63-73 (7.3%) and 1984-2000 (4.7%). How much of this difference is associated to a deterioration in the international conditions faced by the country?

We answer this question by comparing the change in average growth rate predicted by our regression model with the change that is actually observed. On table 6.3, we denote these two periods by Periodo 1 and Periodo 4. When we compare the projected and observed values of domestic growth is each of the periods, we obtain that the predicts a reduction of 2.5 percentage points in growth rate, while the observed reduction is 2.6 percentage points. That is, the evolution of external variables explains almost all of the reduction in domestic growth between periods 1 and 4. Of this projected growth reduction, 0.7 points are explained by the evolution of US GDP growth, and 2 points by the evolution of international interest rates. The evolution of terms of trade was favorable but only contribute with 0.1 percentage points to the change in growth.

VI.b Vector Autoregression Model

In this section we estimate a near-VAR[6], following a similar procedure as that described in Hoffmaister and Roldos (2001). These authors estimate a VAR that includes oil price, US GDP growth, domestic GDP growth, real exchange rate, and domestic prices. In the following model we add the international real interest rate to the previous variables, and substitute oil price for terms of trade faced by Costa Rica.

The procedure followed for the identification of the structural VAR is based on the methodology of Blanchard and Quah (1989), in which they propose using long run restrictions on endogenous variables to achieve identification.

Model Specification:

This VAR model is composed of six equations, one for each of the following endogenous variables: terms of trade, international real interest rate, US GDP, domestic GDP, real exchange rate, and domestic prices. These variables are denoted by $p^*, r^*, y^{us}, y, q, p$ respectively.[7]

The specification used is the following:

$$y_t = A(L) y_t + v_t \tag{7}$$

where A(L) is a lags polinomial,

$$y_t = x_t - x_{t-1} \tag{8}$$

and

[6] The term near-VAR refers to the fact that not all equations contain lags of the same variables on the right hand side.

[7] We also include three seasonal dummies (s2, s3, s4) for the second, tirad, and fourth quarters of each year.

$$x_t = \left(p_t^*, r_t^*, y_t^*, y_t, q_t, p_t \right) \quad (9)$$

All variables are presented in first differences, as this is necessary to implement the identification procedure proposed by Blanchard and Quah (1989).

The first three equations of the model correspond to external variables (terms of trade, international real interest rate, and US production). These are modeled as independent of domestic variables and their lags both in the short and the long run (small economy assumption). The last three equations correspond to the domestic variables. The equation with domestic GDP on the left hand side is interpreted as a supply equation. The equation for real exchange rate is interpreted as a demand equation for non tradables; and the equation for domestic prices is interpreted as an aggregate demand equation. We impose the following long run restrictions for the identification of the structural VAR. In the long run, terms of trade are independent of the other variables in the model, and the international real interest rate only depends on the terms of trade. Also, in the long run, we assume that shocks on the relative demand for tradable goods (shocks on real exchange rate), do not affect domestic production, and shocks on aggregate demand (and therefore on general level of domestic prices) have no effect on either production or real exchange rate.

The methodology followed for error orthogonalization is described in Appendix C.

General Evolution of Endogenous Variables

Graphs 6.1 and 6.2 show the evolution of endogenous variables in levels and first differences respectively, over the 1991-2000 period. Terms of trade level is characterized by two main peaks, one during 94-95, and another one in 97-98, while the end of the period sees a sizable deterioration (decrease) in this variable. The international real interest rate maintains a relatively low level during the initial years of the period (until 1994), but then increases by three or four percentage points, and keeps this high level for the rest of the period except for the first half of 1999. As we explain below, this behavior will be an important determinant in the production slowdown observed after 1996. This variable is obtained based on the Prime Rate, deflated by the inflation rate of one year ahead.

The growth rate in quarterly US GDP (graph 6.2 and table 6.4) is relatively high during most of the period (0.9% on average). However, in the second half of 1992, and at the beginning of 1995, we observe significant decelerations in production which, as noted below, had important effects on Costa Rican GDP growth.

Regarding the evolution of domestic variables, the following features are worth highlighting. The domestic growth rate decreased significantly in 1995 and 1996 (with 3.9% and 0.9% respectively). The real exchange rate is characterized by a continuous appreciation during the 1991-1998 period (graph 6.1), but this trend reverts after 1998. Inflation is relatively high especially at the beginning of the decade, and in 1994 and 1995. After 1995, inflation decreases to levels around 12%.

Empirical Results

Estimated coefficients for the VAR model are presented on table 6.5. Table 6.6 shows the decomposition of forecast error variance for Costa Rican GDP. The decomposition of variance for the other five endogenous variables are presented in Appendix C.

The forecast error variance of each endogenous variable can be expressed as the sum of variances of orthogonal errors corresponding to each of the equation in the structural VAR. Using the methodology described above for error orthogonalization, we obtain a variance decomposition. Since the variance is conditional on the number of periods ahead for which the forecast is made, we present the variance decomposition for one through twelve quarters ahead. Table 6.6 contains the variance decomposition for Costa Rican GDP, which almost converges within 12 quarters. The resulting decomposition is the following: 26% is associated with external variables (change in terms of trade, change in international real interest rate, and US GDP growth), 47% is associated with supply shocks, and the rest is associate with shocks on relative demand for non tradables and aggregate demand.

Histórical Decomposition

The evolution of each endogenous variable during the 1991-2000 period can be decomposed in two parts. The first one is the projection of the model given information available at the beginning of the period (i.e. the values the each variable takes during 1991). The second one is the deviation of the forecast (based on beginning of period information) from the observed value due to shocks on each of the endogenous variables. This second part can be attributed to orthogonal shocks on the variable in question and the other five. Here we focus on the historical forecast error for Costa Rican GDP, and the contribution of shocks on each endogenous variable to this observed error in forecast.

Graphs 6.3 and 6.4 show observed and forecasted values of Costa Rican GDP. The forecast is obtained using the VAR estimates and the 1991 values that each variable took in 1991. In the first graph, we present both series in logs. Observed GDP is higher than the projected value during the whole first half of the 90's. On average, the difference is nearly 2%, as shown on graph 6.4. From the fourth quarter of 1995 on, the situation is reverted, with a production forecast higher than the values observed until 1998. During this period, the difference between forecasted and observed values reaches up to 7% of the forecasted value. The evolution of both series during 1998 and 1999 reflects the beginning of operations of INTEL. The observed GDP is higher than the forecast during these two years, and this situation only reverts in 2000.

Graph 6.5 gives a clear picture of the relation between external variables and domestic production deceleration during the second half of the 90's. Here we present a) the percentage difference between observed and projected (or fitted) GDP, b) the part of this difference due to innovations in internal variables, and c) the part due to innovations in external variables. Observe that the fall of the observed GDP below the projected value in 95-97 is strongly associated with shocks on external variables that negatively affected domestic production beginning in the second half of 94 and until the first half of 1998. Likewise, a deterioration in external conditions at the end of the period reflects on below-forecast GDP levels. In this last episode, internal shocks also had a negative effect on domestic production.

The negative effect of external variables is associated mainly with the behavior of international interest rates and US GDP slowdown episodes. Graphs 6.6, 6.7, and 6.8 show the percentage difference between observed and projected GDP, that is associated with the evolution of terms of trade, interest rates, and US GDP respectively. Notice that interest rates and US GDP growth explain up to a four percent difference between observed and forecasted domestic GDP in 1996 and 1997.

Impulse-Response Functions

Impulse response functions, shown on graphs 6.12, 6.13, and 6.14, give the effect on an endogenous variable of a one-standard-deviation orthogonal shock on each of the structural VAR equations. In each case we show the response of the endogenous variable´s *level*, to shocks on the structural equations. We focus on the response of domestic variables to shocks on external variable equations.

Graph 6.13 presents the effect of external shocks on domestic variables. As expected, domestic GDP has a positive response to improvements in terms of trade and higher US GDP growth, while it reacts negatively to increases in international real interest rates.

Real exchange rate responses are consistent with the theory too. Real exchange rate decreases as a response to a positive shock on terms of trade, which could reflect a positive wealth effect on the demand of non-tradable goods. Also, the real exchange rate depreciates in response to increases in real interest rates, an intertemporal substitution effect in the demand for non-tradables. Finally, shocks on US GDP growth seem to produce a depreciation in real exchange rate on the long run.

The response of the general price level to improvements in terms of trade is consistent with a positive wealth effect, but its reaction to increases en real interest rates and US economic growth is puzzling.

Graph 6.14 shows the reaction of domestic variables to domestic shocks. A positive supply shock has a positive and permanent effect on domestic GDP. A shock on real exchange rate has positive (but temporary by construction) effect on GDP. Oddly, an aggregate demand shock has an oscillatory effect on GDP, which disappears in the long run owing the imposed long run restrictions.

A supply shock causes a permanent appreciation in the ral exchange rate (consistent with a wealth effect on the demand for non-tradables), but, for no clear reasons, an aggregate demand shock produces a temporal real depreciation in the exchange rate. Finally, the response of general domestic prices to a supply shock is negative, while the response to real exchange rate shock is positive.

VII – Conclusions, final remarks and directions for further research

We pointed out at the beginning of this study that the rate of growth of Costa Rica´s income per capita has been mediocre, in spite of the country´s very favorable conditions. We also pointed out that the rate of growth has declined in recent decades, in comparison with the high growth rates experienced during the sixties. This is surprising because it is in the 80s and 90s when important reforms have taken place, mainly in the fiscal, trade and financial areas. Two main questions arise: why is the rate of growth in Costa Rica so mediocre? Why is it that growth has decelerated in the last two decades? We now summarize what the different quantitative exercises done in the previous sections suggest about possible answers to these two questions.

Why is the rate of growth in Costa Rica so mediocre?

The first thing we discovered is that there is an important contribution from the increasing participation rate to the growth in income per capita. In the period under study (1963 – 2000), this element has contributed 0.7 percentage points to the annual rate of growth of income per capita, a contribution that is similar to the one experienced in other developing countries such as Mexico, Brazil and Chile, although lower than that in the countries of East Asia. This increase in the participation rate is due mainly to the demographic change, which generates an increase in the proportion of the population that has working age, but it also comes from an increase in participation of women and immigration, mainly from Nicaragua.

Given that the increasing participation rate has contributed significantly to the growth of income per capita, it follows that the main reason behind slow growth is the slow growth of labor productivity, which has been 1.57% annually in the period under study, in comparison with rates between 3% and 4% in East Asian countries. We can thus reformulate the question: why is that the rate of growth of labor productivity has been so mediocre in the Costa Rican case?

A first analysis we performed to answer this question is based on a careful exercise of growth accounting. This exercise shows very clearly that the main reason for the slow growth of labor productivity is the slightly negative growth rate of total factor productivity. This is very surprising, because it is clear that from 1963 to 2000 there have been enormous technological improvements that have allowed the most advanced countries to sustain rates of TFP growth above 1% annually, and even higher growth rates in the East Asian countries. How can it be that Costa Rica has not been able to increse its TFP level in almost four decades?

We turned next to a sectoral analysis, to determine whether the slow growth of productivity is a general phenomenon or if it is associated more closely with a particular sector. Here we also arrived at a very clear conclusion, and that is that the industrial and agricultural sectors have experienced high rates of growth of labor productivity and TFP, and that the main reason for the slow TFP growth is the productivity stagnation in the service sector. This problem becomes even more interesting when we note that this sector absorbs a large share of resources. In fact, the services share of GDP in Costa Rica is even larger than in countries such as Brazil, Chile and clearly larger than in the countries of East Asia with significant agricultural sectors (which excludes Singapore and Hong Kong), such as Malaysia and South Korea. Two new questions arise: first, why is it that the services sector is not able to sustain positive growth in productivity? Second, why is it that the agricultural and industrial sectors are so small in Costa Rica?

Regarding the first question, several reasons lead us to discard the hypothesis that this is an internationally common phenomenon, perhaps because it is difficult to capture productivity growth in the services sector. We thus performed a more disaggregate analysis for this sector in Costa Rica, with data from the period 1991 – 2000. This analysis suggests that the sub-sectors that generate the stagnation are "commerce, restaurants and hotels," and "community, social and personal services," which includes the general government. It is surprising that the boom in tourism during the 90s did not generate an increase in productivity in the "commerce, restaurants and hotels," sector. This is an interesting and important area for future research.

Turning to the second question, it is clear that the problem is not in the agricultural sector, which is even larger in relation to total GDP than in various other developing countries (Chile, Brazil, Mexico, Malaysia, South Korea). The problem is associated with the industrial sector, which is significantly smaller in relation to GDP than in this group of countries. We have proposed three hypotheses to explain this phenomenon, but their empirical evaluation is left for future research. The first hypothesis is that Costa Rica being so small, the only way to sustain a large industrial sector is through international trade, but this process started only recently, so it has not had enough time to flourish. The second hypothesis is that the relative price of services is relatively high, something which could be associated with an appreciated real exchange rate. Finally, the third hypothesis is that there are several elements that lower productivity in the industrial sector, such as limitations in infrastructure (roads, ports, airport), the high real interest rates that prevail in the country, the problems in telecommunications, and several other regulations that increase the cost of doing business in the country.

Why has growth decreased in the last decades?

Even though there is a small decline in the contribution from the increasing participation rate to income per capita growth as we move from the 63 – 73 to the 84 – 2000 period, the main reason behind this decline in growth is related to the decrease in the rate of growth of labor productivity, which goes from 3.5% annually in the first period, to only 1.4% in the second period.

The growth accounting exercise suggests that this deceleration is due to several factors. Firstly, there is a small reduction in the contribution from increasing schooling levels to growth, caused mainly by the decline in public investment in education during the eighties, which happend in response to the fiscal problems experienced during that decade. Secondly, there is a decline in the contribution from private investment to growth, which could be due to the high interest rates that exist in the country. Thirdly, there is a significant fall in public investment, both in state enterprises and in infrastructure, which given the likely complementarities and externalities associated with these kinds of investments, probably also generates a decline in private investment and in total factor productivity growth. Finally, there is a reduction in the contribution from TFP growth.

Obviously, all these different elements reinforce each other. It is possible, for example, that the low rate of growth of total factor productivity, in part due to the low investment in infrastructure, is responsible for the low rate of private investment, and that all this in turn, generate little incentive for people to invest in education.

The sectoral analysis can give us come additional clues about the poor performance of productivity in recent decades in comparison with the experience of the sixties. In particular, this analysis shows that an important source of productivity growth in the 63 – 73 period was the reallocation of resources from agriculture to industry and services, which at that time had much higher productivity levels than agriculture. This reallocation has a limit, however, so that it did not contribute much to growth in the most recent period (1984 – 2000). Additionally, the increase in the relative size of the services sector also helps explain the deceleration of productivity growth in the last two decades, given what we have mentioned before about productivity stagnation in this sector.

So far, the discussion has focused on identifying a few variables that could explain the slowdown of the Costa Rican economy. We have identified the decline in public investment in education in the 80s and in infrastructure, together with the fall in TFP growth, which could be associated with the stagnation of productivity in the services sector and the small size of the industrial sector. We have also offered some hypotheses about the cause of these two features of the Costa Rican economy. We must also recognize, however, that Costa Rica is not alone in experiencing this economic slowdown. In general, the growth rate has fallen in all developing countries in the last two decades, with the notable exceptions of China and India.

As Easterly (2001) has pointed out, this is particularly surprising in light of the fact that in these last two decades developing countries have performed intensive structural reforms, and have improved their infrastructure, telecommunications, education, health, democracy and stability, something that should have increased growth in these economies. Easterly ventured several hypotheses about this phenomenon, among which we think two are particularly relevant: the slowdown in the rich countries, and the increase in the international interest rates.

We have done a statistical analysis for the Costa Rican case, to determine to what extent these exogenous external variables could have affected growth in the country. The results are clear: in the first place, these external variables have an enormous importance in the economic cycles in the country. In the second place, the fall in growth in the United States, and specially the increase in the international interest rate, explain almost all the decrease in the growth rate as we move from the 63 – 73 sub-period to the 84 – 2000 sub-period. It is clear then that the international conditions that the country has confronted in the recent decades have been much worse than the ones that prevailed in the sixties.

We also performed a time series analysis, for a shorter time interval (1991-2000), but with quarterly data and including also domestic endogenous variables. The result is similar to the one just mentioned for yearly data in the whole 1963 – 2000 period: the slowdown experienced in the second half of the nineties is mainly associated with the increase in the international interest rate and – to a lesser extent – with the behavior of the US economy, which negatively affected the Costa Rican economy in the years 95, 96 and 97. It should also be pointed out that the worsening of the terms of trade and the slowdown of the US economy explain part of the fall in the Costa Rican growth rate in the year 2000, although here there were also important domestic shocks to the real exchange rate and the domestic demand that share part of the blame.

We must interpret these results with caution. The point is not that these adverse international conditions make it impossible for the country to experience better economic results. In particular, these results are based on the historic relationship between US growth and international interest rates with the growth rate in Costa Rica. But it is obvious that this relationship is not immutable. In fact, the reforms that the country must undertake are precisely to change this relationship and achieve higher growth rates, even if the international context is not as favorable. In other words, with international conditions such as those that prevailed in the 60s, with low interest rates and high growth rates in the developed countries, it is relatively easy to achieve phase growth. The true challenge is to find a way to grow in spite of more adverse international conditions. This is, just to provide one example, what Chile has been able to do, as it achieved an average growth rate of 5.1% from 1984 to 1999, a period where Costa Rica managed only to grow at 2.5% per year on average (data from the World Bank data base).

Bibliography

Blanchard, O.J. and Quah, D. 1989. "The dynamic effects of Aggregate Demand and Supply Disturbances". American Economic Review. 79 (4): 655-672.

Cavalcanti, P. 2001. "Public Versus Private Provision of Infrastructure in a Neoclassical Growth Model".

Christensen, L., Jorgenson, D.W., and Lau, L.J. 1971. "Conjugate Duality and the Transcendental Logarithmic Production Function". Econometrica. 39: 255-56.

Christensen, L., Jorgenson, D.W., and Lau, L.J. 1973. "Transcendental Logarithmic Production Frontiers". Review of Economics and Statistics. 60: 28-45.

de Ferranti, D., D. Lederman, W. Malloney, and Guillermo Perry, From Natural Resources to the New Economy, Banco Mundial, 2001.

Easterly, W., "The Lost Decades: Developing Countries` Stagnation in Spite of Policy Reform 1980 – 1998, Banco Mundial

Fernández and Trejos 1997

Gollin, D. 2000. "Getting Income Shares Right". Mimeo Williams College.

González-Vega, C and V. H. Céspedes, The Political Economy of Poverty, Equity and Growth: Costa Rica and Uruguay, ed. Simon Rottenberg, World Bank Oxford University Press, 1993)

Grilliches, Z. and Ringstad, V. 1971. Economies of Scale and the Form of the Production Function. Amsterdam: Northholland Publishing Company.

Harberger, A. 1998. "A Vision of the Growth Process". The American Economic Review. 88 (1): 1-32.

Herrera, S., Perry, G., and Quintero, N. 1999. "Output Fluctuations in Latin America: What Explains the Recent Slowdown?". Mimeo.

Hoffmaister, A.W. and Roldós, J. 2001. "The Sources of Macroeconomic Fluctuations in Developing Countries: Brazil and Korea". Journal of Macroeconomics. 23 (1): 213-239.

Klenow, P. and Rodríguez-Clare, A. 1997. "Has the Neoclassical Revolution Gone Too Far?," NBER Macroeconomics Annual 1997, Brookings Institution

Lewis, W. A., "Economic Development with Unlimited Supplies of Labour," The Manchester School, Mayo 1954: 139-91

Maddison, A., Phases of Capitalist Development, Oxford University Press, 1982

Monge, A., Hoffmaister, A.W., Hall, L.J., and Robles, E. 1999. "Fluctuations, Trends, and Transmission of Shocks in Central America, Mexico, and U.S.A."

Sargan, J.D. 1971. "Production Functions". Qualified Manpower and Economic Performance, P.R.G. Layard, J.D. Sargan, M.E Ager, and D.J. Jones, eds. London: Penguin Press.

Young, A. 1995. "The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience". Quarterly Journal of Economics.

