On the Determinants of the Chilean Economic Growth[1]

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Abstract

This paper presents several methodologies for understanding the Chilean growth process. By using univariate time series representations, we find that the Chilean data is more consistent with exogenous than with endogenous growth models. Growth accounting exercises show that the mild growth rates of the sixties are mainly due to the accumulation of human and physical capital, while the booms of the mid seventies and the one from 1985 until 1998 are mainly due to TFP growth. We also find that among the most important determinants of the evolution of TFP are the evolution of terms of trade, improvements on the quality of capital, and the presence of distortions. In fact, distortions do not only eliminate the positive effects of improvements on the quality of capital, but also precede the evolution of technology shocks and increase their volatility. A dynamic stochastic general equilibrium model that explicitly incorporates the relative price of investment with respect to consumption goods, terms of trade, and distortionary taxes is able to successfully replicate the impulse-response functions found on the data. This exercise suggests that distortions play a key role in explaining the growth dynamics of the Chilean experience.

Key Words: Economic Growth, Chile.
JEL Classification: C22, E13, O40, O54.

1 Introduction

If looked at since the mid-eighties, Chile's economic performance has been short from impressive when compared not only to the rest of the Latin American economies, but also to most of the countries in the World. Nevertheless, from a long-run perspective, Chile did not display such an outstanding performance in the sixties and seventies (see Table 1).

In fact, Chile's per capita GDP growth was way below the average of East Asia, OECD countries and the World economy during those decades. When compared with the other Latin American countries, the Chilean economy was about average in the sixties, below average in the seventies and it outperformed the rest of Latin American economies in the eighties and the nineties. This difference is even larger if we consider the period 1984-1998 (see Figure 1).[1]

	60-70	70-80	80-90	90-95	60-95
Chile	2.3	0.8	1.1	5.4	1.9
Latin America (21)	2.3	2.3	-1.5	1.4	1.1
Sub-Saharan Africa (17)	2.1	1.1	-0.8	-1.9	0.5
East Asia	4.7	6.0	4.6	4.1	5.0
OECD (22)	4.3	2.5	2.1	1.1	2.7
World (81)	3.2	2.6	0.6	1.1	2.0

Table 1: Average annual per capita GDP growth. Source: de Gregorio and Lee (1999)

Figures 2 and 3 show that, depending on the period under consideration; Chile presents statistically significant differences, not only in the average per capita GDP growth, but also on its volatility when compared to other Latin American countries. The informal evidence presented in these figures, shows that Chile is "influential" in the sense that valuable information with respect to the economic performance of the region would be left out without Chile. This is so because Chile displays four characteristics that are not present (at least to the same extent) in other countries. First, Chile's economic performance (both in terms of growth rate and volatility) was similar to the average of the Latin American countries considered until the oil crisis. Between the oil crisis and the debt crisis, Chile displayed "atypical" vulnerability given the low growth and high volatility exhibited during those crises (Chile's figures lie outside the 95% confidence intervals). Third, the speed of recovery after these crises is unsurpassed by the other countries. Finally, after the debt crises, Chile exhibited not only the highest growth rates of the region, but also a level of volatility that is not statistically different from the average of the region.

A usual candidate for explaining the economic performance of an economy is its investment rate. However, the correlation between per capita GDP growth and the

[1] Figure 1 is obtained from the latest Penn World Table (see Summers and Heston, 1991 for details).