Tables and Charts

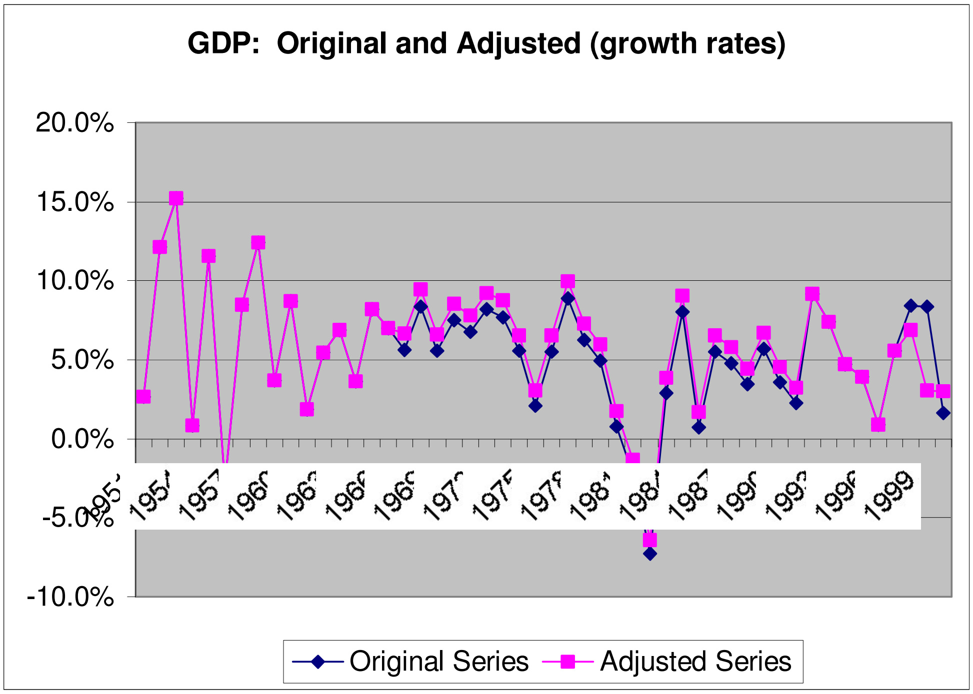
Table 1.1
Per capita GDP of Costa Rica Selected Regions
(Tasa de crecimiento)

	Costa Rica	East Asia and Pacífico	Latin America	OECD	Africa Sub-Sahara	World
1963-73	4.3%	4.7%	3.6%	4.4%	2.4%	3.3%
1973-80	2.9%	4.6%	2.8%	1.9%	0.4%	1.3%
1980-84	-1.8%	5.9%	-2.2%	1.9%	-1.5%	0.8%
1984-99	2.1%	6.0%	1.0%	2.1%	-0.8%	1.3%
1963-99	2.4%	5.3%	1.7%	2.6%	0.2%	1.8%

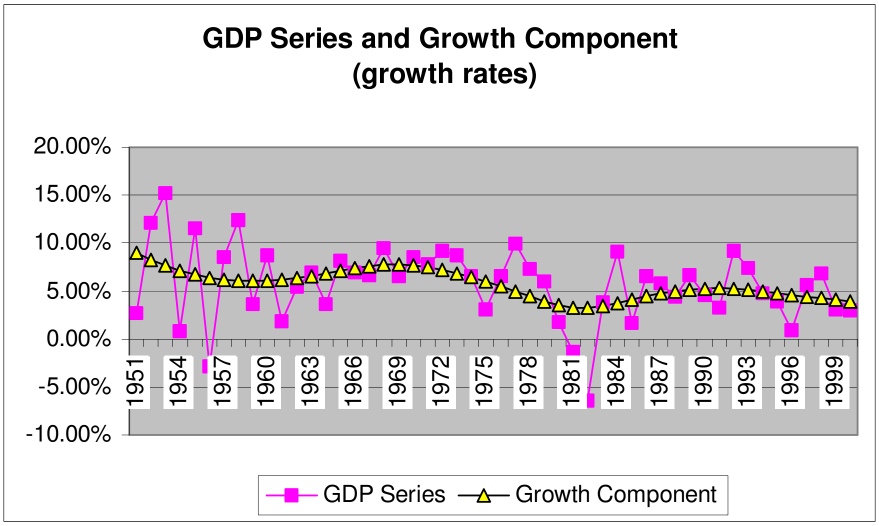
Table 2.1
Gini Coefficient

Year	Coefficient
1961	0.5
1971	0.43
1983	0.45
1986	0.45
1988	0.42
1992	0.43

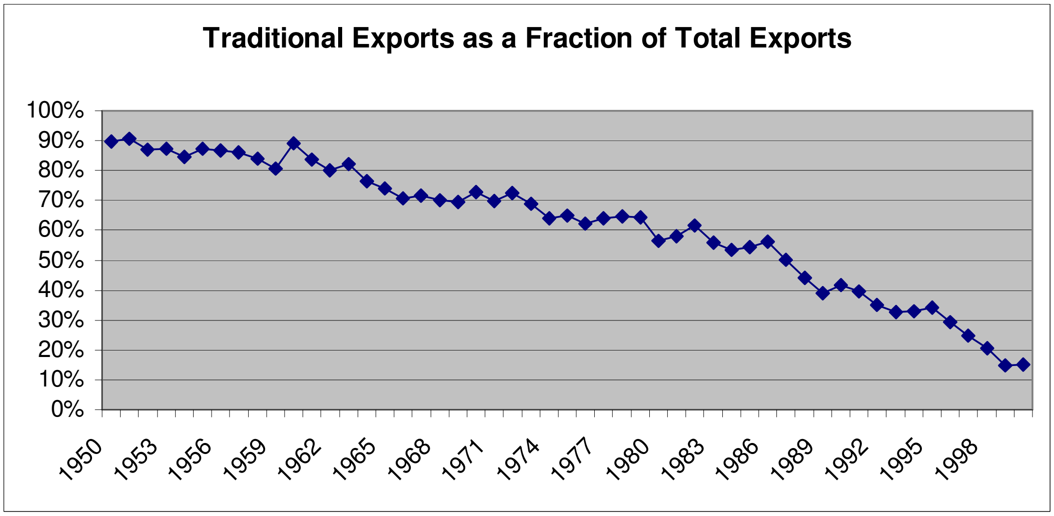
Graph 2.1


GDP: Original and Adjusted (growth rates)
20.0%
15.0%
10.0%
5.0%
0.0%
-5.0%
-10.0%
1999
Original Series
Adjusted Series

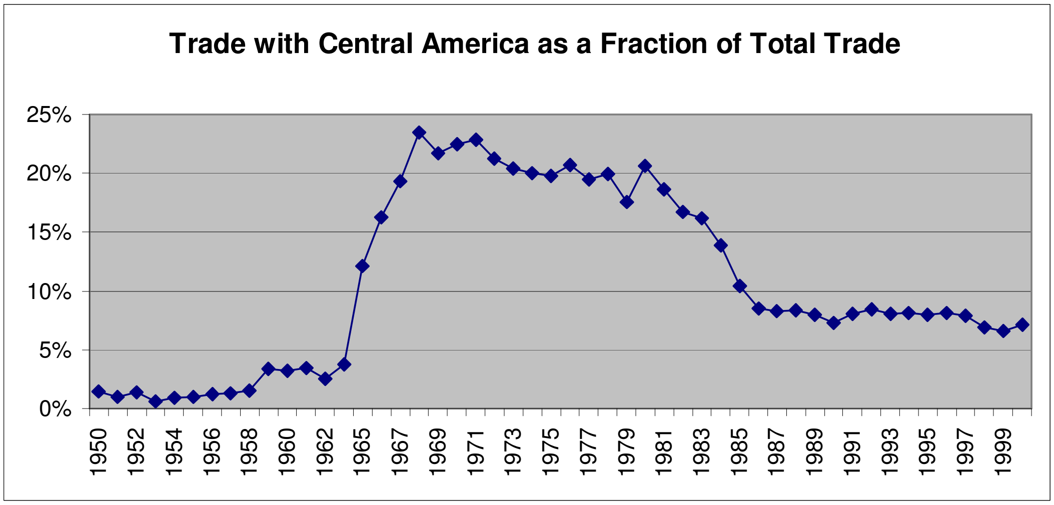
Graph 2.2



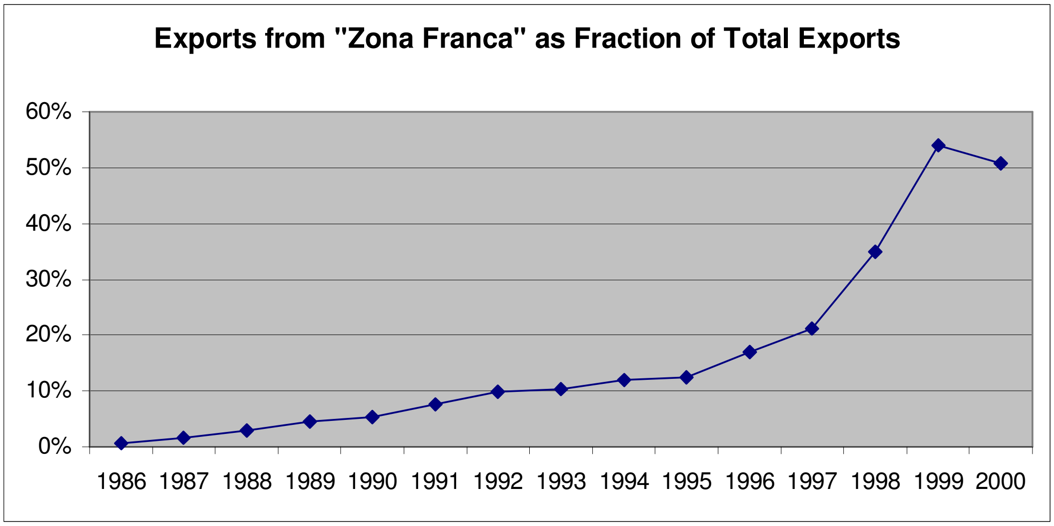
Graph 2.3



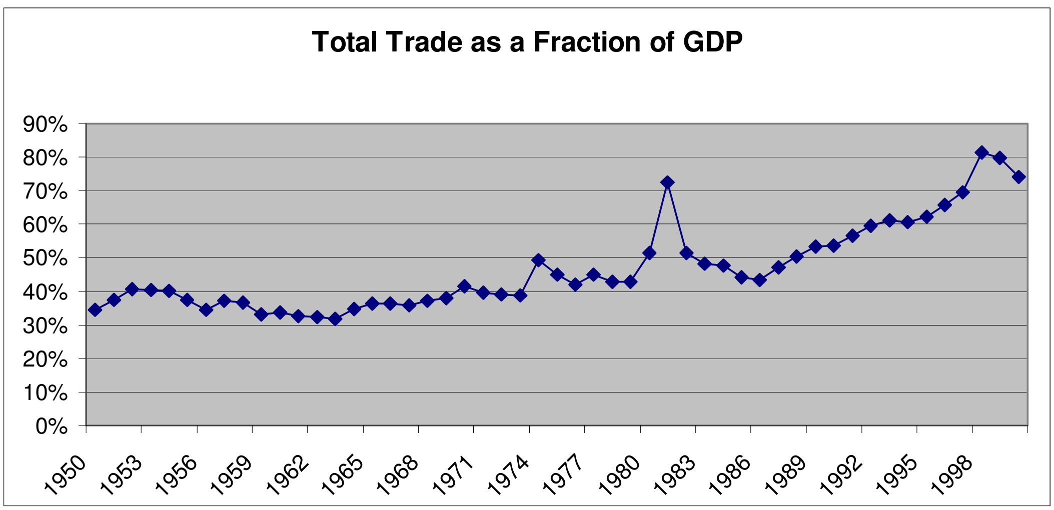
Graph 2.4


Trade with Central America as a Fraction of Total Trade
25%
20%
15%
10%
5%
0%
1950
1952
1954
1956
1958
1960
1962
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999

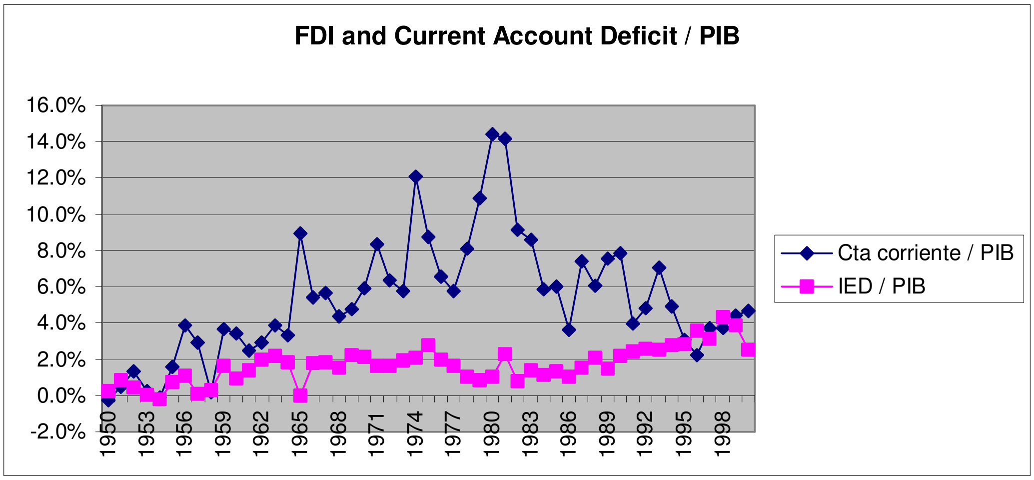
Graph 2.5



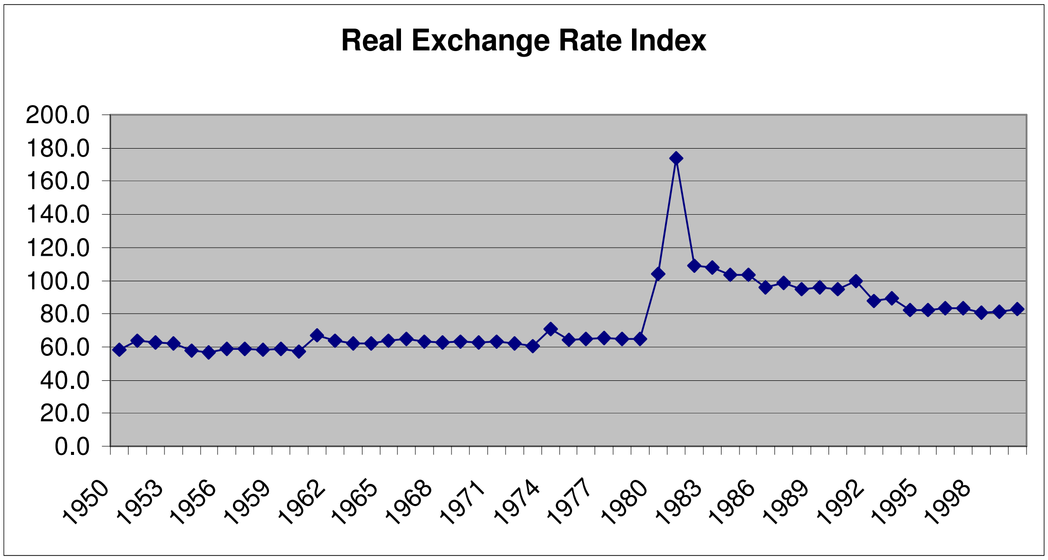
Graph 2.6



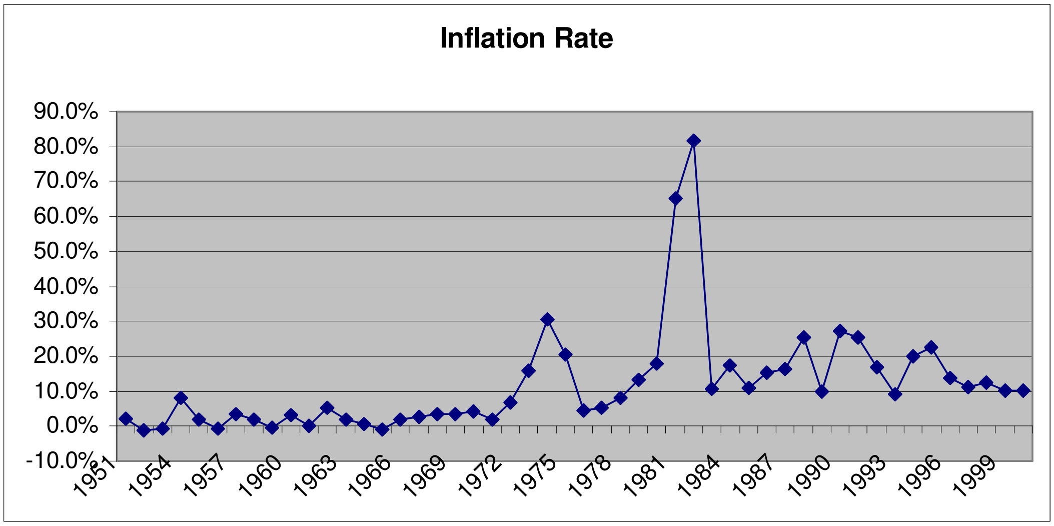
Graph 2.7



Graph 2.8



Graph 2.9



Graph 2.10

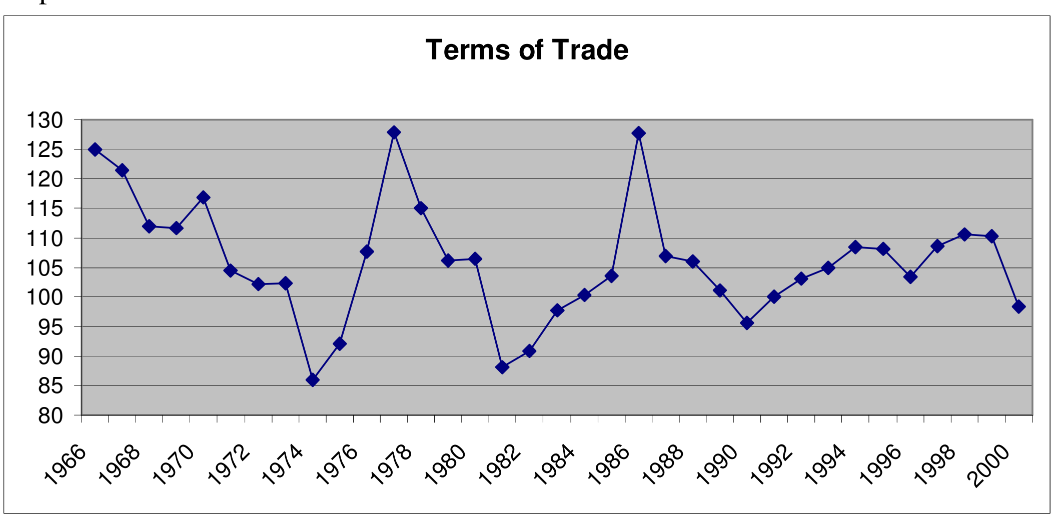
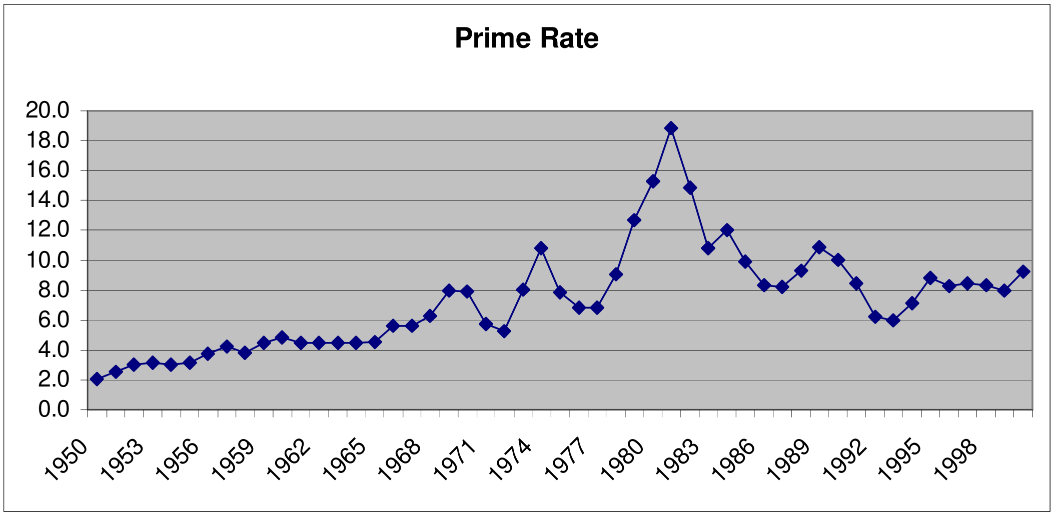
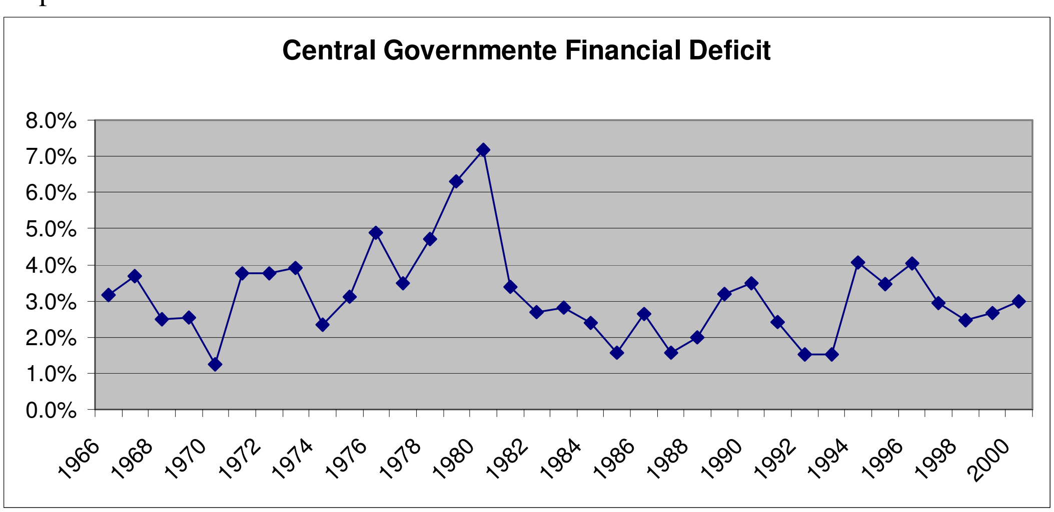