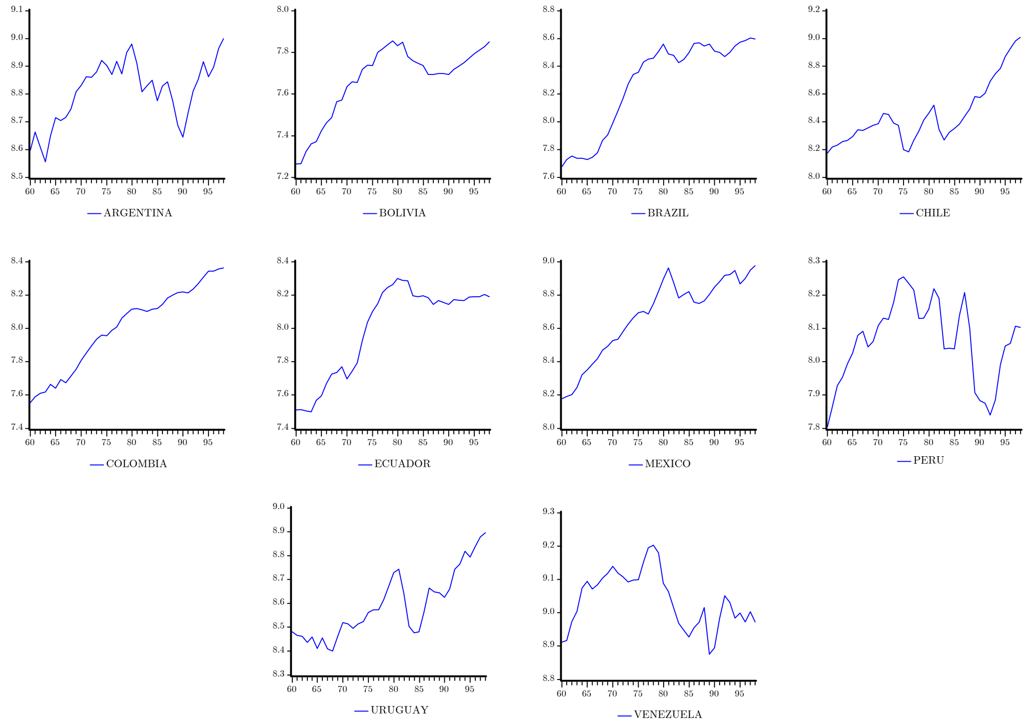

Figure 1: Evolution of (log) per capita GDP in different countries

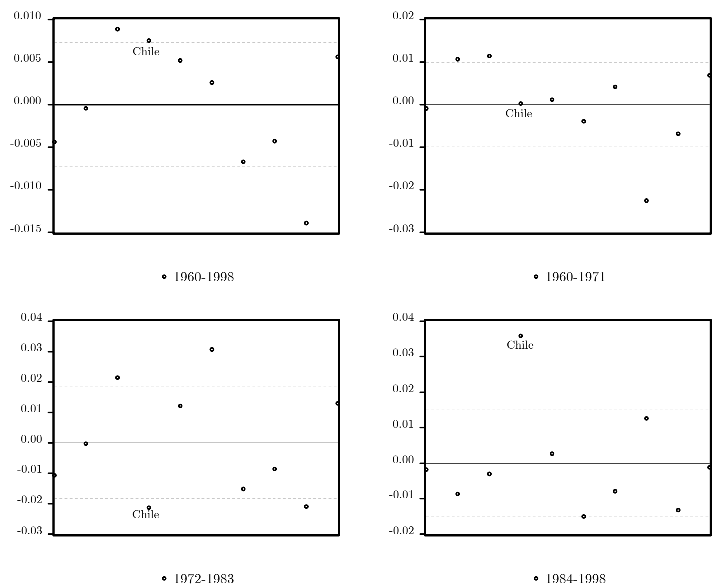

Figure 2: Deviations from the Latin American's average growth

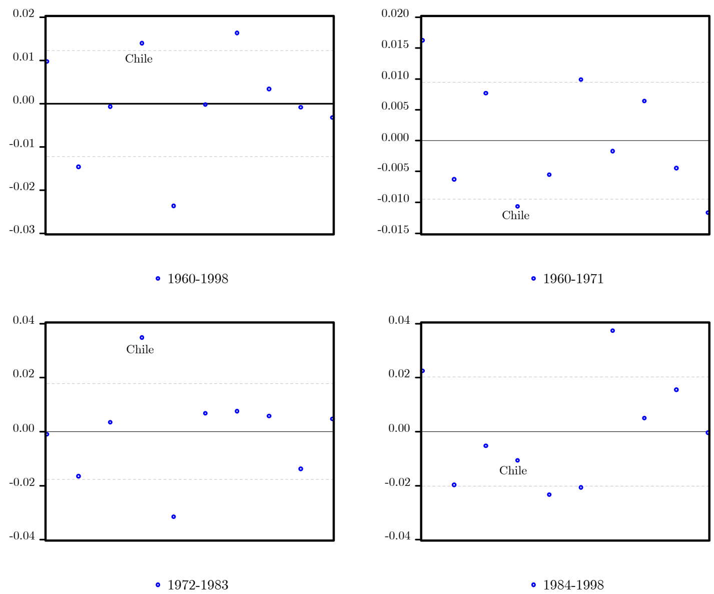

Figure 3: Deviations from the Latin American's average volatility of growth

investment rate is of at most 0.35. Furthermore, while the investment rate from 1960 to 1973 was steadily declining, it has been rising from 1984 until 1998 (see Figure 4). It could be argued that in the first period, the contribution of capital to growth was very important, while in the second, the recovery from the deep recession of the early eighties made the growth rate lead the economy to higher investment rates. Anecdotal (statistical) evidence is readily available, given that Granger causality tests suggest that both the level and first difference of per capita GDP preceded the investment rate in the 1984-2000 period, while there is no discernible direction of statistical causation in the 1960-1973 period.

Thus, it would be instructive to have formal measures to evaluate the determinants of such an heterogeneous performance during these periods. In particular, one would like to know which of its characteristics made it so average until the oil crisis, so sensitive to the two major international crises in the early seventies and eighties, and which made it exhibit the accelerated growth rates and decreased volatility that came after these episodes.

Studying Chile's economic performance is interesting not only because of its remarkable differences in terms of growth rates and volatility with respect to other countries in the region, but also because, as will be discussed below, it has experienced major swings in terms of its institutional arrangements and economic policies.

This document intends to provide a qualitative and quantitative evaluation of the main factors behind the Chilean growth process. The rest of the paper is organized as follows: Section 2 provides the historical background for the period under analysis.

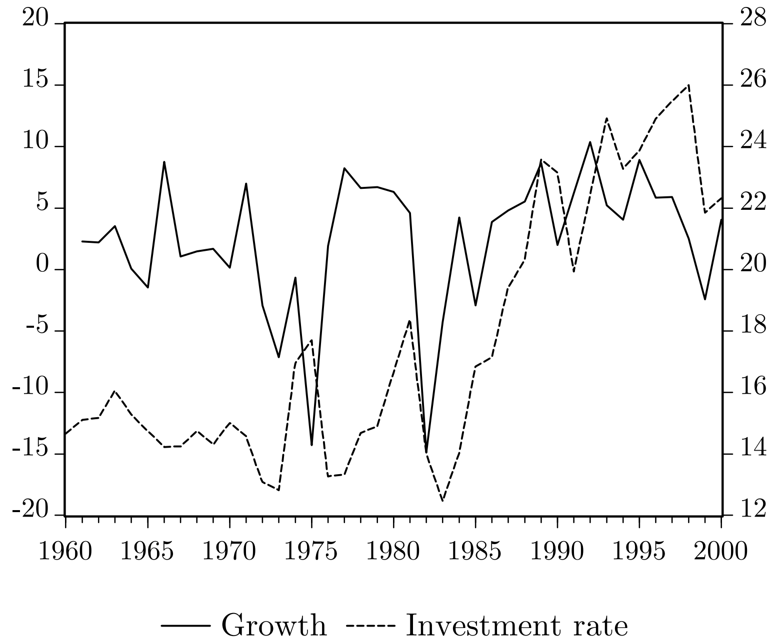

Figure 4: Per capita GDP growth and investment rate

Section 3 uses univariate econometric techniques useful for characterizing the growth dynamics of Chile, and that provide guidelines with respect to the types of theoretical models that are better suited to understand it. Section 4 uses some results from Section 3 and conducts a growth accounting exercise that pretends to recover Total Factor Productivity (TFP). Section 5 takes the results from Section 3 and 4 and conducts a multivariate time series analysis that includes several measures of distortions of the Chilean economy and evaluates which of them are important determinants (or consequences) of its economic performance. Section 6 develops a model that incorporates the features found to be relevant on the previous section and quantifies the growth effects of several shocks. Finally, Section 7 summarizes the main conclusions and draws policy implications from the Chilean experience.

2 Historical Background

One of the purposes of this paper is to better understand the role of economic policy in the Chilean growth process. This section presents a brief overview of the main economic policies that Chile undertook. Lüders (1998) provides a long-term analysis (1820-1995) of the performance of the Chilean economy and compares it to other developing and developed countries. Here, we will focus on the last 40 years for which more reliable information is available.

Chile achieved its political independence from Spain in 1810. According to Lüders (1998), the first period of the Chilean economic history can be characterized as liberal, with two different periods 1820-1878 and 1880-1929 (before and after the Pacific War). In the first period, Chile grew above the Latin American countries (1.39% compared to 0.1%), while in the second period the growth rate was about average with respect to the same group of countries. Lüders (1998) also highlights that the Pacific war had a positive wealth effect for the Chilean economy, but since the country annexed nitrate and silver mines, this may have induced two negative effects: government expenditures increased very rapidly (more rent seeking activities) and a "Dutch Disease" phenomenon that cut off some traditional activities. From the political stand point, the second phase of liberal economy was unstable, with a civil war in 1891 and military takeovers in 1924 and 1927-1932.

After the Great Depression, Chile started a strategy of import substitution, mainly due to the negative experience with the price of nitrate. The sudden drop in the price and sales of most of the products that Chile exported, induced a significantly negative wealth effect. According to Lüders (1998) Chile was one of the economies that suffered the most during the Great Depression (per capita GDP fell by 47% and exports by 79%).

In addition, the economic ideas that were prevalent at the time, led the economy towards more inward oriented economic policies. An active role was assigned to the government, which implemented industrial policies and created state owned enterprises. The manufacturing industry was protected with high tariff, non-tariff barriers (NTBs), and multiple exchange rates. All these movements were implemented between 1940 and 1970; with a weak and failed attempt to reverse this trend between 1959 and 1961.

In 1970, the newly elected socialist government exacerbated the inward oriented economic policy and government intervention. From that year until 1973, Chile could accurately be described as a virtually closed economy. Moreover, between 1971 and 1973, the economic policy was characterized by strong government interventions, price, interest rate and exchange rate controls, high (tariff and non-tariff) barriers to trade and to international capital flows, and a very high inflation rate. Furthermore, it was in this period that the government expropriated a significant number of private companies.

After the military coup of 1973, the economy was moving from a highly intervened, towards a market-oriented economy. Among the most important changes, the economic policy focused on price liberalizations, an aggressive opening of the economy to trade and international capital flows, a reduction of the size of government, and privatizations. Furthermore, Chile introduced pioneering reforms to the social security regime, financial markets, and the health care system. One of the most profound reforms was the trade reform that eliminated all the NTBs and reduced tariffs to 10% across the board (except for automobiles).

All these changes coincided with major international crises. In fact, the economy was affected by two important international crises during the reforms (the oil and the debt crisis). The first one took place at the time when the economy was starting the reforms. Thus, the sum of the external shock and the reform affected the performance of GDP (as shown in the figures below). The origins of the second crisis consisted of a mix between a negative external shock (increase in the international interest rate and terms of trade deterioration) and internal policy mistakes. A fixed exchange rate policy, combined with a very low convergence of the domestic to international inflation, induced a large real appreciation of the peso with respect to the dollar, creating a large current account deficit. Given the external situation, the foreign sector was not willing to finance the current account deficit; while at the same time, the financial system was not consolidated in terms of regulation, supervision and expertise.[2] As a result, the Chilean economy experienced a twin crisis (external and financial).

The real exchange rate appreciation of that period constituted a second shock for the tradeable sector (the trade reform being the first), which induced several bankruptcies and the need for increased productivity in that sector. In fact, the manufacturing sector experienced important reallocations of resources coupled with productivity increases (see Fuentes, 1995 and Alvarez and Fuentes, 2001).[3] In 1982 the peso was devaluated and the tariffs started to increase until 1985 (reaching a peak of 35% across the board) to then decline until 1991.

Finally, after the return of democracy in 1990, the major economic reforms formulated in the eighties were virtually unchanged. The newly appointed government reduced tariffs even further, from 15% to 11% (in 1991), and negotiated free trade agreements with Mexico, Colombia, Venezuela, Canada, and Mercosur. These agreements reduced the average tariff paid on imported products. Recently, the tariff structure has reduced even further (from 11% to 8%) for countries that are non-members of free trade agreements.

3 Univariate Time Series Analysis

This section analyzes the univariate time series properties of per capita GDP and GDP per worker. We contend that a rigorous statistical analysis of these series can shed some lights with respect to several key properties of the economy at hand. Among them, a careful characterization of these variables is useful for assessing whether the evidence is consistent with models of endogenous or exogenous growth. Furthermore, univariate time series models can be used to recover "deep parameters" of the aggregate production function (such as the capital share) that are used in Section 4.

[2] See Fuentes and Maquieira (2000) and the references therein.

[3] Fuentes (1995) shows that during the trade and market reform period (1975-1982) there were substantial increases in the productivity of different sectors of the manufacturing industry. As a pattern across sectors could not be found, this feature is consistent with the idea of a "mushroom" process.

Finally, the statistical properties of the residuals of the univariate representation can be helpful to understand which factors are behind the volatility and other moments of the innovations of the Solow residual.

Two sources of information are available for constructing these series. The first is based on official records obtained from the Central Bank of Chile and the National Bureau of Statistics; it spans the period 1960-2000. The second spans a longer period (1810-1995) and is based on Braun et al (2000), Díaz et al (1999) and Jofré et al (2000) who discuss the methodologies used for constructing them.[4]

These time series (in logs) are presented in Figure 5 along with some descriptive statistics of their growth rates (Table 2). The first data base indicates that the average annual growth rate of per capita GDP was of 2.2%, while the growth rate of GDP per worker was of 1.8%. These figures are significantly lower when the period prior to 1960 is considered. In fact, the second data base shows that the growth rates of both series are 1.4% and 1.3% respectively. These lower growth rates are heavily influenced by the Great Depression which produced declines that exceed 25%.[5] Furthermore, both data sets indicate that the unconditional distribution of the growth rate of per capita GDP presents important departures from normality. This last characteristic is not shared by the series of GDP per worker when using the first data set. Finally, independently of the time series considered, the growth rate of the variables display high degrees of volatility given that the standard deviations always more than double the average growth rates.

	GDP per capita		GDP per worker	
	1960-2000	1810-1995	1960-2000	1810-1995
Mean	0.022	0.014	0.018	0.013
Median	0.036	0.018	0.021	0.018
Maximum	0.099	0.194	0.089	0.198
Minimum	-0.161	-0.253	-0.078	-0.261
Standard Deviation	0.057	0.065	0.042	0.065
Skewness	-1.541	-0.730	-0.598	-0.764
Kurtosis	5.606	6.130	2.798	6.348
JB	0.000	0.000	0.294	0.000

Table 2: Descriptive statistics of the first difference of per capita GDP and GDP per worker. JB=P-value of the Jarque-Bera test for normality

The rest of this section analyzes the stochastic properties of the four time series and describes some of the key characteristics that will be used in the following sections.

[4] All the series used in this paper are presented in Appendix A.

[5] It is important to mention that the second data base does not have records of the number of workers, but of the labor force and assumes a constant participation rate of 38.4% between 1810 and 1853. Thus the striking resemblance between series of GDP per capita and per worker.

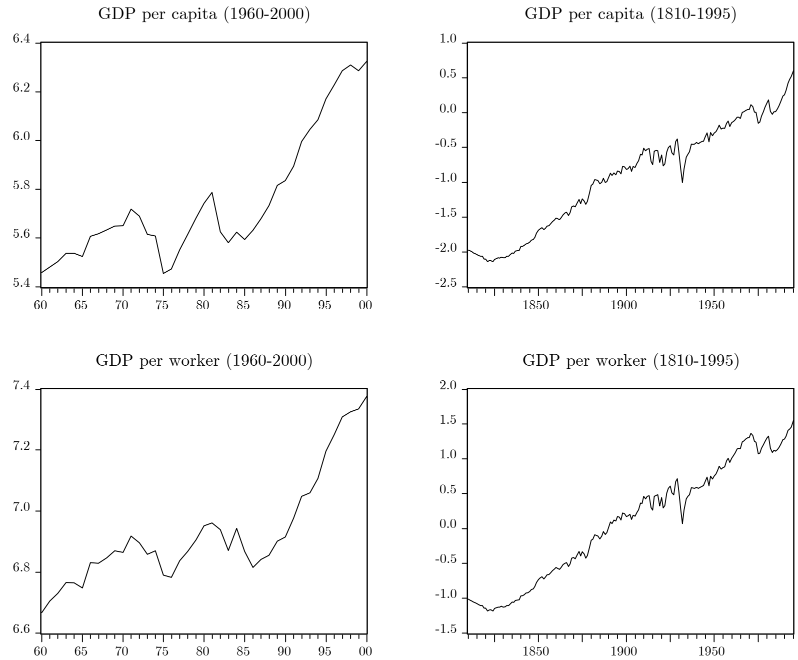

Figure 5: Log of GDP per capita and per worker

3.1 Unit Roots and Economic Theory

Lau (1997) and Lau (1999) show that a necessary condition for an economy to be consistent with endogenous growth models is that the marginal process for per capita GDP must contain a unit root. This is, however, not a sufficient condition, as exogenous growth models may also be consistent with a unit root on GDP as long as technology shocks have one. Nevertheless, a rejection of a unit root firmly suggests that endogenous growth models may not be valid theoretical approximations of a particular economy. In this sense, unit root tests provide useful guidelines with respect to the type of theoretical model that best matches the empirical evidence; particularly if stochastic trends are rejected.