Gráfico 2.11


Prime Rate
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998

Graph 2.12


Central Governmente Financial Deficit
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000

Graph 2.13

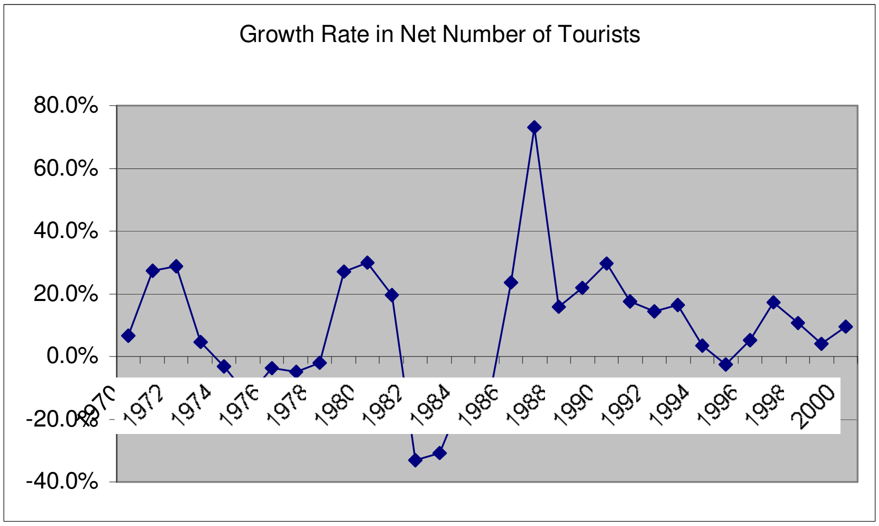
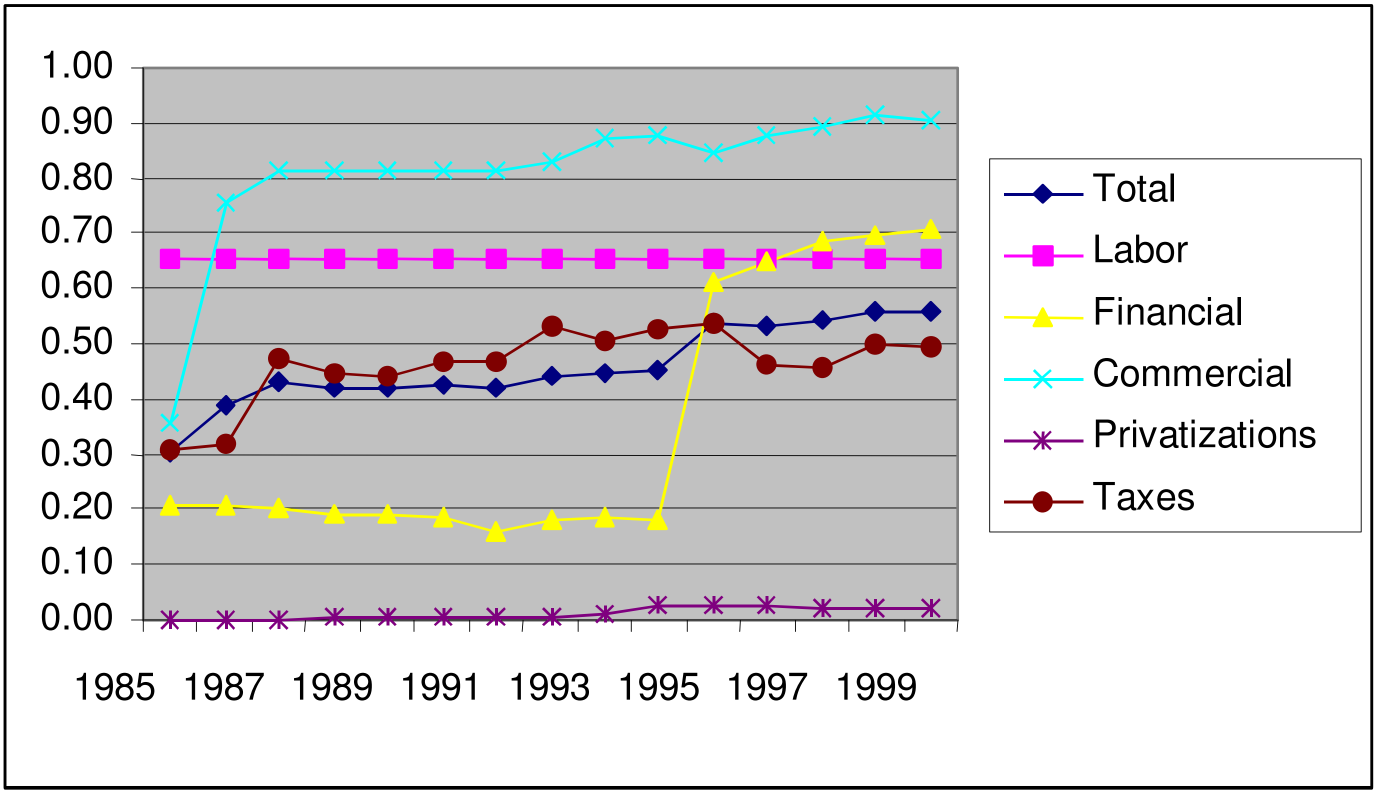

Growth Rate in Net Number of Tourists
80.0%
60.0%
40.0%
20.0%
0.0%
-20.0%
-40.0%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000

Gráfico 2.14 – Structural Reforms Index for Costa Rica, Source IDB (Eduardo Lora)



Graph 3-1: Net Participation Rate

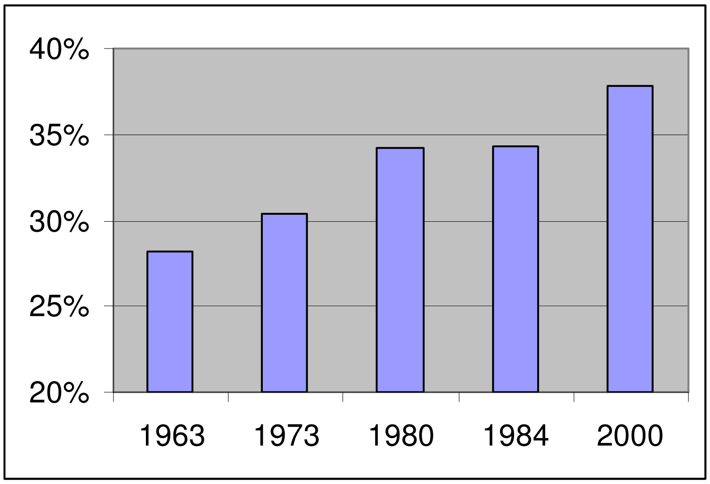


Table 3-1
GDP per Capita Growth Decomposition
(into GDP per Worker and Workers per Capita)

	GDP / N	GDP / L	L / N
1963-73	4.26%	3.47%	0.76%
1973-80	2.92%	1.21%	1.69%
1980-84	-1.77%	-1.84%	0.08%
1984-2000	2.03%	1.41%	0.61%
1963-2000	2.38%	1.57%	0.80%

Table 3-2
GDP per Cápita Decomposition 1963-2000
(into GDP/Labor Force and Labor Force/Total Pop)

	PIB / N	PIB/FL	FL/N
Costa Rica	2.40%	1.60%	0.70%
Brazil	2.50%	1.60%	0.80%
Chile	2.50%	1.90%	0.60%
Mexico	2.00%	1.10%	0.90%
Hong Kong	5.00%	4.10%	0.80%
South Korea	6.30%	5.10%	1.10%
Malaysia	4.00%	3.50%	0.50%
Singapore	6.10%	5.00%	1.10%
USA	2.20%	1.60%	0.60%
France	2.50%	2.30%	0.10%
Italy	2.60%	2.40%	0.20%
UK	2.10%	1.90%	0.20%

Source: World Bank, Instituto Nacional de
Estadística, y Censos and Central Bank of Costa Rica

Table 3-3: Change in Participation Rate, decomposed into change in age structure and other causes

	L/N	L / Pop 15-65	Pop 15-65 / N
1963	28.20%	53.20%	53.00%
1973	30.40%	56.30%	54.00%
1980	34.20%	60.00%	57.10%
1984	34.30%	58.30%	58.80%
2000	37.80%	59.70%	63.30%

Table 3-4
Workers per Capita Growth Decomposition
(into Workers / Pop 15-65 y Pop 15-65 / Total Pop)

	L/N	L / Pop 15-65	Pop 15-65 / N
1963-73	0.76%	0.57%	0.18%
1973-80	1.69%	0.89%	0.80%
1980-84	0.08%	-0.69%	0.77%
1984-2000	0.61%	0.15%	0.46%
1963-2000	0.80%	0.31%	0.48%

Table 3-5
Employment as a Fraction of Population in Working Age, by Gender

	Total	Hombres	Mujeres
1963	53.2%	88.2%	18.2%
1973	56.3%	90.1%	22.5%
1984	58.3%	86.8%	29.8%
2000	59.7%	80.3%	39.1%

Table 4-1

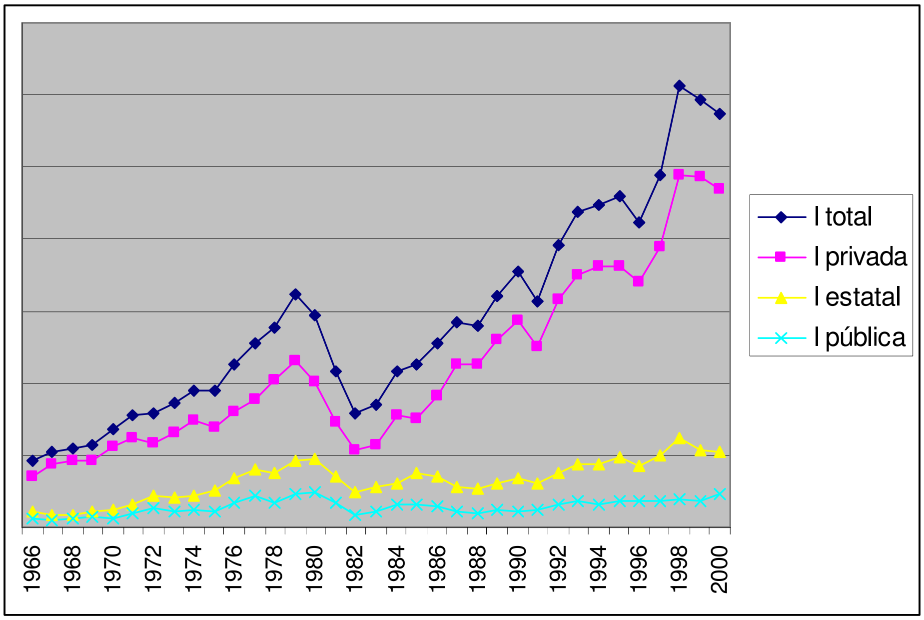
Variables Used for Growth Decomposition

	GDP	Physical Capital	Schooling Index**	Employment *
1963	197,036.6	388,585.5	5.7	18,267,022.7
1973	408,725.3	786,639.7	6.7	27,353,650.0
1980	608,105.2	1,359,754.3	7.6	35,891,229.0
1984	636,226.5	1,493,735.3	8.1	40,171,083.8
2000	1,351,704.5	3,187,743.3	9.3	67,760,741.7
Growth Rates				
63-73	7.6%	7.3%	0.10	4.1%
73-80	5.8%	8.1%	0.12	4.0%
80-84	1.1%	2.4%	0.13	2.9%
84-2000	4.8%	4.9%	0.08	3.3%
63-2000	5.3%	5.9%	0.10	3.6%

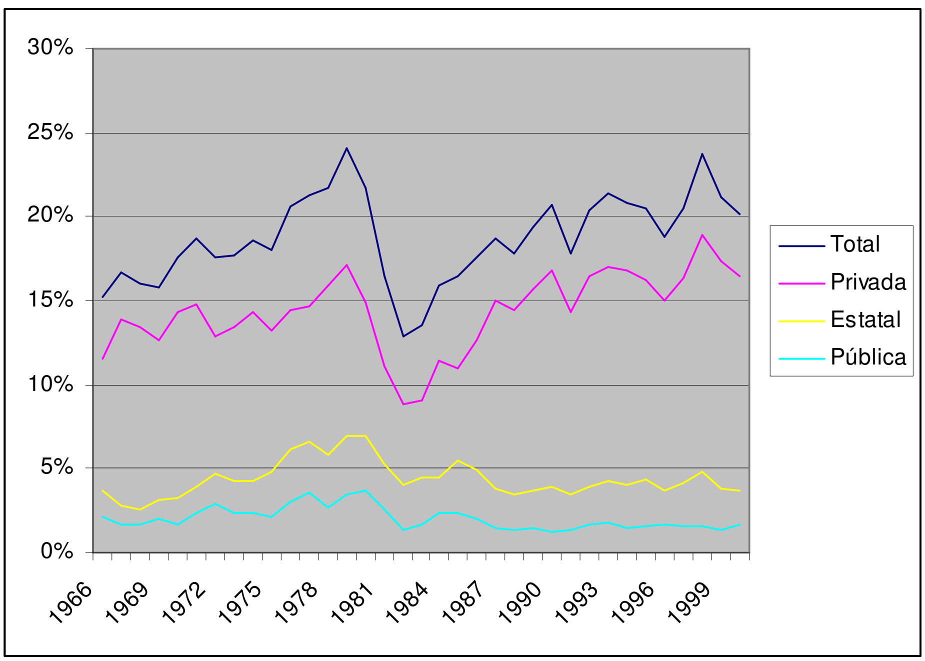
* Measured in terms of weekly hours

** In the case of the schooling index, the annual growth is expressed in absolute terms. This is because, in our production function specification, an additional year of schooling has the same proportional effect on human capital independently of the initial schooling level.

Graph 4-1
Total Investment



Graph 4-2: Investment as a Fraction of GDP



Graph 4-3

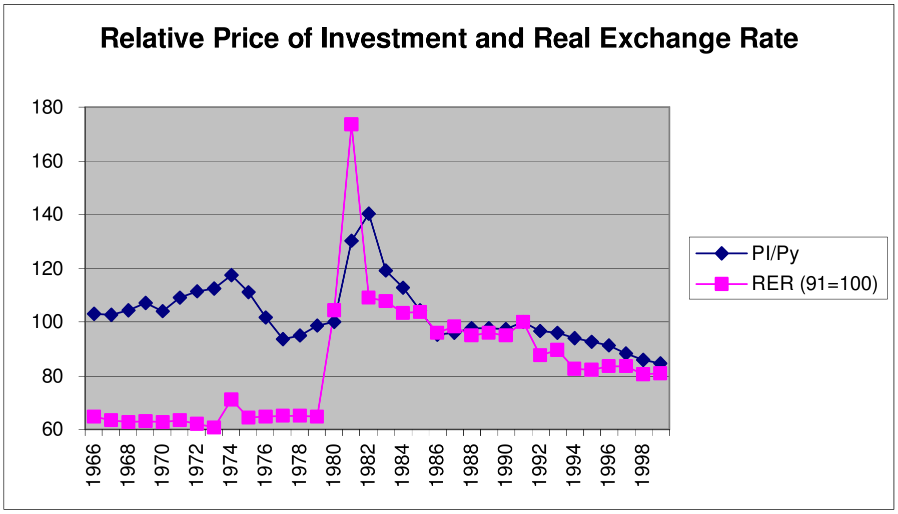


Table 4-2

Relative Price of Investment with respect to Consumption

(Promedio del período 1988-1992)

Costa Rica	1.47
USA	0.75
Mexico	1.50
Chile	0.81
Hong Kong	1.75
Korea	1.04
Malaysia	1.02
Singapore	1.33

Table 4-3: Population 15 and older

Schooling (Average years of schooling in the population)

	Total	Barro-Lee	Male	Female
1963	3.92	4.16	3.91	3.92
1973	5.12	5.14	5.13	5.11
1980	6.29	5.19	6.30	6.28
1984	6.42	5.39	6.41	6.43
1990	6.74	5.55	6.76	6.72
1995	7.19	Na	7.20	7.18
2000	7.45	Na	7.41	7.49

Table 4-4
Working Population: Average Schooling by Gender

	Total	Male	Female
1963	4.69	4.42	6.02
1973	5.53	Na	Na
1980	6.41	na	Na
1984	6.85	6.35	8.58
1987	6.98	6.56	8.10
1990	7.20	6.80	8.24
1995	7.68	7.28	8.62
2000	8.08	7.61	9.05

Table 4-5: Participation Rates by Schooling Level

	Total	Male	Female
Complete Primary	57.0	83.2	30.2
Complete Secundary	65.7	86.3	48.3
University	71.9	80.0	63.4

Table 4-6
Employed Population: Average and Effective Schooling

	Average Schooling	Effective Schooling Index
1963	4.69	5.70
1973	5.53	6.71
1980	6.41	7.55
1984	6.85	8.06
2000	8.08	9.30

Graph 4.4
Secondary Education Coverage

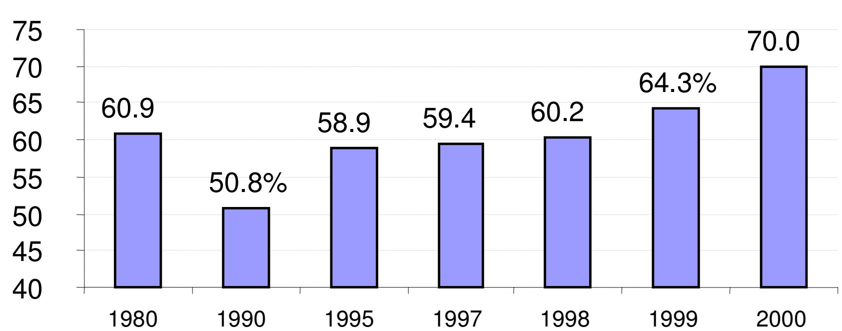


Table 4-7
Growth Decomposition using DeGregorio and Lee methodology, with different Data Bases

Using De Gregorio and Lee data

	GDP	K	L	TFP
60-70	6.9%	2.7%	1.9%	2.3%
70-80	5.4%	3.5%	2.4%	-0.4%
80-90	2.2%	1.6%	1.8%	-1.1%
60-90	4.8%	2.6%	2.0%	0.2%
Using our corrections to the database				
63-73	7.6%	2.9%	2.5%	2.2%
73-80	5.8%	3.3%	2.4%	0.2%
80-90	3.4%	1.4%	2.1%	-0.1%
90-2000	4.8%	2.1%	1.8%	0.9%
63-90	5.6%	2.4%	2.3%	0.8%