However, unit root tests have a long but conflicting tradition in econometrics given that they are usually associated with very low power. Chumacero (2001a) shows that the case for a unit root in scale variables, such as GDP or consumption, is very difficult to defend unless one is willing to accept the idea that interest rates are deterministic functions of present and past realizations of the growth rate of the scale variable. Furthermore, even when applying traditional unit root tests for the Chilean economy, Chumacero (2000) shows that the evidence for a unit root is rather weak.

Table 3 presents the results of applying seven tests for unit root to each of the four series introduced above. The tests correspond to the traditional ADF test (Dickey and Fuller, 1979), the PP test (Phillips and Perron, 1988), the KPSS test that takes deterministic trends as its null hypothesis and stochastic trends as the alternative (Kwiatowski et al., 1992), the ZA tests that consider the alternative hypothesis of a break in level, break in trend, and break in level and trend (Zivot and Andrews, 1992), and the Bierens test that considers as alternative hypothesis that the deterministic trend may be non-linear (Bierens, 1997).[6] Even though the power of most of the tests that have as null hypothesis the presence of a unit root is questionable, the results suggest that when considering more general alternative hypotheses (as in the case of the Bierens test) or a large sample (second data set), the evidence with respect to the presence of stochastic trends is dubious. These results suggest that we can motivate the univariate time series representations of the scale variables using simple exogenous growth models.

	GDP per capita		GDP per worker	
	1960-2000	1810-1995	1960-2000	1810-1995
ADF	Yes	Yes	Yes	No
PP	Yes	No	Yes	No
KPSS	No	No	No	No
ZA (level)	Yes	No	Yes	No
ZA (trend)	Yes	No	Yes	No
ZA (level and trend)	Yes	Yes	Yes	Yes
Bierens	No	No	No	No

Table 3: Unit root tests. No = A unit root is rejected at a 5 percent significance level. Yes = A unit root is not rejected at a 5 percent significance level

3.2 A Simple Model

Following Chumacero (2001b), consider a representative, infinitely-lived household that maximizes

$$\mathcal{U}_0 = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t L_t \frac{c_t^{1-\gamma} - 1}{1-\gamma}$$

where $0 < \beta < 1$ is the subjective discount factor, c_t ($=C_t/L_t$) is per capita consumption,[7] $\gamma > 0$ is the Arrow-Pratt relative risk aversion coefficient, and E_t is the expectation operator conditional on information available for period t. There is no utility for leisure and the labor force is equal to L_t. Utility is maximized with respect

[6] See Chumacero (2000) for details of each test.

[7] Lower-case letters denote per capita; upper-case total; and a hat above a variable denotes per unit of effective labor.

to per capita consumption, and per capita capital stock, k_{t+1}, subject to the budget constraint:

$$K_{t+1} + C_t = e^{z_t} K_t^{\alpha} \left[(1+\lambda)^t L_t \right]^{1-\alpha} + (1-\delta) K_t$$

where α is the compensation for capital as a share of GDP. In this economy, technological progress is labor-augmenting and occurs at the constant rate λ. Production is affected by a stationary productivity shock z_t. It is straightforward to show that capital and consumption per unit of effective labor, $\widehat{k}_t$ and $\widehat{c}_t$ are stationary.[8] We can transform the economy above to a stationary economy and obtain exactly the same solutions for $\widehat{k}_t$ and $\widehat{c}_t$. Such an economy can be characterized by the following maximization problem:

$$\max_{\left\{\widehat{k}_{t+1}, \widehat{c}_t\right\}} \mathrm{E}_0 \sum_{t=0}^{\infty} \left[\beta (1+\lambda)^{1-\gamma} \right]^t L_t \frac{\widehat{c}_t^{1-\gamma} - 1}{1-\gamma} \tag{1}$$

subject to

$$\left(1+\eta_{t+1}\right)(1+\lambda)\widehat{k}_{t+1} + \widehat{c}_t = e^{z_t}\widehat{k}_t^{\alpha} + (1-\delta)\widehat{k}_t \tag{2}$$

where η_t is the rate of population growth for period t.

The law of motion of the technology shock is given by

$$z_t = \rho z_{t-1} + \varepsilon_t, \quad \varepsilon_t \backsim \mathcal{N}\left(0, \sigma_{\varepsilon}^2\right) \tag{3}$$

In order for the model to be fully characterized, a stance regarding the rate of population growth has to be taken. Here we will consider the case in which fertility is exogenous and has the following law of motion:

$$\ln(1+\eta_t) = \overline{\eta}(1-\tau) + \tau \ln\left(1+\eta_{t-1}\right) + n_t \tag{4}$$

where n_t is an independent $\mathcal{N}(0, \sigma_n^2)$ random variable.

Given specific values of the parameters that describe the model, numerical methods can be used in order to derive the optimal policy functions for the control variables of the problem. If $\gamma = 1$ and $\delta = 1$, the dynamic programming problem maximizing the objective function (1) has logarithmic preferences subject to a Cobb-Douglas constraint (2), in which case an analytical expression for the capital stock policy function is available and is expressed as:

$$\ln \widehat{k}_{t+1} = \ln(\alpha\beta) - \ln(1+\lambda) + \ln \widehat{y}_t \tag{5}$$

where $\widehat{y}_t = e^{z_t}\widehat{k}_t^{\alpha}$ is the per unit of effective labor GDP.

[8] $\widehat{k}_t = k_t / (1+\lambda)^t$ and $\widehat{c}_t = c_t / (1+\lambda)^t$.

Given that $\ln \widehat{y}_t$ can be expressed as:

$$\ln \widehat{y}_t = z_t + \alpha \ln \widehat{k}_t \tag{6}$$

we can replace (3) and (5) in (6) to obtain:

$$\ln \widehat{y}_t = A + (\alpha + \rho) \ln \widehat{y}_{t-1} - \alpha\rho \ln \widehat{y}_{t-2} + \varepsilon_t \tag{7}$$

where $A = \alpha(1-\rho)[\ln(\alpha\beta) - \ln(1+\lambda)]$. Recalling that $\widehat{y}_t (1+\lambda)^t = y_t$ we can use (7) to obtain a compact representation of the Data Generating Process (DGP) of per capita GDP:

$$\ln y_t = B + Dt + (\alpha + \rho) \ln y_{t-1} - \alpha\rho \ln y_{t-2} + \varepsilon_t \tag{8}$$

or equivalently

$$(1 - \alpha L)(1 - \rho L) \ln y_t = B + Dt + \varepsilon_t \tag{9}$$

with L now denoting the lag operator and B and D being constants.[9]

Three features of (8) are worth mentioning: First, as is typical of exogenous growth models, per capita GDP is trend stationary.[10] Second, given that the technology shock follows an AR(1) process, $\ln y$ follows an AR(2) process.[11] Finally, this specification can be used in order to recover α (share of capital on GDP) and ρ (persistence of the technology shock) by imposing non-linear restriction among the parameters of the AR(2) representation.

Next, we estimate the univariate representation compatible with (8) using both data sets for series of per capita GDP and GDP per worker.[12]

3.3 Estimation of Univariate Time Series Models

Even a simple model as the one just described, provides important empirical implications for the univariate time series representation of GDP per capita or per worker. It states that in the exogenous growth model framework, an AR(2) representation of the series is compatible with an AR(1) law of motion for the technology shock. A simple way to evaluate if such specification constitutes a good statistical description

[9] Where $B = \alpha(1-\rho)\ln(\alpha\beta) + \rho(1-\alpha)\ln(1+\lambda)$ and $D = (1-\alpha)(1-\rho)\ln(1+\lambda)$.