Table 4-8
Labor and capital income shares

Year	Labor share	Capital share
1963	59.2%	40.8%
1973	63.6%	36.4%
1980	62.0%	38.0%
1984	61.2%	38.8%
1990	72.9%	27.1%
1995	71.5%	28.5%
2000	75.9%	24.1%

Table 4-9: Growth Decomposition Using a Translog

	GDP/L	K/L	TFP
63-73	3.3%	1.2%	2.1%
73-80	1.8%	1.5%	0.3%
80-84	-1.7%	-0.2%	-1.5%
84-00	1.5%	0.4%	1.0%
63-00	1.7%	0.8%	0.9%

Table 4-10:
Growth Decomposition Taking in Account Schooling per Worker

	GDP/L	K/L	S~	TFP
63-73	3.31%	1.18%	1.06%	1.07%
73-80	1.81%	1.49%	1.27%	-0.95%
80-84	-1.67%	-0.18%	1.33%	-2.83%
84-00	1.45%	0.41%	0.81%	0.23%
63-00	1.68%	0.76%	1.02%	-0.10%

Graph 4-5: Public Investment as a Fraction of Total Investment

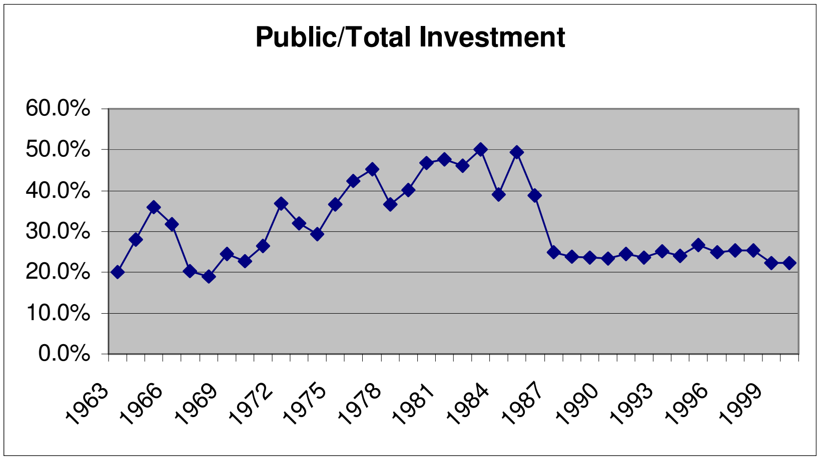


Table 4-11
Growth Rates

	Public capital	Private capital	Total capital
1963-1973	7.9%	7.6%	7.7%
1973-1980	11.2%	7.6%	8.5%
1980-1984	3.9%	1.7%	2.3%
1984-1990	3.3%	4.8%	4.4%
1990-1995	3.7%	5.8%	5.2%
1995-2000	4.0%	5.6%	5.2%
1984-2000	3.6%	5.4%	4.9%
1963-2000	6.2%	6.0%	6.0%

Graph 4 – 6: Public and State Investment as a Fraction of Total Investment

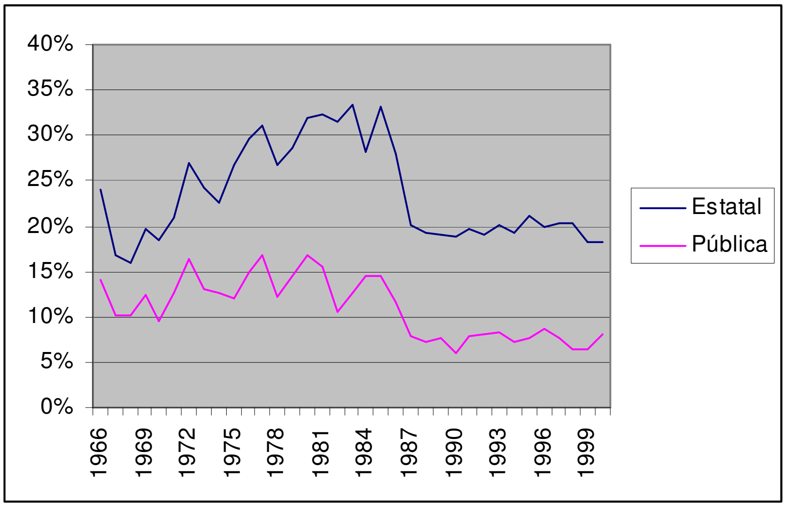


Table 4 -12: Growth Decomposition
Model with physical capital per worker, schooling, and distinctions between varieties of physical capital

	GDP/L	K empres/L *	Schooling	TFP	Residual Componen t	Public K
63-73	3.31%	1.27%	1.06%	0.98%	0.68%	0.30%
73-80	1.81%	1.47%	1.27%	-0.93%	-1.35%	0.42%
80-84	-1.67%	-0.18%	1.33%	-2.83%	-2.95%	0.12%
84-00	1.45%	0.52%	0.81%	0.12%	0.01%	0.12%
63-00	1.68%	0.83%	1.02%	-0.17%	-0.39%	0.22%

Table 4-13: GrowthDecomposition
Model with physical capital per worker, schooling, and distinctions between varieties of physical capital
(allows for complementarity between private capital and that of state firms)

	GDP/L	K empres/L *	Schooling	TFP	Residual Component	Public K
63-73	3.31%	1.29%	1.06%	0.97%	0.67%	0.30%
73-80	1.81%	1.50%	1.27%	-0.95%	-1.37%	0.42%
80-84	-1.67%	-0.19%	1.33%	-2.81%	-2.93%	0.12%
84-00	1.45%	0.52%	0.81%	0.12%	0.00%	0.12%
63-00	1.68%	0.83%	1.02%	-0.18%	-0.40%	0.22%

Table 4-14
Private and State Firms Capital Levels

Year	Kpriv	K state firms	K state firms / Kpriv
1963	287,277.7	35,752.2	12.4%
1973	587,604.7	81,160.9	13.8%
1980	971,430.4	180,673.5	18.6%
1984	1,042,432.8	223,675.0	21.5%
2000	2,393,642.6	465,787.7	19.5%

Table 4-15
Measures of TFP with different methodologies

Period	Model 1	Model 2	Model 3		Model 4	
			TFP	Residual	TFP	Residual
63-73	2.13%	1.07%	0.98%	0.68%	0.97%	0.67%
73-80	0.32%	-0.95%	-0.93%	-1.35%	-0.95%	-1.37%
80-84	-1.49%	-2.83%	-2.83%	-2.95%	-2.81%	-2.93%
84-00	1.04%	0.23%	0.12%	0.01%	0.12%	0.00%
63-00	0.92%	-0.10%	-0.17%	-0.39%	-0.18%	-0.40%

Model 1: DeGregorio y Lee Methodology
Model 2: Klenow y Rodríguez Methodology with Schooling Data
Model 3: With schooling and distinction between entrepreneurial capital (private y state), and capital of public nature.
This model assumes that private and public entrepreneurial capital are perfect substitutes.
Modelo 4: Same as model 3 but with complementarity between private and public entrepreneurial capital.

Table 5.1
Working Population by Sector
Structure
July of each year

Economic Sector	**1963**	**1973**	**1980**	**1984**	**1998**
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%
Agriculture and fishing	49.7%	38.2%	27.4%	27.7%	20.1%
Industry and mining	11.7%	12.9%	16.3%	16.2%	15.8%
Construction	5.5%	6.9%	7.8%	5.1%	6.2%
Wholesale and Retail Commerce, Restaurants y Hotels	9.9%	12.2%	18.1%	18.5%	19.4%
Social and Personal Services plus Basic services and services to firms /1	23.1%	29.8%	30.4%	32.4%	38.5%

/1 Includes public administration; public and private education, health services, and personal services; plus electricity, gas and water; transportation, storage, and comunications; financial and insurance services, and other services to firms.

Table 5.2
GDP per worker
1966 base year

Economic Sector	1963	1973	1980	1984	1998
TOTAL	9449.1	12786.1	13312.7	12186.6	12925.8
Growth rate %		3.07%	0.58%	-2.19%	0.42%
Agriculture and fishing	4680.4	7556.4	8730.4	9003.6	11474.8
Growth rate %		4.91%	2.08%	0.77%	1.75%
Industry and mining	11494.5	19548.8	17984.0	16255.8	17796.8
Growth rate %		5.45%	-1.18%	-2.49%	0.65%
Construction	8710.9	9026.0	10726.3	10244.3	7577.5
Growth rate %		0.36%	2.50%	-1.14%	-2.13%
Wholesale and Retail Commerce, restaurants y hotels	19052.3	20452.0	13262.9	10697.7	11290.3
Growth rate %		0.71%	-6.00%	-5.23%	0.39%
Social and Personal Services, plus basic services and services to firms	14738.9	14296.3	15636.4	14029.6	13378.2
Growth rate %		-0.30%	1.29%	-2.67%	-0.34%

/1 Includes public administration; public and private education, health services, and personal services; plus electricity, gas and water; transportation, storage, and comunications; financial and insurance services, and other services to firms.

Table 5.3
"Shift-share" Analysis for GDP per worker
Growth Rates
(Base 66)

Economic Sector	1963-73	1973-80	1980-84	1984-98
TOTAL	35.3%	4.1%	-8.5%	6.1%
Cross Products	-2.5%	-4.5%	-0.2%	-2.1%
Growth from change in sector composition of L	12.1%	9.6%	0.7%	2.5%
Growth given initial sector composition of L	25.7%	-0.9%	-9.0%	5.7%

Table 5.4
Zona Franca
Value Added per Worker
(1995=100)

	VA Zona Franca adjusted for Intel (in millions of colones)	Employment in Zona Franca (thousands)	VA per worker	% change in VA per worker
1991	4275.2	11.2	381713	
1992	6557.1	13.6	482136	26.3%
1993	7043.4	18.5	380725	-21.0%
1994	8619.5	22.6	381394	0.2%
1995	10610.7	25.4	417745	9.5%
1996	15179.1	25.5	595257	42.5%
1997	20327.3	25.7	790947	32.9%
1998	26568.1	29.7	894850	13.1%
1999	29813.6	30.9	964841	7.8%
2000	32916.3	34.0	968127	0.3%
1991-2000				10.9%

Table 5.5

Annual growth of labor productivity 1991 - 2000	Annual growth rate of labor productivity	Fraction employed out of total employment in services sector
Electricity and water	6,1%	1,4%
Commerce, restaurants y hotels	-0,3%	35,3%
Transportation, storage and communications	1,4%	10,4%
Financial businesses, insurance, real estate and services to firms	-1,7%	8,5%
Communal, social and personal services	-0,7%	44,5%

Table 5.6

VII. GDP Composition, 1999,source Banco Mundial

	Agriculture	Industry	Services
México	5,0	28,2	66,8
Brasil	8,6	30,6	60,8
Chile	8,4	34,2	57,4
Corea	5,0	43,5	51,5
Malasia	10,7	46,0	43,4
Singapur	0,2	35,8	64,1
Costa Rica	9,7	26,7	63,6

Table 6.1
Annual Data Regression, external and internal variables

Dependent Variable: Costa Rica GDP growth rate

Independent Variables	Coefficient	Standard Error	t-ratio
Constant	0.0533	0.0312	1.71
DLYUS	0.6576	0.1839	3.58
DLTOT	0.0158	0.0337	0.47
DLTOT{1}	0.0885	0.0378	2.34
RSTAR	-0.8158	0.1529	-5.33
CICLO1	0.0008	0.0083	0.10
CICLO2	0.0014	0.0082	0.17
CGOB	0.3566	0.2783	1.28
IGOB	-0.8186	0.3144	-2.60
R2	0.67000		
Observations	40		
D-W	1.87		

Table 6.2

Dependent Variable: Costa Rica GDP growth rate

Independent Variables	Coefficient	Standard Error	t-ratio
Constant	0.05478	0.00841	6.52
Growth US GDP	0.68154	0.17415	3.91
Chang in TOT (-1)	0.07991	0.03601	2.22
International Real Interest	-0.69670	0.14401	-4.84
R2	0.59500		
Observations	40		
D-W	1.54		

Table 6.3

Period	Years	Contribution dlyus	dltot{1}	Rstar	Average dly forecast	average observed dly
1	1963-73	2.9%	-0.1%	-1.6%	6.7%	7.3%
2	1973-80	1.7%	0.0%	-0.4%	6.8%	5.6%
3	1980-84	2.0%	-0.2%	-5.3%	1.9%	1.0%
4	1984-2000	2.2%	0.1%	-3.6%	4.2%	4.7%

Change in average between periods

Period 1 to 2	-1.2%	0.1%	1.2%	0.1%	-1.6%
Period 2 to 3	0.3%	-0.2%	-4.9%	-4.9%	-4.7%
Period 3 to 4	0.2%	0.2%	1.8%	2.3%	3.7%
Period 1 to 4	-0.7%	0.1%	-2.0%	-2.5%	-2.6%

Table 6.4

Description of variables used in VAR

Series	Observation	Mean	Standard Desviation	Mínimum	Maximum
Δterms of trade	39	0.0%	0.0264	-0.0679	0.0651
Δinternat real interest	39	0.0%	0.0050	-0.0121	0.0105
Δ US GDP	39	0.9%	0.0046	-0.0003	0.0198
Δ CR GDP	39	1.3%	0.0420	-0.0635	0.0866
Δ real exchange rate	39	-0.4%	0.0193	-0.0842	0.0293
Inflation	39	3.4%	0.0157	0.0091	0.0729
S2	39	0.256	0.4424	0.0000	1.0000
S3	39	0.256	0.4424	0.0000	1.0000
S4	39	0.256	0.4424	0.0000	1.0000

Δ stands for change

Table 6.5

Estimated VAR Coefficients

(t statistic immediately below the coefficient)

Dependent Variable	ΔTOT	Δr_star	ΔGDP US	ΔGDP CR	ΔRER	Inflation
Constante	0.0285	-0.0054	0.0055	0.0652	-0.0162	0.0194
	1.54	-1.79	1.84	2.30	-0.60	1.06
ΔTOT (-1)	-0.1343	-0.0007	-0.0637	0.0344	-0.0625	0.1151
	-0.71	-0.02	-2.09	0.22	-0.41	1.13
ΔTOT {-2}	-0.0152	-0.0167	-0.0098	0.2584	0.0329	0.0413
	-0.07	-0.50	-0.30	1.50	0.20	0.37
ΔRSTAR{-1}	-0.1514	0.3577	-0.2202	-1.6384	-0.8881	0.2453
	-0.12	1.70	-1.06	-1.53	-0.87	0.36
ΔRSTAR{-2}	0.7591	0.0713	-0.0171	0.4211	0.4218	0.3389
	0.60	0.35	-0.08	0.44	0.46	0.54
ΔGDP US{-1}	-0.3410	0.2280	0.1394	0.7932	0.9299	-0.3218
	-0.27	1.11	0.69	0.76	0.94	-0.48
ΔGDP US {-2}	-1.0308	0.2516	0.1494	0.2899	0.5782	-0.4074
	-0.88	1.31	0.79	0.31	0.64	-0.67
ΔGDP CR {-1}				-0.7273	-0.1968	0.0831
				-3.35	-0.95	0.59
ΔGDP CR {-2}				-0.0166	-0.0314	-0.0651
				-0.08	-0.15	-0.46
ΔRER{-1}				-0.3363	0.6699	-0.1042
				-0.98	2.04	-0.47
ΔRER{-2}				-0.1901	-0.5271	0.4214
				-0.60	-1.74	2.07
INFLATION{-1}				-0.5171	0.8324	0.0935
				-1.09	1.83	0.31
INFLATION{-2}				0.2464	-0.8526	0.5661
				0.56	-2.03	2.00
S2	-0.0186	0.0024	0.0018	-0.0908	0.0174	-0.0045
	-1.19	0.94	0.70	-5.97	1.19	-0.46

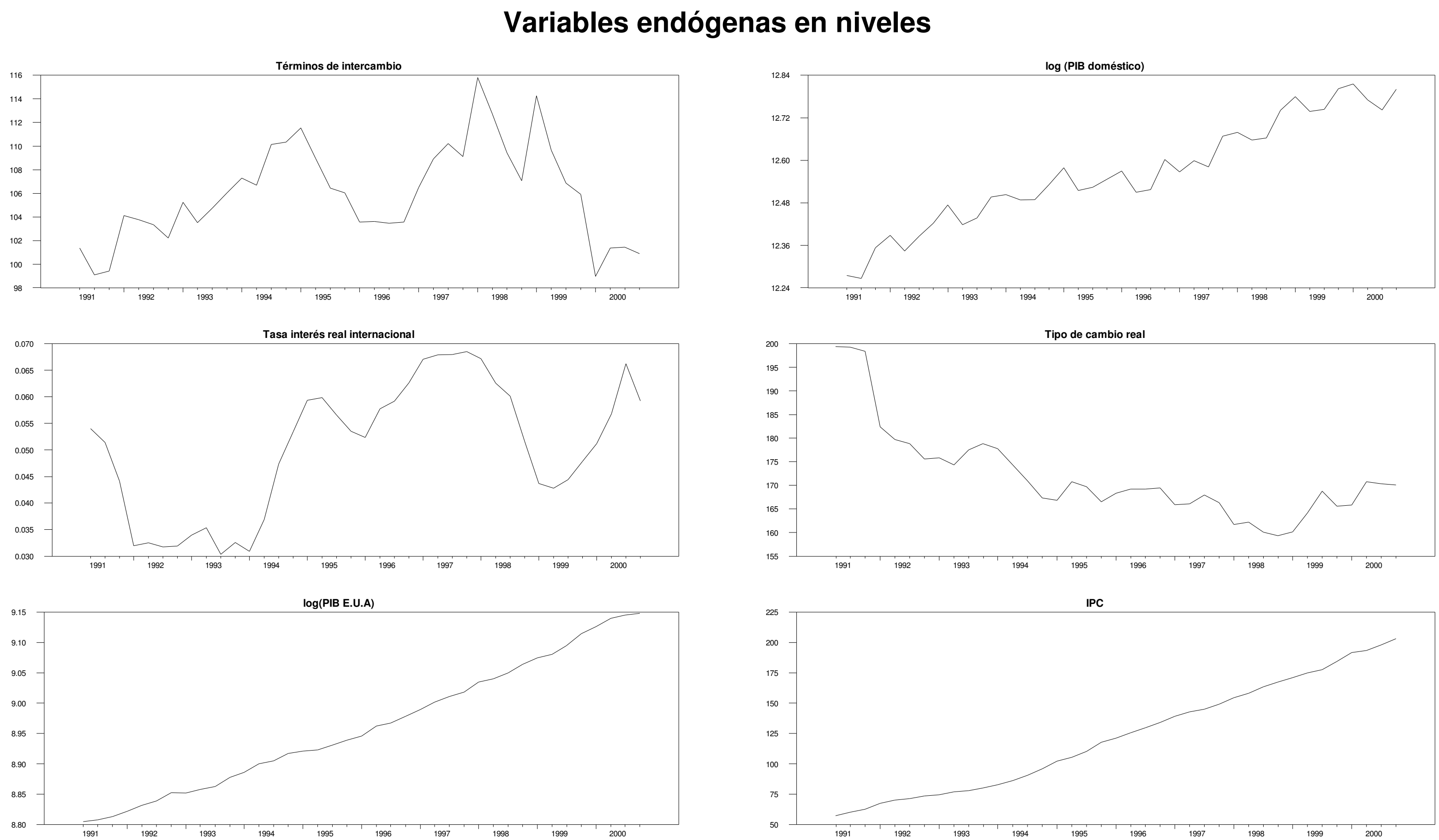
S3	-0.0193	0.0022	-0.0005	-0.0919	-0.0036	-0.0001
	-1.36	0.93	-0.23	-4.12	-0.17	-0.01
S4	-0.0223	0.0001	0.0029	0.0008	0.0008	-0.0015
	-1.55	0.03	1.24	0.04	0.04	-0.11