[10] In fact, (9) makes clear the assertion stated on Section 3.1, given that a unit root in the scale variable would be present if $\alpha = 1$ (in which case we end up with the familiar AK model of endogenous growth) or $\rho = 1$ (where we still have exogenous growth with a random walk on the technology shock). Thus, a unit root is a necessary but not a sufficient condition for endogenous growth to be present.

[11] In general, if the productive shocks follow an AR(j) process, $\ln y$ follows an AR($j+1$) process.

[12] The model assumes that the labor force and the population coincide. Empirically, the distinction would be irrelevant if the participation rate were constant. As this is not the case in practice, we use (8) as a representation for both per capita GDP and GDP per worker.

of the data is to find the best univariate autoregressive model that also contains a deterministic trend. Using either the Akaike or Schwarz criterion an AR(2) presentation is preferred to less parsimonious models.

Given that a characterization such as (8) is consistent with the data, we can recover α and ρ by estimating the referred non-linear restrictions in the autoregressive parameters. The results of such estimation, along with statistics that summarize key properties of the model and the resulting residuals are reported on Table 4.

	GDP per capita		GDP per worker	
	1960-2000	1810-1995	1960-2000	1810-1995
D	0.002 (0.001)	0.002 (0.001)	0.001 (0.001)	0.002 (0.001)
α	0.305 (0.174)	0.174 (0.084)	0.127 (0.173)	0.187 (0.099)
ρ	0.879 (0.111)	0.835 (0.053)	0.943 (0.089)	0.799 (0.059)
R^2	0.957	0.993	0.946	0.994
DW	2.018	1.961	2.036	1.965
Q	0.303	0.373	0.260	0.413
Q^2	0.075	0.000	0.243	0.000
JB	0.000	0.000	0.227	0.000
Ra	0.043	0.006	0.034	0.080

Table 4: Results of univariate time series regressions. R^2=Adjusted R^2. DW=Durbin-Watson statistic. Q=Minimum p-value of the Ljung-Box test for white noise on the residuals. Q^2=Minimum p-value of the Ljung-Box test for white noise on the squared residuals. JB=P-value of the Jarque-Bera normaility test. Ra=P-value of the Ramsey test. Standard errors in parenthesis

In general, the results suggest that a representation such as (8) provides a good statistical representation of the univariate time series properties of per capita GDP and GDP per worker. In particular, all the models are able to induce white noise residuals. Furthermore, the model provides estimates of persistent technology shocks. Nevertheless; the only estimate of the share of capital on GDP that is in line with the international literature corresponds to the estimate obtained with the sample of 1960-2000 and using per capita GDP as the scale variable. At any rate, the other estimates can not be obtained precisely and, in several cases, are compatible with a share of up 1/3. This figure stands in contrast with official estimates from National Accounts that can provide values of α of up to 0.5; but, as noted by Gollin (2001), National Accounts estimates can severely over estimate this parameter. Thus, in the growth accounting exercise of Section 4 we consider both, the capital share of National Accounts and a value that is in line with the international evidence and our estimate that is close to 1/3.

There are three other important features in Table 4 that are worth mentioning. First, all the specifications but one show that even when the residuals are white noise processes, they present important departures from normality. Second, when considering the longer data set (1810-1995) there is strong evidence of conditional heteroskedasticity, while this evidence is only marginally present when considering the data set that spans the 1960-2000 period. Finally, the Ramsey reset test shows that in almost all the models there are omitted non-linearities and/or conditional heteroskedasticity that could affect the level of the series.

Figure 6 presents non-parametric estimates of the unconditional distribution of the residuals of the equations of per capita GDP for both data sets, having as its most relevant feature that in both cases the departures of normality are mainly due to leptokurtic innovations.

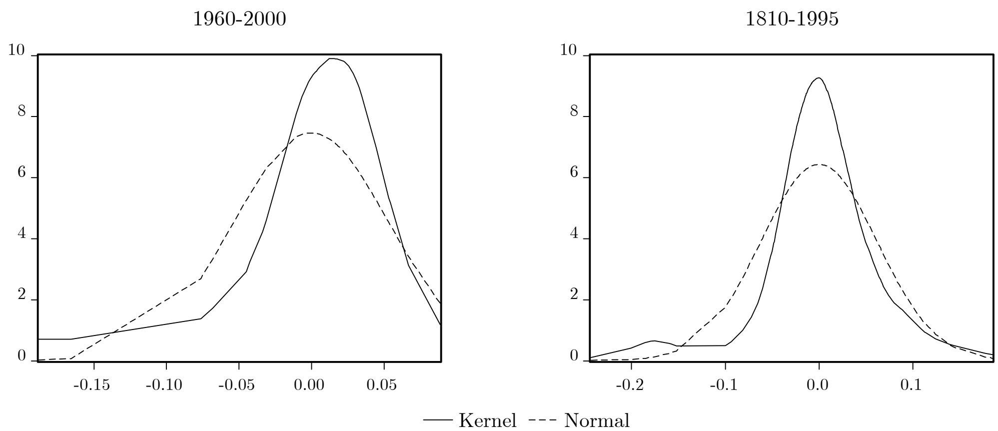

Figure 6: Departures from normality. Kernel = Kernel estimate of the unconditional distribution of the residual. Normal = Normal density with the same mean and variance.

Figure 7 displays the reprojection of the conditional standard deviations obtained from estimating GARCH(1,1) models for per capita GDP using both data sets. In the second panel, the peaks in volatility are associated with the Great Depression, the turmoil of the first years of 1970, and the period of the debt crisis. Notice however that according to this data set, the volatility has consistently declined from 1985 on, while with the first data set, the volatility after 1985 is significantly lower than in the sixties and seventies but has been increasing.

Summarizing, this section presents empirical evidence that suggests that the data is consistent with persistent technology shocks, but not consistent with unit roots in per capita GDP and GDP per worker. This in turn, suggests that the case for using exogenous growth models for characterizing the Chilean experience may be made. When analyzing the univariate time series properties of each scale variable, we find that simple AR(2) processes are able to capture several key regularities of the series and can help to dimension the persistence of technology shocks and recover the

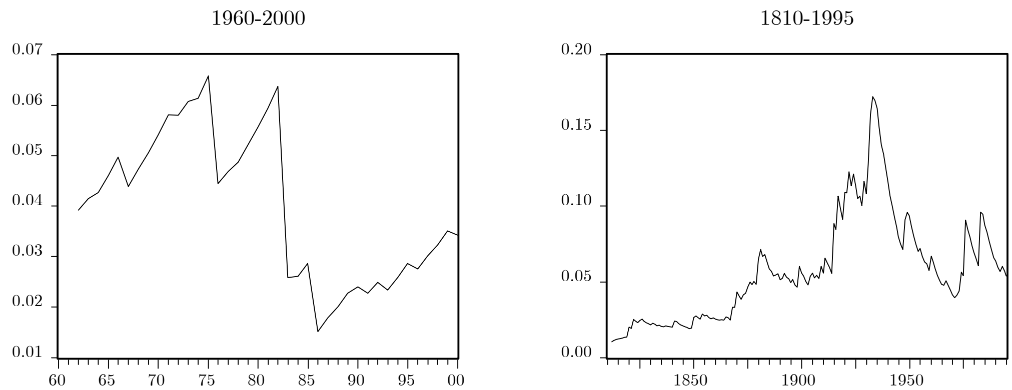

Figure 7: Projected conditional standard deviation estimated from GARCH(1,1) models

capital share to be used in the growth accounting exercise. There are however several properties that can not be accounted for, such as, strong departures from normality in the innovations, the possible presence of conditional heteroskedasticity and/or omitted non-linearities. We will use the information obtained from the residuals of the univariate representations just described, along with Total Factor Productivity (TFP) series recovered from Section 4 to evaluate which other variables may help us to characterize them.

4 Total Factor Productivity Analysis

In this section we present the TFP estimation and the contribution of the different factors to the growth process. Given the data availability and its degree of reliability we conducted this analysis for the period 1960-2000 using mainly the first data set.

4.1 Data

As mentioned, the data on GDP comes from the national accounts system. The capital stock was estimated using the perpetual inventory system from 1940.[13] The data on labor corresponds to the number of people occupied each year and is obtained from the National Bureau of Statistics (INE).

Figure 8 shows the evolution of GDP, capital stock and labor for the 1960-2000 period (expressed as indexes). As can be seen, the capital stock grew faster than labor and GDP over the whole sample. Five periods are clearly distinguishable: three of

[13] We thank Herman Bennett for providing us this series.

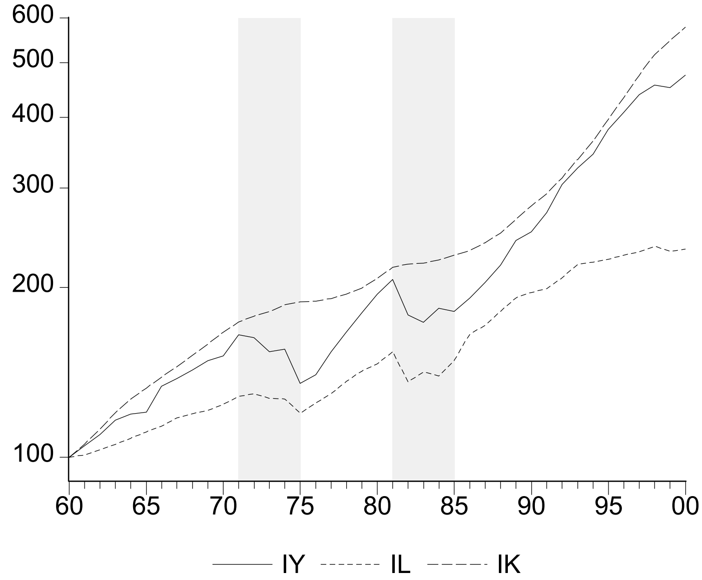

Figure 8: Evolution of GDP, labor and capital: 1960-2000 (Index 1960=100, log scaling)

rapid growth and two severe recessions.[14] In the first period of growth, GDP growth was accompanied by a faster increase in the capital stock and a smooth upward trend in labor. After the recession, in the middle of the seventies, the economy grew very fast with a relatively slow increase in capital and labor until the beginning of the debt crisis. This profound recession affected the economy with a high increase in the unemployment rate. Starting in the mid eighties the economy bounced back with a quick recovery in terms of employment at the beginning, while later the growth rate of capital started picking up.

4.2 Methodology Used to Estimate TFP Growth

Using the data discussed in the previous section, it is possible to have an estimate of TFP growth. One of the key elements necessary to understand the contribution of productivity, is the measurement of production factors and the change of their quality over time. Here we provide two estimates of TFP growth: one using the raw data of capital and labor, and the other correcting labor with a quality index.

[14]The economy experienced a short recession beginning in the last quarter of 1998, recovering from it in the year 2000. In some parts of our analysis we will assume that the third period of expansion ends in 1998.

4.2.1 Input Quality

An important part of the contribution to the growth process in Latin America has been the increase in the quality of factors (Elías, 1992). One of the usual ways to adjust the raw data is by using a labor and capital augmenting type of correction. For labor we used the estimate made by Roldós (1997), which considers that there are different types of labor, L_j with wages w_j, such that the quality correction becomes:

$$\sum_{j=1}^{n} \frac{w_j L_j}{wL} \tag{10}$$

Figure 9 shows the evolution of this index over time. We compare it with an estimation of human capital stock found in Braun et al (2000), where the authors express the level of education of the labor force in tertiary education equivalence using the relationship between market wages. The correlation between both variables is of 0.98.

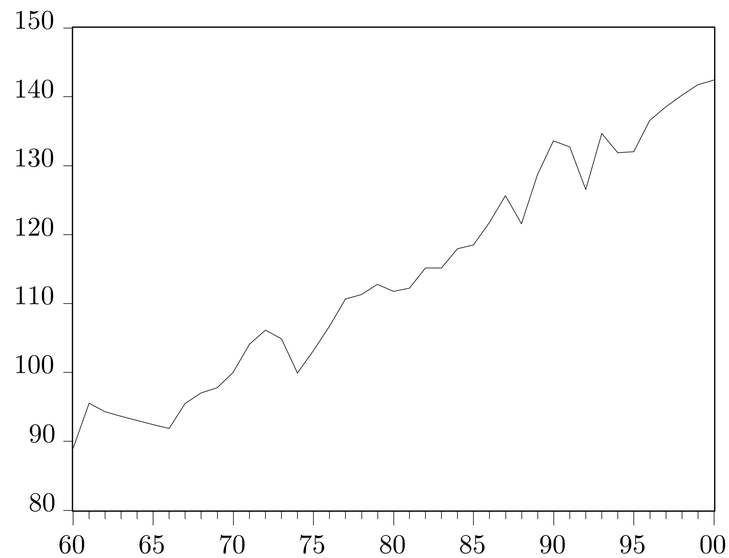

Figure 9: Index of the quality of labor

Roldós (1997) also provides an index of quality for the capital stock. The construction of the index hinges on relative rental rates of different types of capital. As this information is not available, the author estimates this rate using the market price of investment goods. Figure 10 shows the evolution of this index which presents several disturbing features. In particular, it states that the quality of capital goods in 1995 was at about the same level as in 1960. Furthermore, the continuous decline in the quality of capital during the sixties is difficult to explain. For these reasons, we chose not to use this variable in the study.

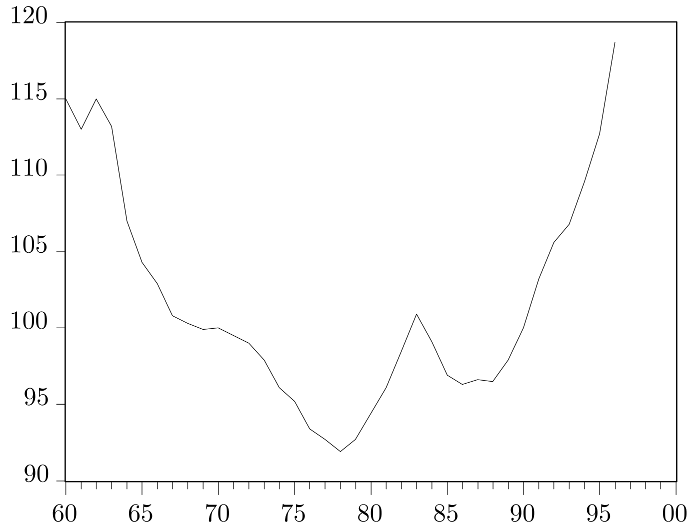

Figure 10: Index of the quality of the capital stock

Greenwood and Jovanovic (2000) provide another view of an improvement in the quality of the capital stock. They associate quality with the evolution of the relative price of investment in terms of consumption; when this relative price decreases, the quality of capital goods rises. There are at least two problems with this interpretation: First, at the aggregate level (even though we separated equipment from structure), there are no permanent decreases in the relative price of equipment. If we consider the case of computers, for example, we can expect a continuous decreases in their relative prices, but when one considers different types of equipment this may not be the case. For instance, when a higher quality of equipment appears in the market, its price might be higher, since the firm may exploit, for a while, monopoly rents in order to pay for the R&D costs (quality ladder type of models as in Grossman and Helpman, 1991), thus the price of equipment may actually go up. The second reason is that in linear technology models of endogenous growth, a decrease in the price of an investment good will increase the capital accumulation and ultimately the rate of growth. This would be the case when an economy opens to trade and starts importing capital goods at a lower price (Jones and Manuelli, 1990).