Table 6.6

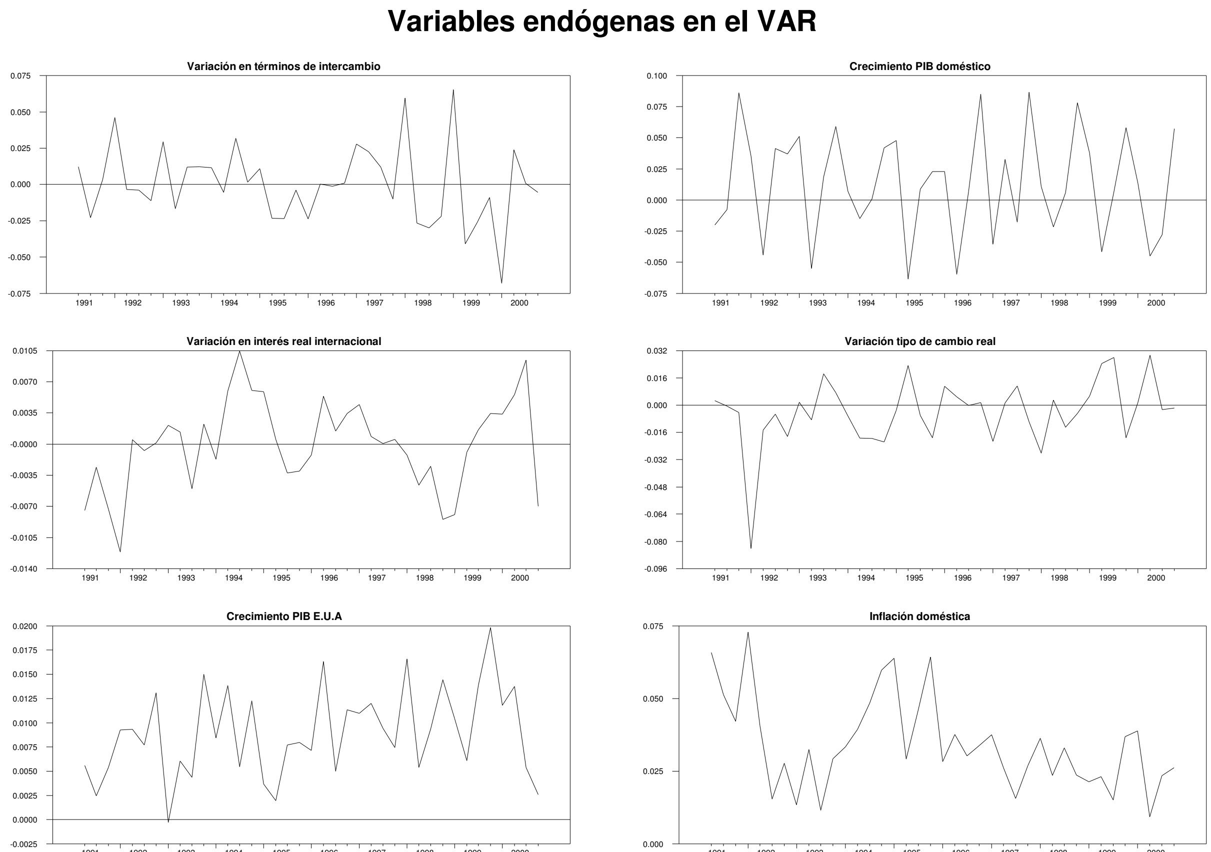
Variance Decomposition CR GDP growth

Period	Std Error	DTOT	DRSTAR	DGDPUS	DGDPCR	DRER	Inflation
1	0.015354	4.46	7.334	6.685	61.068	12.059	8.394
2	0.019168	4.268	5.269	7.761	54.389	12.332	15.981
3	0.021961	11.183	4.039	5.941	53.831	9.531	15.475
4	0.023247	13.201	5.86	5.303	49.879	8.509	17.249
5	0.023815	14.634	5.722	5.53	48.263	8.122	17.728
6	0.023959	14.71	6.035	5.624	47.757	8.031	17.844
7	0.024026	14.866	6.06	5.759	47.508	7.988	17.818
8	0.02403	14.868	6.08	5.759	47.493	7.985	17.816
9	0.024035	14.873	6.097	5.766	47.473	7.982	17.81
10	0.024036	14.873	6.097	5.766	47.472	7.982	17.81
11	0.024036	14.872	6.101	5.766	47.471	7.981	17.809
12	0.024036	14.872	6.103	5.765	47.47	7.981	17.81

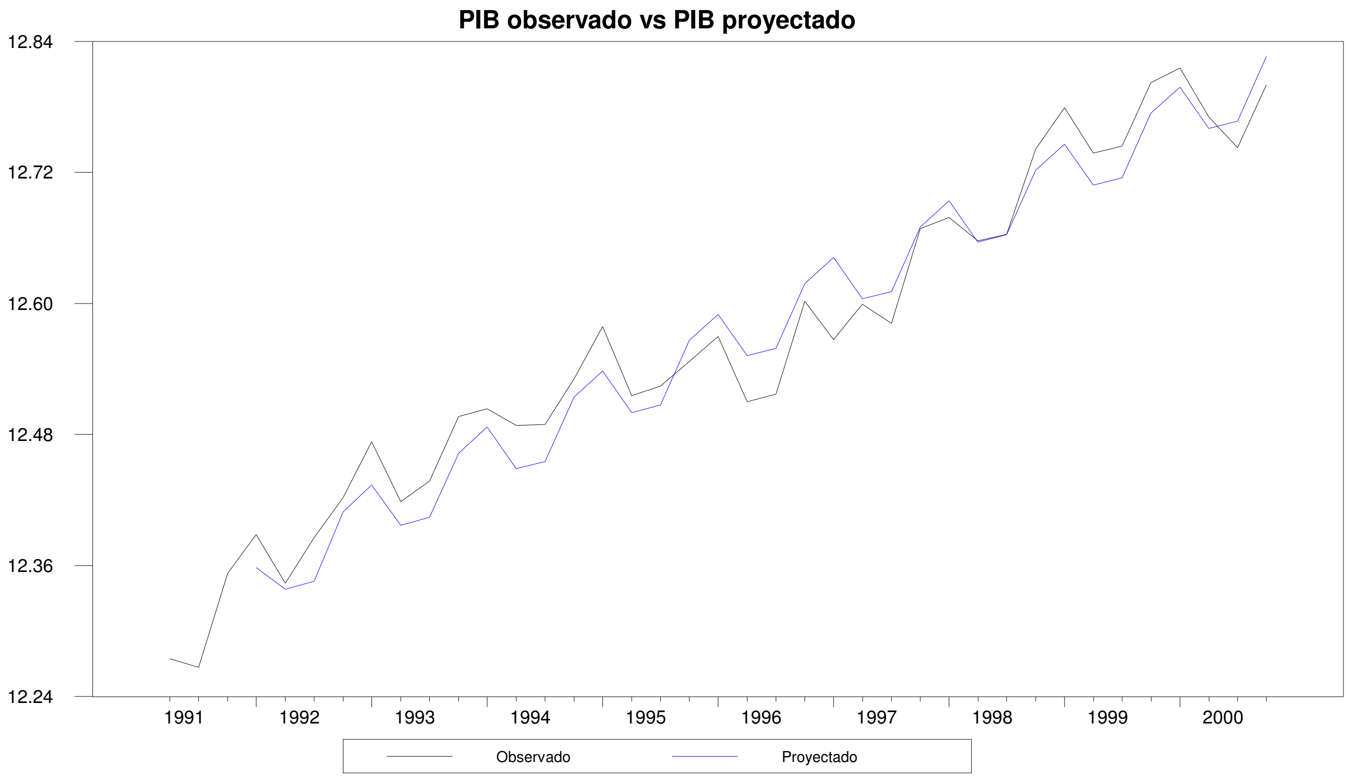
Graph 6.1: Variables in Levels



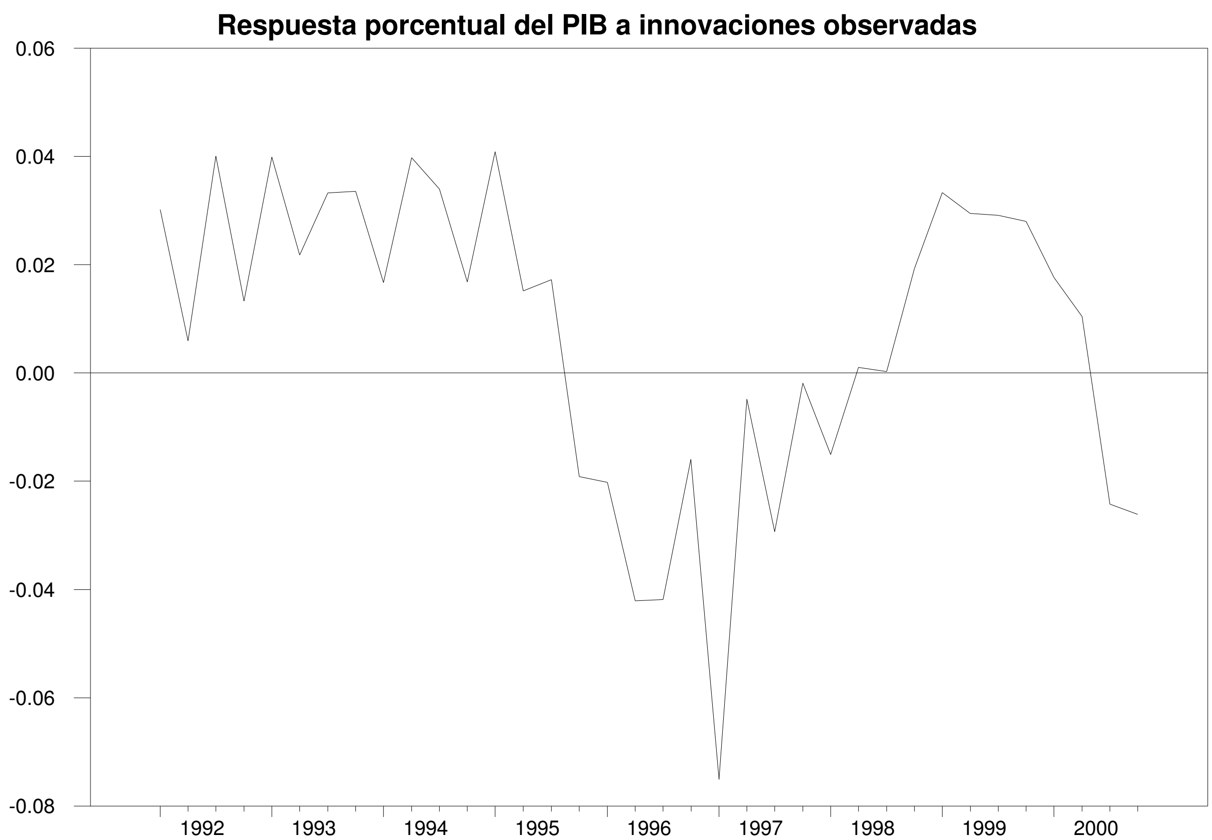
Graph 6.2: Variables in first differences



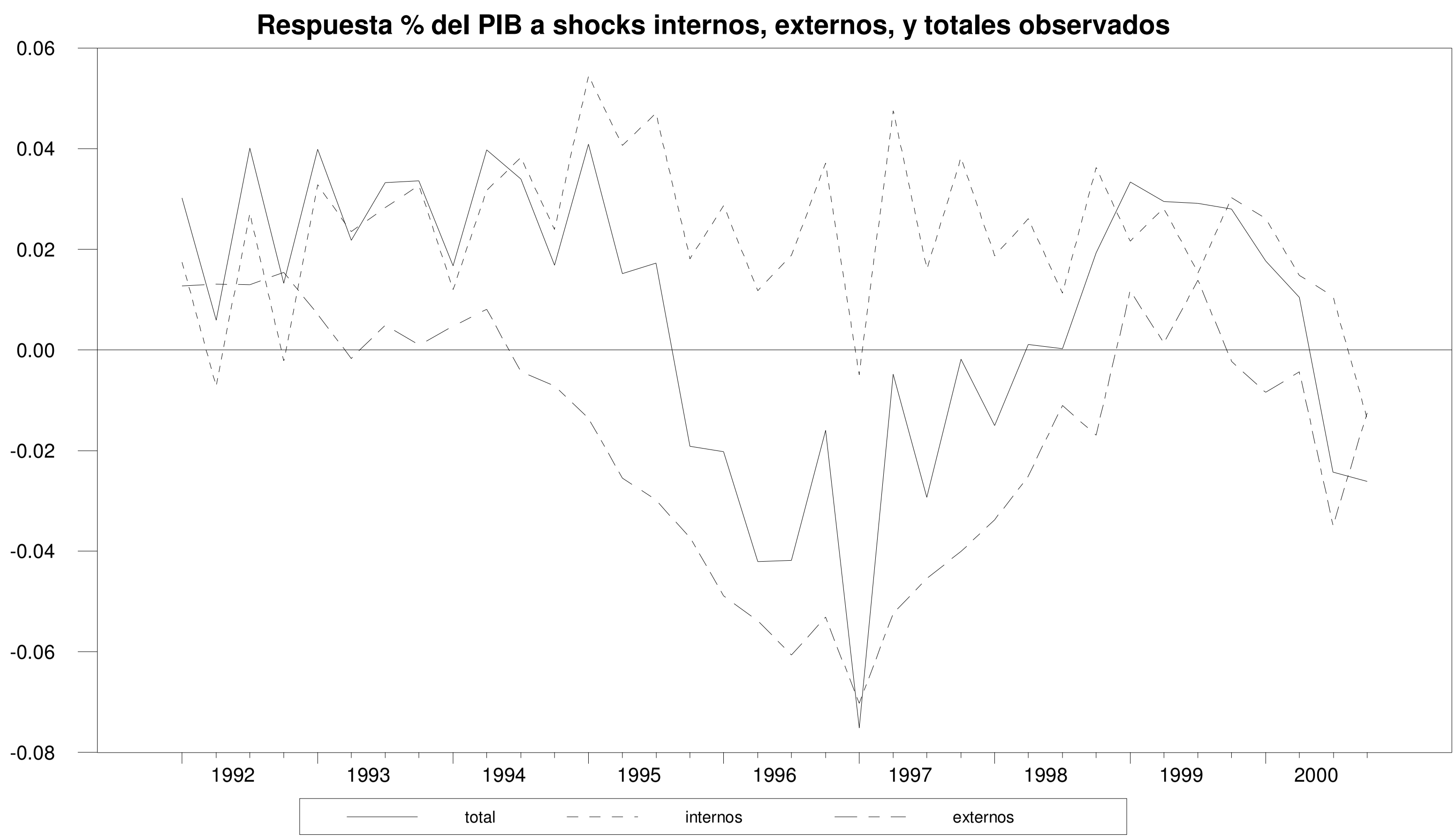
Graph 6.3


PIB observado vs PIB proyectado
12.84
12.72
12.60
12.48
12.36
12.24
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
Observado
Proyectado

Graph 6.4

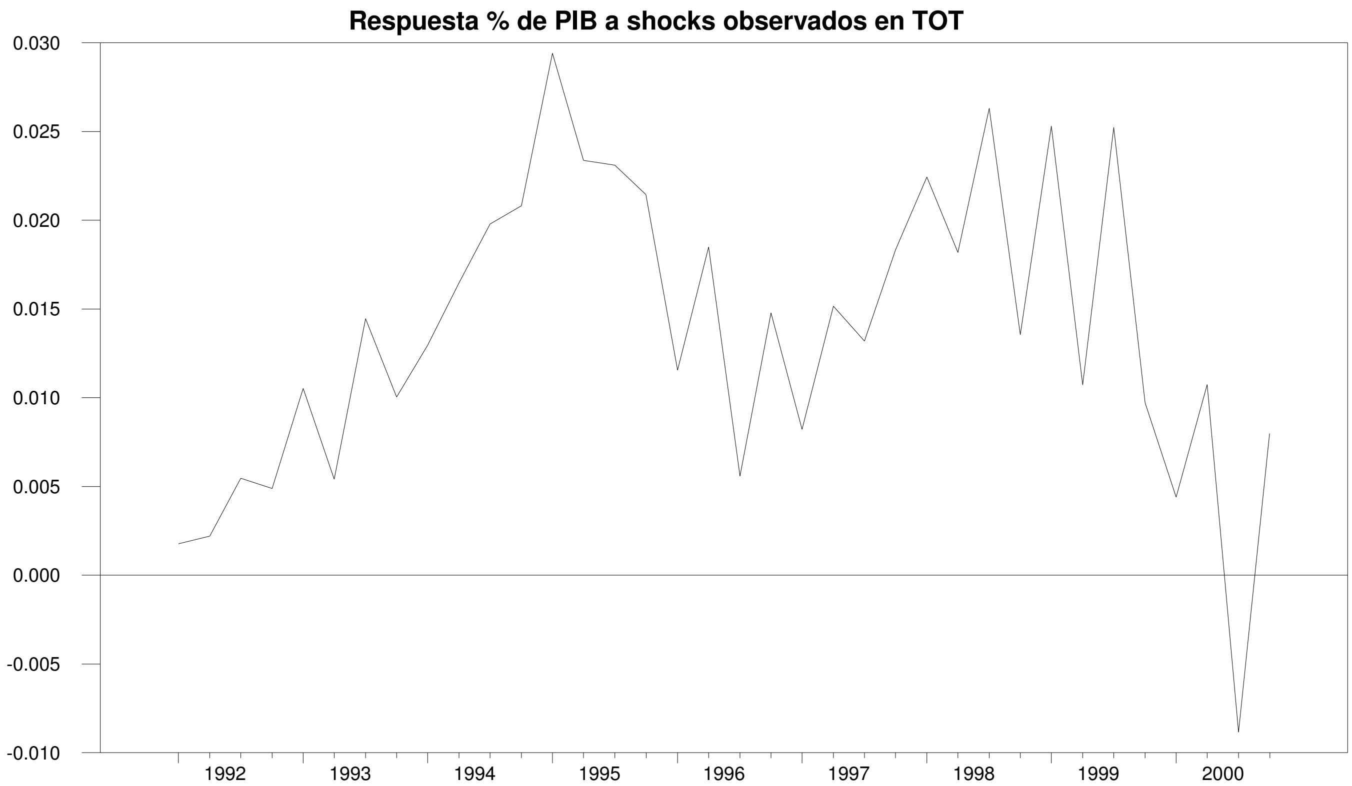

Respuesta porcentual del PIB a innovaciones observadas
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
1992
1993
1994
1995
1996
1997
1998
1999
2000

Graph 6.5



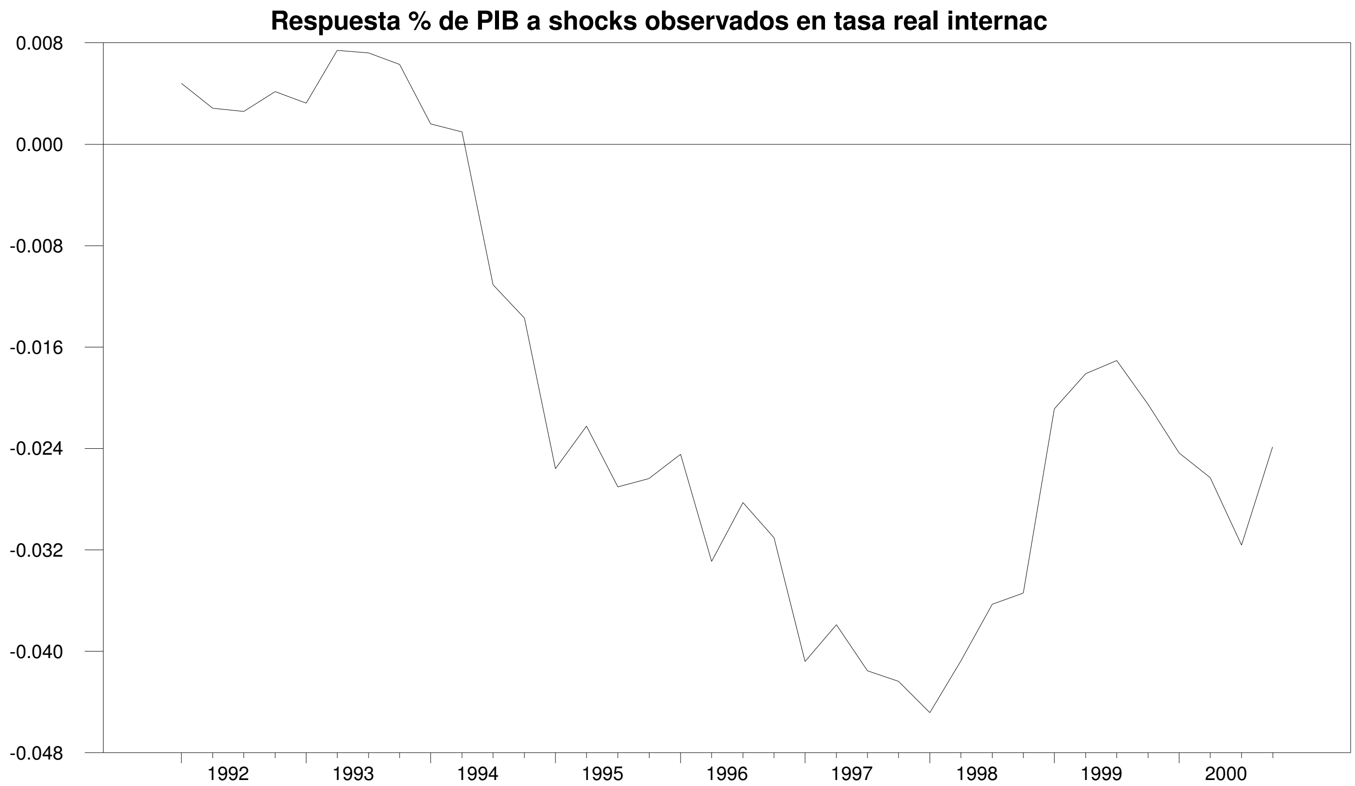
Respuesta % del PIB a shocks internos, externos, y totales observados
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
1992
1993
1994
1995
1996
1997
1998
1999
2000
total
internos
externos

Graph 6.6

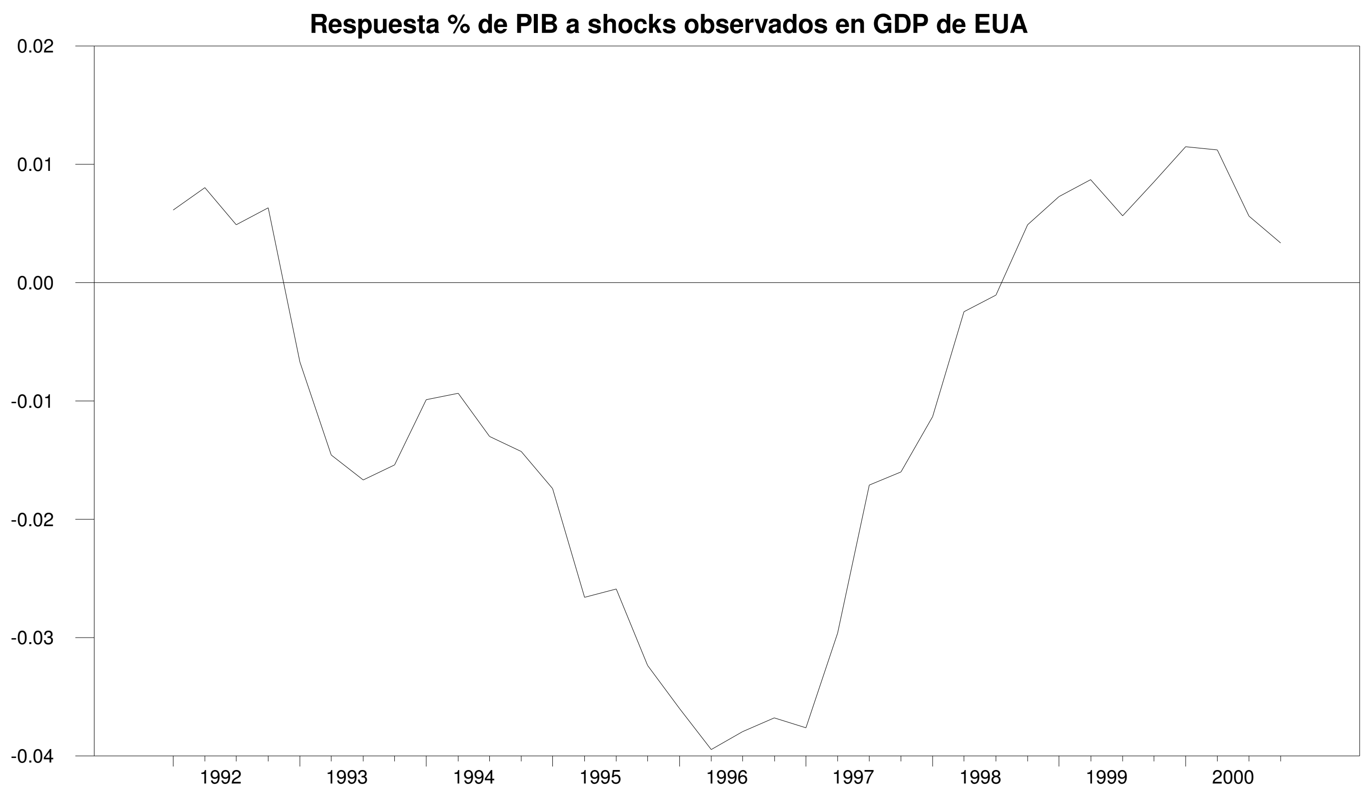


Respuesta % de PIB a shocks observados en TOT
0.030
0.025
0.020
0.015
0.010
0.005
0.000
-0.005
-0.010
1992
1993
1994
1995
1996
1997
1998
1999
2000

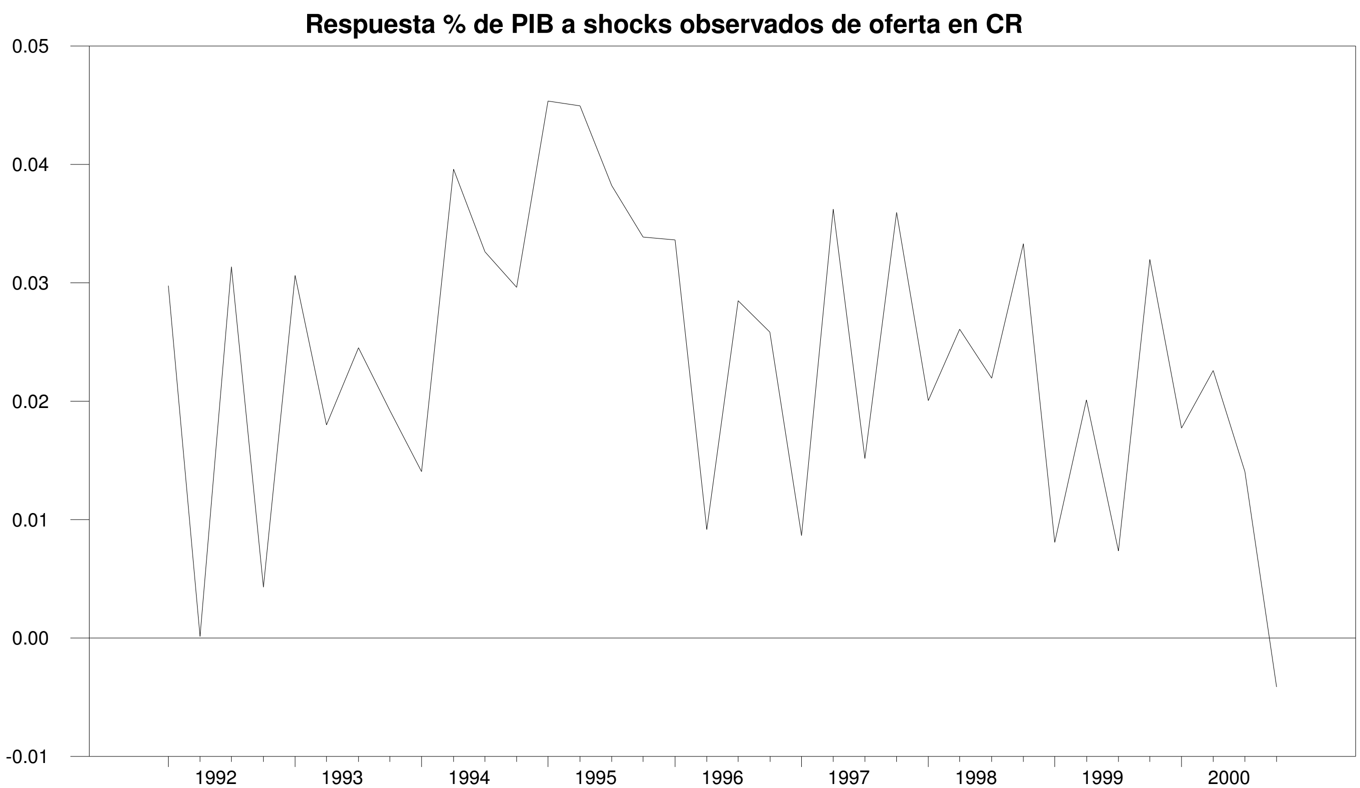
Graph 6.7


Respuesta % de PIB a shocks observados en tasa real internac
0.008
0.000
-0.008
-0.016
-0.024
-0.032
-0.040
-0.048
1992
1993
1994
1995
1996
1997
1998
1999
2000

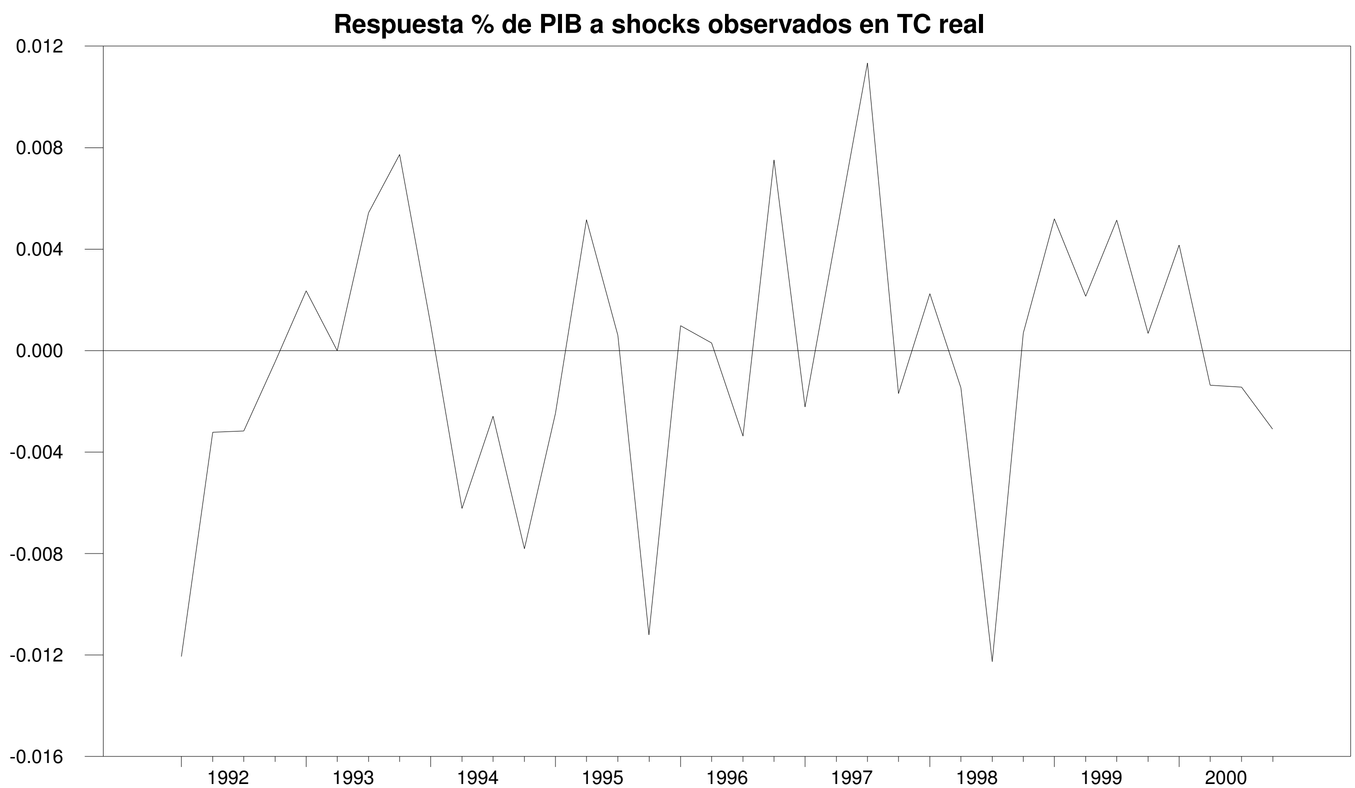
Graph 6.8


Respuesta % de PIB a shocks observados en GDP de EUA
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
1992
1993
1994
1995
1996
1997
1998
1999
2000

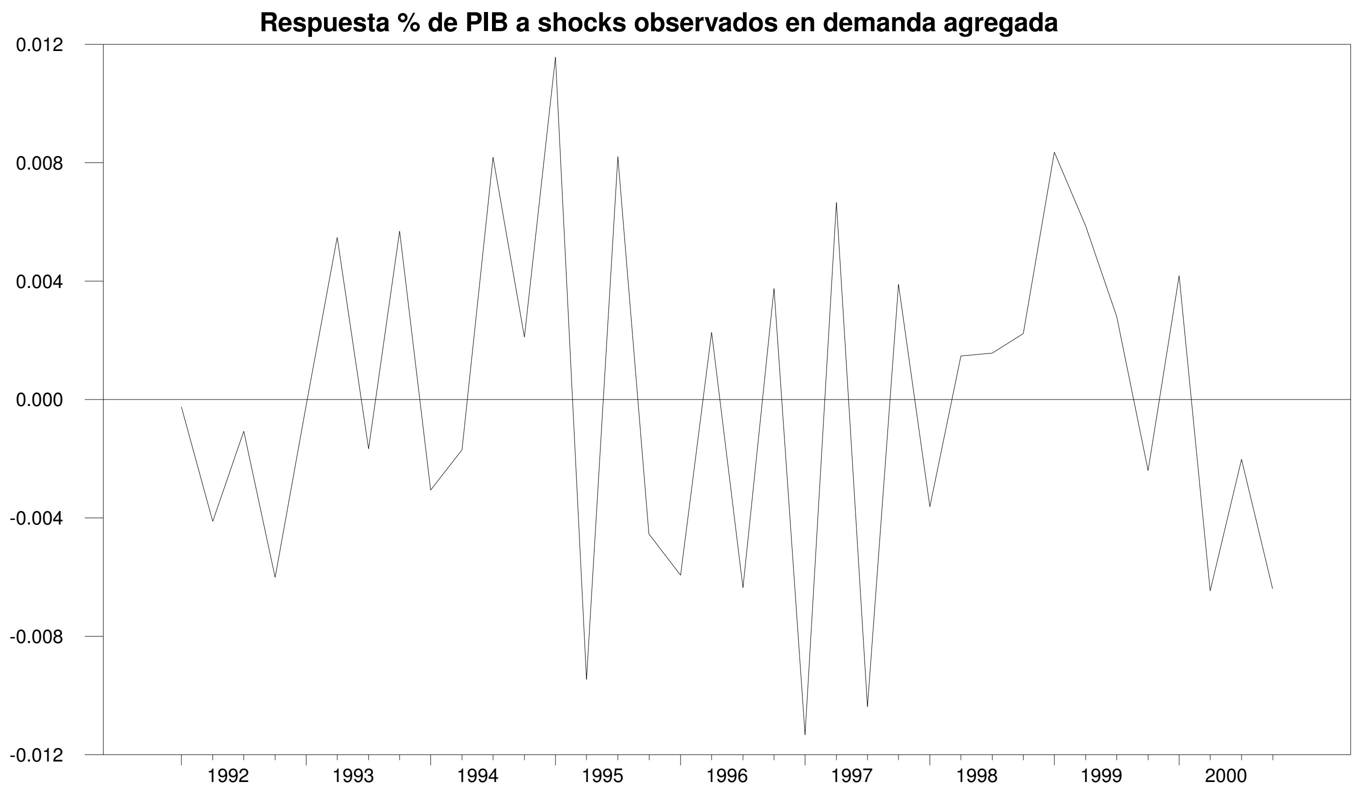
Graph 6.9


Respuesta % de PIB a shocks observados de oferta en CR
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
1992
1993
1994
1995
1996
1997
1998
1999
2000

Graph 6.10


Respuesta % de PIB a shocks observados en TC real
0.012
0.008
0.004
0.000
-0.004
-0.008
-0.012
-0.016
1992
1993
1994
1995
1996
1997
1998
1999
2000

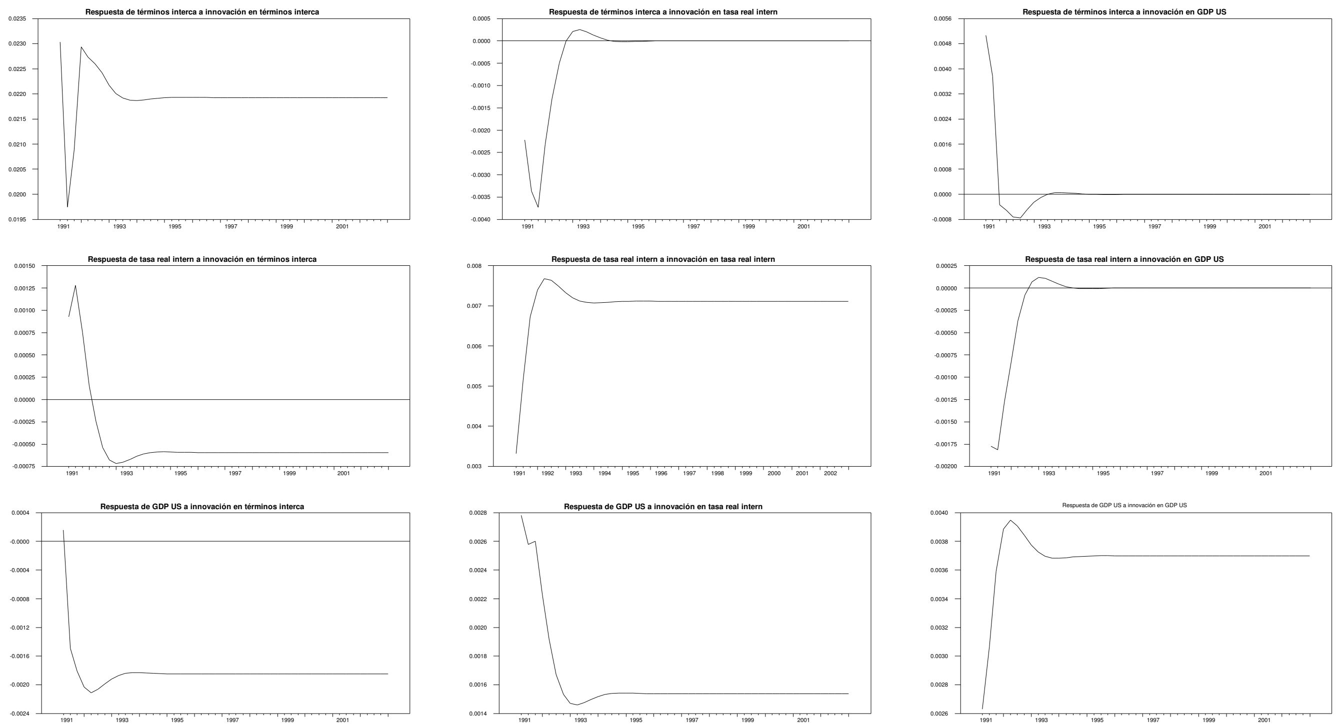
Graph 6.11



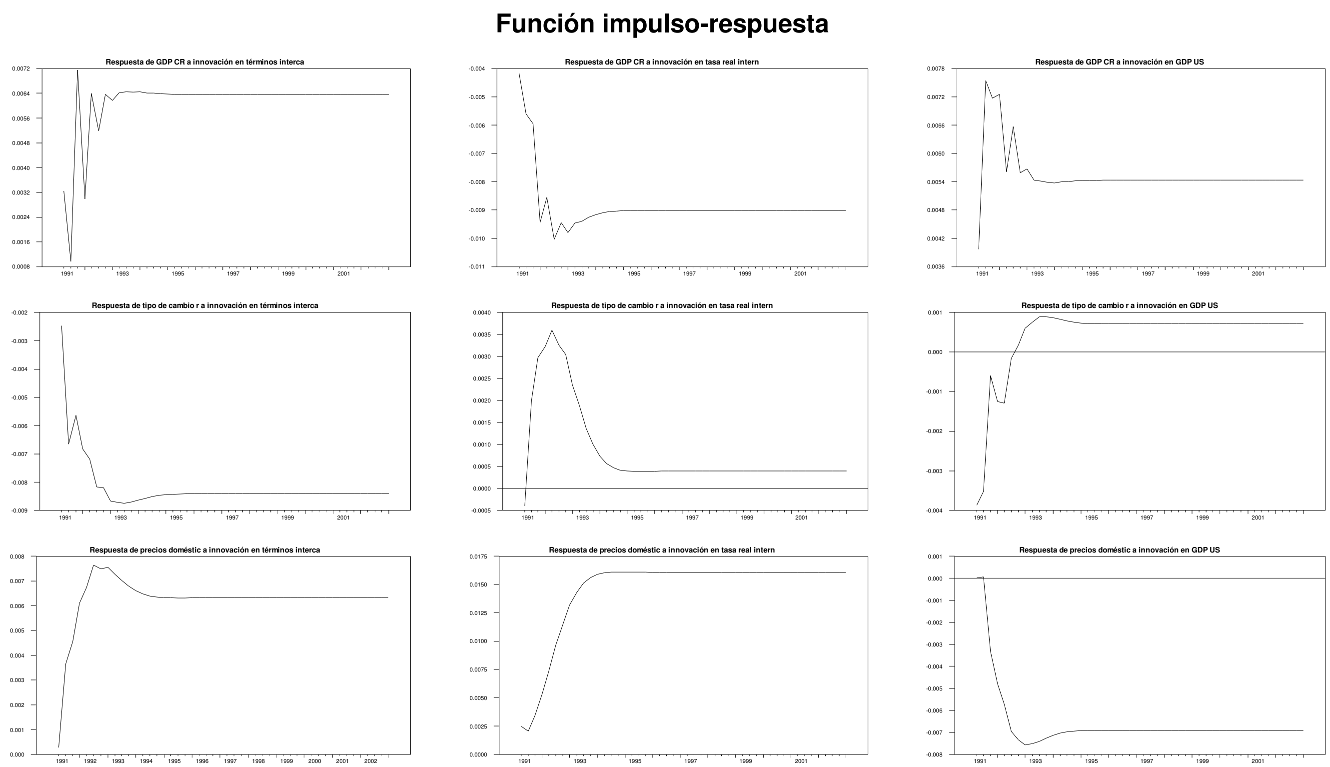
Respuesta % de PIB a shocks observados en demanda agregada
0.012
0.008
0.004
0.000
-0.004
-0.008
-0.012
1992
1993
1994
1995
1996
1997
1998
1999
2000