Figure 11 shows the evolution of the relative prices of equipment goods and investment goods with respect to consumption goods. Even though they seem to follow the evolution of the real exchange rate (rather than being good estimates of the quality of capital) we will assess the impact of these relative prices on TFP in the next section.

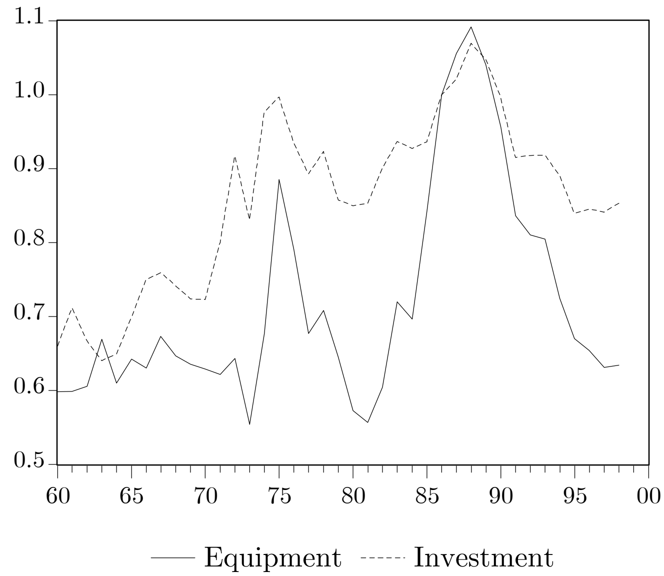

Figure 11: Relative price of equipment and investment goods with respect to consumption goods

4.2.2 TFP Growth Measures and Capital Share Estimates

Given the considerations discussed above, we analyze two different formulations for TFP. The first does not consider any correction for changes in quality of factors, and the second includes a correction for human capital (TFPH). Thus the equations for the TFP growth are:

$$\widehat{TFP} = \widehat{Y} - \alpha\widehat{K} - (1-\alpha)\widehat{L} \tag{11}$$

$$\widehat{TFPH} = \widehat{Y} - \alpha\widehat{K} - (1-\alpha)\widehat{L} - (1-\alpha)\widehat{H} \tag{12}$$

where H stands for the index of labor quality and $\widehat{w}$ denotes the growth rate of variable w. Note that when measured in either way, TFP growth will include both improvements in the quality of capital over time and the technological shock.

The key parameters necessary for the estimation of TFP are the factor-output elasticities. From the pure growth accounting point of view, the estimates of the elasticities are given by the capital and labor shares from National Accounts. These shares vary from year to year, thus the calculations were made using the average capital and labor shares between two years an the average shares for the entire period

(α =0.50733). There is not much difference between these two choices. An alternative estimation used in this exercise is obtained from the capital share reported in the previous section, which is roughly equal to 1/3; thus we also use the conventional capital share considered in growth theory. The correlations of the growth rates of estimates of TFP under different assumptions for α is never smaller than 0.98.

In order to estimate TFP growth we chose two values for α, which imply the maximum and minimum values for the growth rate of TFP. These values are the ones that correspond to the average of capital and labor shares from National Accounts and the traditional one-third.

Despite the similarities of the TFP measures using a variable or a constant α, there is always a "reasonable" doubt with respect to which model best describes the data. For instance a CES function may do a better job than a Cobb-Douglas production function. Figure 12 provides informal evidence that suggests that a constant capital-output elasticity is not a bad approximation. In particular, note that the value in 2000 is about the same than in 1960 and close to the average. However a regression on a constant shows that the mean is not stable over time. This fact could be reconciled with changes in the input-output matrix from National Accounts (1977 and 1986).

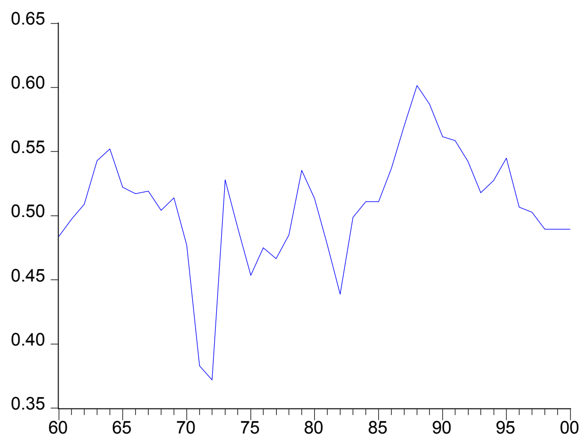

Figure 12: Capital Share

4.3 Estimation of TFP Growth

Table 5 shows the TFP growth rate for the entire period (1960-2000) and for two sub-periods. The first one corresponds to the inward oriented phase and the second starts with the trade reform with more than a one percentage point of difference between periods, mostly accounted for by differences in TFP growth. This feature signals that the elimination of distortions may have significantly increased the efficiency of the economy.

Period	GDP Growth	TFP (α =0.507)	TFP (α =1/3)	TFPH (α =0.507)	TFPH (α =1/3)
1961-2000	3.97	0.67	1.07	0.06	0.24
1961-1974	3.19	0.06	0.55	-0.37	-0.04
1975-2000	4.40	1.00	1.36	0.29	0.39

Table 5: Growth accounting for periods of economic orientation. H denotes the inclusion of human capital

Table 6 shows the TFP growth rate for the entire period 1960-2000 and for the periods of rapid growth in the Chilean economy. Two of them coincide with the trade liberalization of the seventies and with the tariff reduction of the late eighties and early nineties (after the debt crisis). The performance of the TFP growth is rather poor over the whole sample (growing at most at 1%) while GDP grew on average at 4% per year.

Period	GDP Growth	TFP (α =0.507)	TFP (α =1/3)	TFPH (α =0.507)	TFPH (α =1/3)
1960-2000	3.97	0.67	1.07	0.06	0.24
1960-1971	4.65	0.91	1.41	0.18	0.42
1975-1981	7.32	3.97	3.65	3.27	2.69
1985-1998	7.36	2.23	2.72	1.54	1.77

Table 6: Growth accounting for periods of rapid growth. TFPH denotes the inclusion of human capital

As Figure 8 made clear, we distinguished three episodes of growth. Thus it can be instructive to evaluate the differences in growth rates of TFP among these periods. One can say that the growth rate of GDP in the 1975-1981 and 1985-1998 episodes might be influenced by the recovery from the two deep recessions of the seventies and the eighties but, in both cases, there are significant increases in TFP; feature that is not apparent in the sixties. During the trade reform period (late seventies), the average TFP growth reached its highest value. This period is characterized by important factor reallocations, firm bankruptcies and the creation of new firms. In the longest period of continuous growth (1985-1998), the TFP growth was somewhere between 1.5 and 2.7%, being more modest than in the 1975-1981 episode.