Graph 6.12

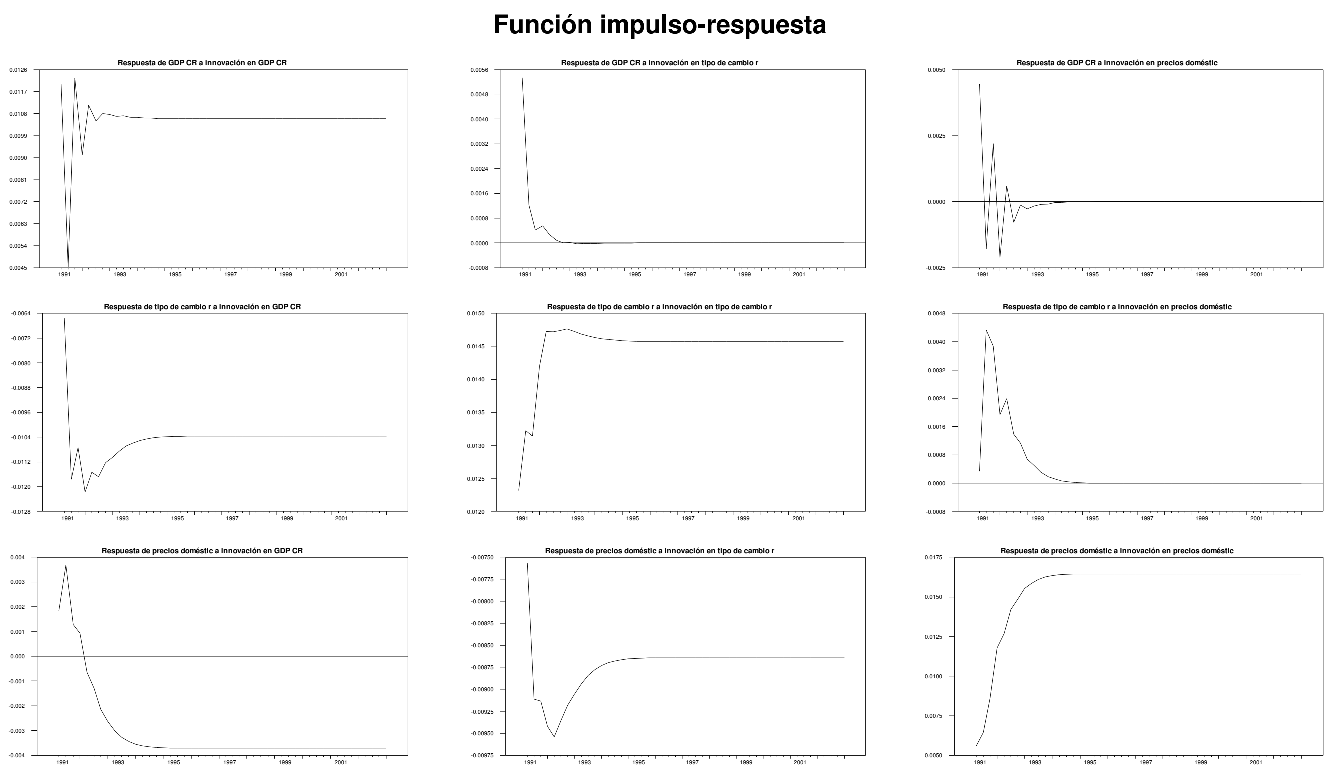
Función impulso-respuesta



Graph 6.13


Función impulso-respuesta
Respuesta de GDP CR a innovación en términos interca
Respuesta de GDP CR a innovación en tasa real intern
Respuesta de GDP CR a innovación en GDP US
Respuesta de tipo de cambio r a innovación en términos interca
Respuesta de tipo de cambio r a innovación en tasa real intern
Respuesta de tipo de cambio r a innovación en GDP US
Respuesta de precios doméstic a innovación en términos interca
Respuesta de precios doméstic a innovación en tasa real intern
Respuesta de precios doméstic a innovación en GDP US

Graph 6.14


Función impulso-respuesta
Respuesta de GDP CR a innovación en GDP CR
Respuesta de GDP CR a innovación en tipo de cambio r
Respuesta de GDP CR a innovación en precios doméstic
Respuesta de tipo de cambio r a innovación en GDP CR
Respuesta de tipo de cambio r a innovación en tipo de cambio r
Respuesta de tipo de cambio r a innovación en precios doméstic
Respuesta de precios doméstic a innovación en GDP CR
Respuesta de precios doméstic a innovación en tipo de cambio r
Respuesta de precios doméstic a innovación en precios doméstic

Apéndice A

Describimos ahora el procedimiento mediante el que obtuvimos los datos utilizados en la descomposición del crecimiento que se muestra en la Sección 4.

A.1 Producción

Nuestra serie de producto fue basada en las series de Producto Interno Bruto que genera el Banco Central de Costa Rica. Esta series requerían ajustes para poder manejar las dos distorsiones principales que afectan los datos. Primero, el cambio en el año base para el cálculo del PIB. La serie originalmente era calculada utilizando 1966 como el año base para precios y canastas. Hace varios años, el año base cambió a 1991. Este cambio implicó, no solamente una variación en los precios para los sectores medidos desde 1966. También representó cambios de metodología de medición, así como la inclusión explícita de sectores nuevos en la economía, que no aparecían en la muestra de 1966, y que han florecido desde entonces, como los bienes de alta tecnología.

La adición de estos sectores resultaba en un estimado de producción más alto que el que hasta entonces se estaba calculando. En particular, en 1991 el PIB nominal se estimó con los nuevos precios y procedimientos en un 27% mayor que el observado con base 66. Presumiblemente, estos sectores nuevos florecieron gradualmente durante el período 67-90, y preferimos empalmar ambas series de la forma más neutra posible, aumentando el factor de crecimiento de cada año en el período 66-90 en $\sqrt[25]{1.27}$. Muy posiblemente este procedimiento sesga los resultados a favor del crecimiento anterior a 1980 y en contra del observado desde 1984, ya que los cambios estructurales que llevaron a la existencia de estos nuevos sectores se dieron a partir de esta última fecha.

El segundo problema con la serie de PIB tiene que ver con INTEL, empresa que empezó operaciones en Costa Rica en 1998. Esta empresa tiene ganancias anormalmente altas para estándares costarricenses, lo que resulta probablemente de dos factores. Primero, el rendimiento a un know-how acumulado por esta empresa en sus operaciones en otros países, factor que no se cuenta explícitamente en los cálculos de nuestra descomposición de la producción. Segundo, porque la operación en Costa Rica de INTEL es exenta de impuestos a las ganancias, y adquiere su materia prima exclusivamente de otras plantas de INTEL en el resto del mundo, incluyendo algunas en las que sí se pagan esos impuestos. Por lo tanto, la compañía tiene incentivos a valuar sus precios de transferencia relativamente bajos, para que Costa Rica sea la localización de sus ganancias, lo que sesga la medición de valor agregado hacia arriba. Como esta empresa es muy grande en relación a la economía del país, el efecto sobre la medida del PIB es significativa. Para corregir estos factores, estimamos la contribución de INTEL al producto costarricense si su rendimiento al capital físico fuera igual al retorno promedio al capital en otros sectores en el país. Estimamos este retorno promedio como el cociente entre la fracción observada del ingreso que absorbe el capital (aproximadamente 0.3), y el cociente capital producto en 1998 (2.14). La tasa de rendimiento implícita es entonces

14%.[8] La siguiente tabla muestra las tasas de crecimiento mostradas en los datos oficiales y en los ajustados según estos procedimientos.

Crecimiento real del PIB

Year	Serie oficial	Serie ajustada
1958	4.6%	4.6%
1959	4.3%	4.3%
1960	6.1%	6.1%
1961	-1.0%	-1.0%
1962	8.1%	8.1%
1963	4.8%	4.8%
1964	4.1%	4.1%
1965	9.8%	9.8%
1966	7.9%	7.9%
1967	5.7%	6.7%
1968	8.4%	9.4%
1969	5.6%	6.6%
1970	7.5%	8.5%
1971	6.8%	7.8%
1972	8.2%	9.2%
1973	7.7%	8.7%
1974	5.5%	6.6%
1975	2.1%	3.1%
1976	5.5%	6.5%
1977	8.9%	10.0%
1978	6.3%	7.3%
1979	4.9%	5.9%
1980	0.8%	1.7%
1981	-2.3%	-1.3%
1982	-7.3%	-6.4%
1983	2.9%	3.9%
1984	8.0%	9.1%
1985	0.7%	1.7%
1986	5.5%	6.6%
1987	4.8%	5.8%
1988	3.4%	4.4%
1989	5.7%	6.7%
1990	3.6%	4.5%
1991	2.3%	3.2%
1992	9.2%	9.2%
1993	7.4%	7.4%
1994	4.7%	4.7%
1995	3.9%	3.9%
1996	0.9%	0.9%

[8] Por supuesto, esta corrección es posiblemente insuficiente, pues el valor agregado de varias otras empresas en régimen de zona franca (y por ende con la misma exención tributaria) puede estar siendo sobreestimado por las mismas razones. Las exportaciones provenientes de zona franca son más de la mitad de las exportaciones totales, e incluyen a casi todas las empresas de alta tecnología, farmacia y otros productos sofisticados.

1997	5.6%	5.6%
1998	8.4%	6.9%
1999	8.4%	3.0%
2000	1.7%	3.0%
1957-1963	4.5%	4.5%
1963-1973	7.2%	7.9%
1973-1980	4.8%	5.8%
1980-1984	0.2%	1.1%
1984-1990	3.9%	4.9%
1990-1995	5.5%	5.7%
1995-2000	4.9%	3.9%

A.2 Stock de capital

El acervo de capital se estima acumulando la inversión observada de acuerdo a la siguiente ecuación

$$K_{t+1} = (1-\delta)\,K_t + I_{t+1}$$

Los datos de inversión en relación al producto vienen de las cuentas nacionales de Banco Central de Costa Rica. Los datos nos permiten distinguir entre inversión en estructuras y en equipo, lo que es importante porque ambos tipos de capital se deprecian a tassa muy distintas. Por lo tanto, se usa la ecuación anterior para estimar dos series separadas, que son luego sumadas para generar el capital total. De acuerdo con Harberger (1998) asumimos una tasa de depreciación de 2.5% para estructuras y de 8% para maquinaria y equipo.[9]

Para estimar el capital inicial con el cual arrancar la serie, aplicamos el siguiente procedimiento. De la ecuación anterior, derivamos

$$\frac{K_{t+1}}{Y_{t+1}} = \frac{(1-\delta)}{(1+g)}\frac{K_t}{Y_t} + \frac{I_{t+1}}{Y_{t+1}}$$

donde g es la tasa de crecimiento del producto. Asumiendo que la relación inversión-producto se mantuvo constante por un período suficientemente prolongado, derivamos la siguiente condición

$$\frac{K}{Y} \cong \left[\frac{1}{\delta+g}\right]\frac{I}{Y}$$

Como en Klenow y Rodriguez (1997), tomamos un momento en el pasado lejano en que la inversión y el producto crezcan a tasas similares, que denotaremos como año 0.

[9] La tasa de depreciación que esto genera para el capital promedio es de 5.3%, cercana al 6% convencionalmente usado, como en Prescott ( ), y Young( ).

Calculamos la relación I/Y en la década que comienza en t = 0 (denotado $\overline{\left(\frac{I}{Y}\right)}$), y entonces

$$K_0 = Y_0 \left[\frac{1}{\delta + g} \right] \overline{\left(\frac{I}{Y} \right)}$$

Idealmente, t= 0 es un momento lo suficientemente antiguo como para que los errores que aparezcan en K0 hayan sido minimizados por la depreciación. En nuestro caso, t=0 es el año 1950, pues este es el primer año para el que tenemos cifras disponibles en Cuentas Nacionales. Debido a que nuestro análisis de descomposición de crecimiento inicia en 1963, esto da cierto margen para reducir el efecto de errores en el cálculo.[10] Los siguientes cuadros muestran las series de capital privado, capital público y sus componentes.

Niveles de capital público y privado

	Capital público	Capital privado	Capital total
1963	79,630.2	269,459.0	349,089.2
1973	170,730.2	562,895.5	733,625.7
1980	357,982.8	939,364.7	1,297,347.5
1984	417,738.0	1,003,677.2	1,421,415.3
1990	506,561.4	1,331,132.6	1,837,694.0
1995	607,846.5	1,761,691.6	2,369,538.0
2000	740,610.0	2,313,890.6	3,054,500.6

Componentes del capital público

Año	Total K público	K empresas estatales	Resto del capital público
1963	101,307.8	35,752.20	65556
1973	199,035.0	81,160.89	117874
1980	388,323.8	180,673.55	207650
1984	451,302.5	223,675.03	227627
2000	794,100.7	465,787.69	328313
	Estructura		
1963	100.0%	35.3%	64.7%
1973	100.0%	40.8%	59.2%
1980	100.0%	46.5%	53.5%
1984	100.0%	49.6%	50.4%

[10] Antes de 1963 existe una estimación de cuentas nacionales para el período que inicia en 1950. Sin embargo, esta estimación (hecha por el ministerio de planificación) no es sistemática, y tiene enormes lagunas. Muchos aspectos metodológicos de su derivacion hoy ya no se conocen. Por tanto optamos por la prudencia y escogemos 1963 como el año de partida para la serie de capital.

2000	100.0%	58.7%	41.3%

A.3 Empleo

Utilizamos tres fuentes principales para la derivación de la serie de empleo: los Censos de 1963 y 1973, la Encuesta Nacional de Hogares (ENH) a partir de 1976, y los datos de población provenientes de estudios hechos por el Programa Centroamericano de Población a partir de 1975.

Los datos de empleo para 1963 y 1973 se basan en los Censos de esos años. Para el período 1976-2000, tomamos la razón de ocupados a población total (denotada L/N de aquí en adelante) proveniente de las Encuestas de Hogares, y las aplicamos al dato de población total proveniente del Programa Centroamericano de Población. Las Encuestas de Hogares también contienen un estimado del empleo total de cada año, basado en las tasas L/N y un estimado de población total. Sin embargo, la estimación de población total en estas encuestas presenta subestimaciones importantes con respecto al dato de los Censos en 1984 y 2000. Buena parte de esto se debe posiblemente a las immigraciones que ocurrieron en los últimos 20 años y que han sido tomadas en cuenta solo parcialmente en la ENH. La serie de población total del Programa Centroamericano de Población sí toma en cuenta el efecto de tales inmigraciones sobre la población total, y produce estimaciones de población más cercanas a los censos de población de 1984 y 2000. De ahí que utilicemos esta serie y las "tasas de empleo" (L/N) de ENH para calcular el total de ocupados en cada año.

La serie de empleo así obtenida requiere de un ajuste adicional debido a un cambio metodológico en ENH en 1987. Como se muestra en el cuadro siguiente, la serie (L/N) obtenida de las ENH presenta un salto importante en este mismo año, aumentando de 33.5% a 35.4%. Suponiendo que este cambio metodológico se hacía necesario desde inicios de nuestro período de estudio, (pero que solo se llevó a cabo a partir de 1987), procedimos a corregir el nivel de L/N reportado en el período 1963-86. Partiendo del valor de L/N para 1987 según ENH, calculamos el nivel que tendría en 1986, si la variación anual ocurrida entre 1986 y 1987 hubiera sido la misma que la variación anual promedio observada durante los tres años siguientes (1987-1990). Luego, obtenemos los niveles de L-N anteriores a 1986, aplicando el crecimiento observado en la serie L/N reportada en ENH (para cada año en el período 1976-1986), al nivel de L/N calculado para 1986. El nivel de ocupados de 1963 y 1973 se corrige aplicando las tasas de crecimiento para 1963-73, y 1973-76, al nivel de empleo corregido para el año 1976. El siguiente cuadro muestra la población, tasas de empleo y número de ocupados obtenido para el período 1976-2000:

Población total, tasa de empleo, y número de ocupados

	Población total	L/N según ENH	L/N corrgida	Ocupados (serie corregida)
1976	2025063	30.6%	32.1%	650152
1977	2083858	31.6%	33.1%	690444
1978	2146542	32.5%	34.0%	729973
1979	2211525	32.6%	34.2%	755332
1980	2278345	32.7%	34.2%	779440
1981	2347010	31.8%	33.4%	783187
1982	2417049	32.7%	34.3%	827929
1983	2487652	32.3%	33.8%	841586
1984	2560244	32.8%	34.3%	878538
1985	2638964	33.3%	34.8%	918401
1986	2721082	33.5%	35.1%	954660
1987	2800752	35.4%	35.4%	990981
1988	2879609	35.6%	35.6%	1024839
1989	2960193	36.1%	36.1%	1067749
1990	3047641	36.3%	36.3%	1105661
1991	3144190	35.0%	35.0%	1101307
1992	3234551	35.5%	35.5%	1148701
1993	3324616	36.5%	36.5%	1215085
1994	3414217	37.0%	37.0%	1264932
1995	3503957	37.3%	37.3%	1305269
1996	3593080	35.8%	35.8%	1285410
1997	3681157	37.5%	37.5%	1380088
1998	3768865	38.9%	38.9%	1465502
1999	3856191	38.1%	38.1%	1467543
2000	3943204	37.8%	37.8%	1491143

El crecimiento en la serie de ocupados que se obtiene presenta una trayectoria mucho más “suave” que la que se desprende de los datos de empleo de ENH directamente. Como se muestra en el siguiente cuadro, el crecimiento en la serie proveniente de ENH presenta dos saltos fuertes, uno en 1987 correspondiente al cambio metodológico y otro en el 2000 debido a una corrección en el cálculo de población total basado en los resultdos del Censo de ese mismo año. Nuestra serie ajustada implícitamente distribuye el salto del 2000 hacia atrás (con lo que las tasas de crecimiento en los años anteriores son mayores que en la serie original), y hace una corrección por el cambio metodológico en el 87.

Número de ocupados

	Serie de ENH y Censos 63, 73	% cambio anual	Serie corregida	% cambio anual
1963	367814		386451	
1973	542332	4.0%	569811	4.0%
1976	616788	4.4%	650152	4.5%
1977	653265	5.9%	690444	6.2%
1978	687044	5.2%	729973	5.7%
1979	707135	2.9%	755332	3.5%
1980	724708	2.5%	779440	3.2%
1981	726227	0.2%	783187	0.5%
1982	759879	4.6%	827929	5.7%
1983	767596	1.0%	841586	1.6%
1984	797147	3.8%	878538	4.4%
1985	826698	3.7%	918401	4.5%
1986	854218	3.3%	954660	3.9%
1987	923310	8.1%	990981	3.8%
1988	951190	3.0%	1024839	3.4%
1989	986840	3.7%	1067749	4.2%
1990	1017151	3.1%	1105661	3.6%
1991	1006646	-1.0%	1101307	-0.4%
1992	1042957	3.6%	1148701	4.3%
1993	1096435	5.1%	1215085	5.8%
1994	1137588	3.8%	1264932	4.1%
1995	1168055	2.7%	1305269	3.2%
1996	1145021	-2.0%	1285410	-1.5%
1997	1227333	7.2%	1380088	7.4%
1998	1300005	5.9%	1465502	6.2%
1999	1300146	0.0%	1467543	0.1%
2000	1455656	12.0%	1491143	1.6%

La serie de empleo que se utiliza en la descomposición de crecimiento se basa en la serie de ocupados ajustada descrita anteriormente y en las horas semanales promedio trabajadas durante cada año. Estimamos el empleo total como el número total de horas trabajadas en una semana promedio del año. El siguiente cuadro muestra el ajuste en empleo por el efecto de cambio en el número de horas trabajadas. Observe que el número de horas trabajadas disminuye levemente en el tiempo.

Promedio de horas trabajadas por semana
y n[umero de ocupados

Año	Promedio horas trabajadas por semana	Número ocupados	Cambio %	Empleo en horas	Cambio %
1963	47.3	386451		18267023	
1973	48.0	569811	4.0%	27353650	4.1%
1976	46.9	650152	4.5%	30462393	3.7%
1977	47.3	690444	6.2%	32684410	7.3%
1978	46.9	729973	5.7%	34219310	4.7%
1979	na	755332	3.5%	n.d.	n.d.
1980	46.0	779440	3.2%	35891229	n.d.
1981	45.3	783187	0.5%	35502258	-1.1%
1982	na	827929	5.7%	n.d.	n.d.
1983	45.0	841586	1.6%	37896939	n.d.
1984	45.7	878538	4.4%	40171084	6.0%
1985	46.4	918401	4.5%	42631659	6.1%
1986	45.8	954660	3.9%	43691212	2.5%
1987	45.9	990981	3.8%	45448844	4.0%
1988	45.5	1024839	3.4%	46607604	2.5%
1989	45.0	1067749	4.2%	48030601	3.1%
1990	45.5	1105661	3.6%	50261954	4.6%
1991	43.9	1101307	-0.4%	48389695	-3.7%
1992	45.6	1148701	4.3%	52398326	8.3%
1993	45.7	1215085	5.8%	55512944	5.9%
1994	45.8	1264932	4.1%	57952531	4.4%
1995	45.0	1305269	3.2%	58799744	1.5%
1996	46.1	1285410	-1.5%	59235040	0.7%
1997	45.5	1380088	7.4%	62814006	6.0%
1998	45.3	1465502	6.2%	66393699	5.7%
1999	45.7	1467543	0.1%	67011789	0.9%
2000	45.4	1491143	1.6%	67760742	1.1%

A.4 Escolaridad y capital humano

Se usaron como fuentes para escolaridad los Censos de 1963 y 1973, y las Encuestas de Hogares del período 1976-2000, con lagunas en los datos disponibles en la ENH para algunos años, y nos enfocamos en dos poblaciones: en edad de trabajar (15 años o más) y empleada. La primera es importante para entender el efecto de la escolaridad en la participación laboral, y la segunda para entender la productividad del trabajo. Para ambas, existe el dato de la escolaridad por género.

La escolaridad es medida en dos maneras. La primera es el número de años completos aprobados de educación formal que en promedio tiene la población en cuestión, que se reporta en el siguiente cuadro:

Escolaridad

	Población de 15 años o más			Población empleada		
	Total	Hombres	Mujeres	Total	Hombres	Mujeres
1963	3.92	3.91	3.92	4.69	4.42	6.02
1973	5.12	5.13	5.11	5.53		
1976	5.51	5.50	5.52	5.74		
1977	5.76	5.74	5.78	5.86		
1978	5.83	5.81	5.85	6.05		
1979	6.04	6.02	6.07	6.21		
1980	6.29	6.30	6.28	6.41		
1981	6.38	6.43	6.33			
1982	6.37	6.40	6.34	6.46		
1983	6.61	6.67	6.56	6.86		
1984	6.42	6.41	6.43	6.85	6.35	8.58
1985	6.83	6.79	6.87			
1986						
1987	6.60	6.55	6.65	6.98	6.56	8.10
1988	6.74	6.71	6.77	7.15	6.73	8.26
1989	6.71	6.70	6.71	7.17	6.73	8.30
1990	6.74	6.76	6.72	7.20	6.80	8.24
1991	6.71	6.73	6.69	7.22	6.84	8.15
1992	6.92	6.91	6.93	7.41	6.97	8.46
1993	7.02	7.05	6.99	7.56	7.15	8.52
1994	6.96	6.98	6.95	7.48	7.07	8.43
1995	7.19	7.20	7.18	7.68	7.28	8.62
1996	7.16	7.14	7.18	7.71	7.24	8.83
1997	7.26	7.21	7.32	7.75	7.29	8.77
1998	7.35	7.33	7.37	7.90	7.45	8.85
1999	7.30	7.27	7.33	7.87	7.44	8.75
2000	7.45	7.41	7.49	8.08	7.61	9.05

La segunda es un índice de escolaridad, derivado de la función de producción utilizada en Klenow and Rodríguez (1997), y que toma la forma

$$Y = K^{\alpha} H^{1-\alpha}$$

donde

$$H = \sum_{i=1}^{L} e^{\phi s_i}$$

Esta especificación alternativa nos permite tomar en cuenta, adecuadamente, los rendimientos no lineales a la educación evidenciados en los datos, y tiene importante apoyo empírico en la literatura sobre capital humano. Derivamos un índice de escolaridad, o sea un nivel (s~) que depende de la distribucion completa de la poblacion, y tal que:

$$L \cdot e^{\phi \cdot s\sim} = \sum_{i=1}^{L} e^{\phi s_i}$$

Indice de escolaridad

	Total	Hombres	Mujeres
1963	5.70	5.30	7.37
1973	6.71		
1976	6.84		
1977	6.81		
1978	7.17		
1979	7.35		
1980	7.55		
1981			
1982	7.61		
1983	8.02		
1984	8.06	7.51	9.69
1987	8.12	7.67	9.21
1988	8.30	7.83	9.37
1989	8.33	7.86	9.41
1990	8.38	7.93	9.42
1991	8.35	7.93	9.26
1992	8.55	8.07	9.58
1993	8.72	8.28	9.66
1994	8.65	8.21	9.60
1995	8.85	8.43	9.75
1996	8.86	8.33	9.98
1997	8.91	8.42	9.90
1998	9.11	8.63	10.03
1999	9.07	8.60	9.95
2000	9.30	8.79	10.24

A.5 Participación del trabajo en el ingreso total

Para estimar el coeficiente α que requiere la función de producción, seguimos el procedimiento en Gollin (2000). Obtenemos pagos por salarios de las cuentas nacionales, e inferimos de ahí un salario promedio dados los trabajadores asalariados estimados en la ENH o el censo. Asumiendo que el ingreso para los trabajadores autoempleados es igual, en promedio, al de los asalariados, obtenemos un ingreso total para el trabajo. La fracción que este ingreso representa del PIB, excluyendo de este los impuestos indirectos (netos de subvenciones), se utiliza para la estimación de α.

En el cuadro siguiente se muestran los datos utilizados para obtener la participación del trabajo. Las series de remuneraciones al trabajo y de PIB son valores nominales base 91 obtenidos al empalmar las series base 66 y base 91. Como se explicó en la primera sección del apéndice, el PIB base 91 supera el valor nominal de la base 66 en aproximadamente 27% debido a la incorporación de nuevos sectores de la economía. Para empalmar las series, se multiplicó el factor de crecimiento del PIB nominal base 66 por $\sqrt[25]{1.27}$ para cada año del período 1966-1991. Un procedimiento se sigue con las remuneraciones al trabajo, cuyo valor nominal en la base 91 es, en el año 1991, un 16.5% mayor que el valor nominal base 66. En el caso de impuestos netos de subvenciones, el cambio de base presenta problemas porque cambian los impuestos y subsidios incluidos. En este caso, nos aseguramos de que los impuestos y subsidios del 91 en adelante fueran los mismos incluidos en la base 66.

Participación del trabajo y su derivación

Año	# asalariados	Total ocupados	asal/ocup (A)	Total remuneraciones (nominal) (B)	PIB - Impuestos indirectos+subsidios ©	Participación del trabajo =(B/A)/C
1963	245308	367814	66.7%	1573.5	3984.0	59.2%
1973	348251	542332	64.2%	4797.5	11745.3	63.6%
1976	447395	616788	72.5%	10226.0	23705.2	59.5%
1980	546116	724708	75.4%	22324.3	47747.3	62.0%
1984	546538	746860	73.2%	82066.7	183206.8	61.2%
1985	606724	813382	74.6%	104035.6	224804.7	62.0%
1990	712479	1017151	70.0%	306103.2	599739.5	72.9%
1991	701087	1006646	69.6%	380870.9	788434.1	69.4%
1995	833786	1168055	71.4%	961516.9	1885042.1	71.5%
2000	1029997	1455600	70.8%	2204705.9	4102519.9	75.9%

Apéndice B

Análisis de "Shift-share" con datos base 1991.

PIB por trabajador
Niveles

Sector Económico	1991	1995	2000
TOTAL	816126.7	887242.2	950013.1
Variación anual %		2.11%	1.38%
Agricultura y pesca	422792.0	511458.3	564338.9
Variación anual %		4.87%	1.99%
Manufactura, minas y canteras	973987.6	1208693.4	1408680.9
Variación anual %		5.55%	3.11%
Construcción	521331.0	657337.8	543658.2
Variación anual %		5.97%	-3.73%
Comercio al por mayor y detalle, restaurantes y hoteles	1001324.0	942248.9	970714.0
Variación anual %		-1.51%	0.60%
Servicios sociales y personales más servicios básicos y a las empresas /1	994111.1	973722.6	1042607.9
Variación anual %		-0.52%	1.38%

/1 Incluye administración pública; educación pública y privada, servicios de salud, y servicios personales; más electricidad, gas y agua; transporte, almacenamiento, y comunicaciones; servicios financieros y de seguros, y otros servicios a las empresas.

Ocupados por rama de actividad
Estructura
Julio de cada año

Sector económico	**1991**	**1995**	**2000**
TOTAL	100.0%	100.0%	100.0%
Agricultura y pesca	25.5%	21.6%	20.4%
Industria, minas y canteras	18.9%	16.7%	14.6%
Construcción	6.3%	6.3%	6.8%
Comercio al por mayor y detalle, restaurantes y hoteles	15.6%	19.3%	20.2%
Servicios sociales y personales más servicios básicos y a las empresas /1	33.7%	36.1%	37.9%

/1 Incluye administración pública; educación pública y privada, servicios de salud, y servicios personales; más electricidad, gas y agua; transporte, almacenamiento, y comunicaciones; servicios financieros y de seguros, y otros servicios a las empresas.

PIB por trabajador
Decomposición de crecimiento en crecimiento por sector,
y cambios en la estructura de ocupados por sector

Sector Económico	**1991-1995**	**1995-2000**
TOTAL	8.7%	7.1%
Productos cruzados	-1.4%	-0.4%
Crecimiento por cambio en estructura de trabajadores	2.8%	-0.2%
Crecimiento dada estructura inicial de trabajadores	7.3%	7.7%

Apéndice C

C.1 Metodología seguida para la ortogonalización de errores con restricciones de largo plazo en vectores autorregresivos

La ortogonalización de los errores se logra a través de la imposición de restricciones de largo plazo. La especificación del sistema de ecuaciones estimado es la siguiente (ecuación 4.1 del texto):

$$y_t = A(L)\,y_t + v_t,\ \text{donde}\ \mathrm{E}\left(v_t v_t^{'}\right) = \Omega \tag{1}$$

Debido a que los errores asociados a los distintos componentes de *y* están correlacionados (omega no es diagonal), la simulación de un shock a una de las variables dado el valor de las otras requiere que primero se ortogonalicen los errores. Para esto, suponemos que hay un modelo estructural, cuya forma reducida es (1), y en el que los errores asociados a cada ecuación no están correlacionados. Este modelo estructural se obtiene al premultiplicar ambos lados de (1) por una matriz G tal que:

$$Gy_t = GA(L)\,y_t + e_t,\ \text{donde}\ e_t = \mathrm{G}v_t,\ \mathrm{E}\left(e_t e_t^{'}\right) = I \tag{2}$$

Blanchard y Quah usan restricciones de largo plazo para identificar esta matriz G. Esto se hace expresando (1) como una media móvil (mediante la inversión del polinomio de rezagos A(L)), y definiendo $A_0 = G^{-1}$, con lo que se obtiene:

$$\begin{aligned} & y_t = v_t + C_1 v_{t-1} + C_2 v_{t-2} + \ldots \\ & \Rightarrow y_t = A_0 e_t + A_1 e_{t-1} + \ldots \end{aligned} \tag{3}$$

donde: $v_t = A_0 e_t$, $A_j = C_j A_0$, y $A_0 A_0^{'} = \Omega = E(vv')$

Supongamos que $y_t = \Delta x_t$. La restricción de largo plazo de Blanchard y Quah es que, por ejemplo, e_{2t} no tiene efecto en el largo plazo sobre x_{1t}, por lo que la entrada en la primera fila y segunda columna de la matriz $A1 = \sum_{i=1}^{\infty} A_i$ es igual a cero. Definiendo $C1 = \sum_{i=1}^{\infty} C_i$, tenemos que:

$$A1 = C1 \cdot A_0$$

Por lo tanto: $A1 \cdot A1' = C1 \cdot \Omega \cdot C1'$.

Con el orden de ecuaciones apropiado, A1 es la descomposición Cholesky de $C1 \cdot \Omega \cdot C1'$.
Así obtenemos A1, y finalmente $A_0 = inv(C1)A1$.

C.2 Descomposiciones de varianza con base en el VAR

Cuadro B.1

Descomposición varianza dtot

Step	Std Error	DTOT	DRSTAR	DYUS
1	0.023688	94.539	0.873	4.588
2	0.023979	94.14	1.084	4.776
3	0.024356	91.462	1.073	7.465
4	0.024484	91.213	1.394	7.392
5	0.024507	91.05	1.564	7.386
6	0.02452	90.954	1.668	7.378
7	0.024527	90.906	1.708	7.386
8	0.024531	90.892	1.716	7.392
9	0.024532	90.888	1.716	7.396
10	0.024532	90.887	1.716	7.397
11	0.024532	90.886	1.717	7.397
12	0.024533	90.885	1.718	7.397

Cuadro B.2

Descomposición Varianza drstar

Step	Std Error	DTOT	DRSTAR	DYUS
1	0.00388	5.723	73.372	20.906
2	0.004302	5.325	77.664	17.012
3	0.004645	5.857	78.213	15.93
4	0.004751	7.174	76.732	16.094
5	0.004799	7.732	75.553	16.715
6	0.004817	8.048	75	16.953
7	0.004824	8.11	74.891	17
8	0.004827	8.106	74.907	16.987
9	0.004828	8.101	74.923	16.976
10	0.004829	8.103	74.923	16.974
11	0.00483	8.107	74.917	16.976
12	0.00483	8.109	74.913	16.978

Cuadro B.3

Descomposición varianza dyus

Step	Std Error	DTOT	DRSTAR	DYUS
1	0.003831	0.169	52.685	47.146
2	0.004199	15.584	44.096	40.32
3	0.004244	15.812	43.176	41.012
4	0.004276	15.842	43.285	40.872
5	0.004288	15.785	43.556	40.659
6	0.004296	15.741	43.738	40.522
7	0.004299	15.748	43.771	40.48
8	0.004301	15.761	43.762	40.478
9	0.004301	15.77	43.75	40.48
10	0.004302	15.772	43.747	40.48
11	0.004302	15.772	43.748	40.479
12	0.004302	15.772	43.75	40.479

Cuadro B.4

Descomposición varianza depreciación real

Step	Std Error	DTOT	DRSTAR	DYUS	DY4	DRE	DPDT
1	0.014694	2.828	0.071	6.924	19.844	70.282	0.051
2	0.016831	8.331	2.067	5.32	24.732	53.855	5.695
3	0.017178	8.354	2.304	7.994	24.101	51.708	5.539
4	0.017433	8.58	2.259	7.9	24.072	50.573	6.616
5	0.017466	8.591	2.295	7.87	24.113	50.472	6.659
6	0.017563	8.806	2.306	8.199	23.855	49.919	6.915
7	0.017575	8.795	2.318	8.224	23.888	49.851	6.925
8	0.017607	8.838	2.464	8.25	23.81	49.671	6.967
9	0.017616	8.829	2.532	8.249	23.799	49.62	6.97
10	0.017626	8.82	2.615	8.246	23.78	49.564	6.974
11	0.01763	8.816	2.655	8.242	23.771	49.54	6.975
12	0.017633	8.815	2.678	8.24	23.767	49.525	6.975

Cuadro B.5

Descomposición varianza inflación doméstica

Step	Std Error	DTOT	DRSTAR	DYUS	DY4	DRE	DPDT
1	0.009904	0.077	6.243	0	3.44	58.339	31.901
2	0.010781	9.899	5.411	0.001	5.848	51.289	27.551
3	0.011867	8.755	5.822	8.099	8.93	42.335	26.059
4	0.012611	9.264	7.33	8.529	7.986	37.538	29.352
5	0.012951	9.016	9.404	8.6	9.057	35.6	28.323
6	0.013352	8.94	11.907	8.952	8.752	33.513	27.935
7	0.013524	8.727	13.38	8.806	8.933	32.684	27.469
8	0.013658	8.558	14.673	8.665	8.883	32.053	27.169
9	0.013717	8.526	15.219	8.593	8.884	31.786	26.992
10	0.01375	8.516	15.514	8.557	8.878	31.639	26.897
11	0.013764	8.529	15.608	8.552	8.875	31.579	26.856
12	0.013769	8.54	15.639	8.554	8.875	31.554	26.838

C.3 Descomposición histórica

a. Descripción analítica

La especificación (4.1) del texto se puede expresar como promedio móvil de la siguiente forma:

$$y_{T+j} = \sum_{s=0}^{\infty} \Phi_s \varepsilon_{T+j-s} \qquad (4)$$

$$y_{T+j} = \sum_{s=0}^{\infty} \Psi_s \upsilon_{T+j-s} \qquad (5)$$

$$y_{T+j} = \sum_{s=0}^{j-1} \Psi_s \upsilon_{T+j-s} + \sum_{s=j}^{\infty} \Psi_s \upsilon_{T+j-s} \qquad (6)$$

donde $\upsilon_t = A\varepsilon_t$ es un vector de errores ortogonalizados.

El primer término de (6) es la parte de Y_{T+j} que se debe a innovaciones en el período T+1 hasta T+j. El segundo término corresponde al pronóstico Y_{T+j}, condicional en la información disponible en el momento T.

En los gráficos siguientes, mostramos la serie observada Y_{T+j}, la proyección dada la información disponible en T, y una tercera serie formada por la proyección, más las innovaciones de T en adelante asociadas cada una de las variables endógenas. Así, por ejemplo, el aporte de tot al crecimiento en (GDP CR) está dado por

$$y_{4,T+j} = \sum_{s=0}^{j-1} \Psi_{4,s} \upsilon_{1,T+j-s} + \sum_{s=j}^{\infty} \Psi_{4,s} \upsilon_{T+j-s}$$

donde $y_{4,T+j}$ es el cuarto elemento del vector y_{T+j}, $\Psi_{4,s}$ es la cuarta fila de la matriz Ψ_s, y $\varepsilon_{1,T+j-s}$ es el vector de errores en T+j-s, con ceros en todas las entradas excepto la primera (que es el shock sobre TOT).

Nos concentramos en el efecto sobre el nivel (en logs) de cada variable, mostrando en los gráficos, el crecimiento doméstico ($y_{4,T+j}$) acumulado, más el nivel de producto inicial. La fecha (T) inicial utilizada es el primer trimestre de 1992.