How important was TFP in accounting for GDP growth? This is important because TFP growth rates were higher in the 1975-1981 and 1985-1998 episodes, but so were the growth rates of GDP. Table 7 shows the contribution of factor accumulation (including human capital) and TFP to growth. As expected, for the entire period the contribution of TFP was very small after including human capital. The most important contribution to growth was physical capital that accounts for 57% of total GDP growth.

(α =0.5073)				
Period	Labor	Human Capital	Capital	TFPH
1960-2000	0.27	0.15	0.57	0.01
1960-1971	0.25	0.15	0.56	0.04
1975-1981	0.29	0.09	0.17	0.45
1985-1998	0.25	0.09	0.45	0.21
(α =1/3)				
Period	Labor	Human Capital	Capital	TFPH
1960-2000	0.36	0.20	0.38	0.06
1960-1971	0.33	0.21	0.37	0.09
1975-1981	0.39	0.13	0.11	0.37
1985-1998	0.33	0.12	0.30	0.25

Table 7: Growth accounting for periods of rapid growth

The growth rate of GDP over the sixties is characterized by capital accumulation, human capital accumulation and the lack of total factor productivity growth. As expected after 1975 the growth rate of TFP played a key role in accounting for growth, however there is an important difference between the 1975-1981 and 1985-1998 periods that is given by capital accumulation. The successful period after the debt crisis is accounted for by capital accumulation, which was not as fast as in the sixties but still very important. Furthermore, as the growth literature predicts, the trade liberalization and the movement of the Chilean economy towards a free market economy that began in the mid-seventies brought important total factor productivity growth.

However, as mentioned above, our TFP growth estimates are also capturing improvements in the quality of the capital stock and other factors (such as changes in relative prices, resources allocations, etc.) From this view point, taking Greenwood and Jovanic's (2000) idea, the reduction in trade restrictions should have increased the average quality of the capital stock and this should lead to a higher TFP growth. This feature is even more important if we take into consideration that in the first period of growth (1960-1971), the contribution of capital accumulation was very high, while in the other two period, a lower rate of capital accumulation was accompanied by higher growth rates in the Chilean economy. This feature is in line with economic theory that suggests that opening to trade and the elimination of distortions increase the average quality of capital and improve the allocation of capital towards sectors with higher marginal productivity. For convenience, we reproduce the evolution of the investment rate (using current prices) where the efforts from increasing the investment rate in the last period are made evident (see Figure 13).

It is important to emphasize that the trade reform and the reduction of government interventions in the economy appear to be key features to consider when evaluating the performance of the economy in the eighties and nineties. However,

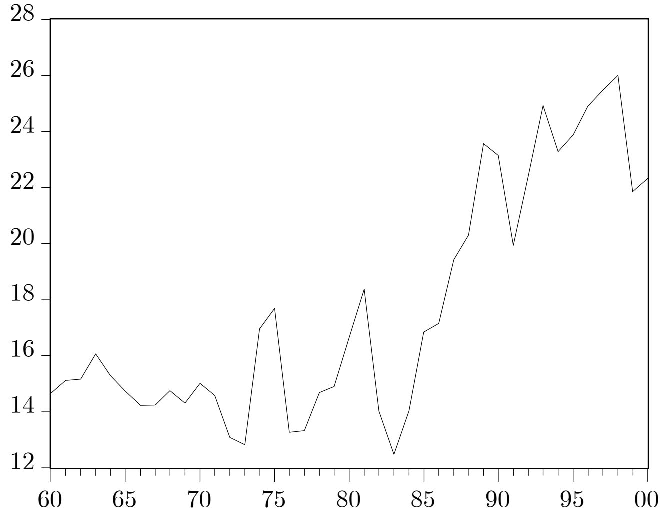

Figure 13: Investment rate (1960-2000)

as mentioned in Section 2, there were several other reforms that could be considered when accounting for a higher marginal productivity of capital and higher growth. For example, this is the case with the banking and capital market reforms combined with a new bankruptcy law.[15] In a recent paper, Bergoeing et al (2001) highlight these reforms as key in explaining the fast recovery of the Chilean economy after the debt crisis.

Another important difference between the rapid growth in the sixties compared to the other two episodes is in the contribution of human capital. Two caveats can be made with respect to this observation: First, educational attainment has continuously increased over time; thus, it may be contended that "enough" human capital was already accumulated from the seventies on, thus making the marginal contribution of human capital modest. Finally, the human capital series was measured using relative wages, but the changes in these wages may be due to different factors than human capital accumulation. At any rate, other studies show that even when measured differently, the contribution of human capital is not that different from the one found here (Schmidt-Hebbel, 1998).

[15] Fuentes and Maquieira (1999) provide an explanation on how these laws affected the recovery of the banking system after the deep banking crisis in the early 80s.

5 Multivariate Analysis

In Sections 3 and 4 we constructed variables that can help us to better understand the growth experience of the Chilean economy. On the one hand, Section 3 provided us with an analytical framework that is used to recover what are supposed to be innovations for the scale variable. If there is relevant information on other variables available on the information set, we can better understand which factors may be behind the important departures of normality and the volatility of the distribution of these residuals. On the other hand, Section 4 provides us with estimates of Total Factor Productivity which can be used to evaluate their main determinants.

Here, we conduct several econometric exercises that intend to provide quantitative and qualitative guidelines with respect to the type of theoretical model that can be used to understand the growth dynamics of the Chilean economy.

5.1 Factors Behind the Distribution of Technology Shocks

Section 3 motivated a simple time series model for the scale variable. This model was able to capture several characteristic of the series. Nevertheless, the model had two features that we try to account for here. First, the model was able to produce white noise residuals but they appear to display important departures from normality and the possible presence of conditional heteroskedasticity. Furthermore, the specification presented some evidence of omitted non-linearities.

Here we evaluate if there is relevant information on other variables not included in the univariate model that are able to account for these features.[16] Among the candidates, we consider variables such as terms of trade, relative prices of equipment and investment goods with respect to consumption goods, and some measures of distortions.

In order for the residuals to be considered as innovations, they have to be orthogonal to the information set that the econometrician possesses. Thus, a simple way to evaluate if valuable information has been left out from the univariate model, is to evaluate if the residuals obtained in Section 3 can be forecasted with any of the variables mentioned above.

Our results indicate that the ratio between fiscal expenditures and GDP (denoted by g) has indeed predictive power over these residuals, displaying always a robust negative association. Thus, while having transitory effects, increased distortions indeed hinder the growth process. Even more instructive, we verify that this measure of distortion is not only relevant to forecast the residual, but also that it statistically precedes (Granger causes) it (see the first panel on Figure 14).

Furthermore, given that we were able to recover projections for the conditional heteroskedasticity of the residuals of the univariate representation, we can also evaluate if some of these variables are useful to characterize volatility. In this case, we

[16] If that were the case, the model presented on section 3 can be improved by using this information.

also find that g is robustly (and positively) associated with our measure of volatility; although in this case, volatility statistically precedes the distortion (see the second panel of Figure 14).

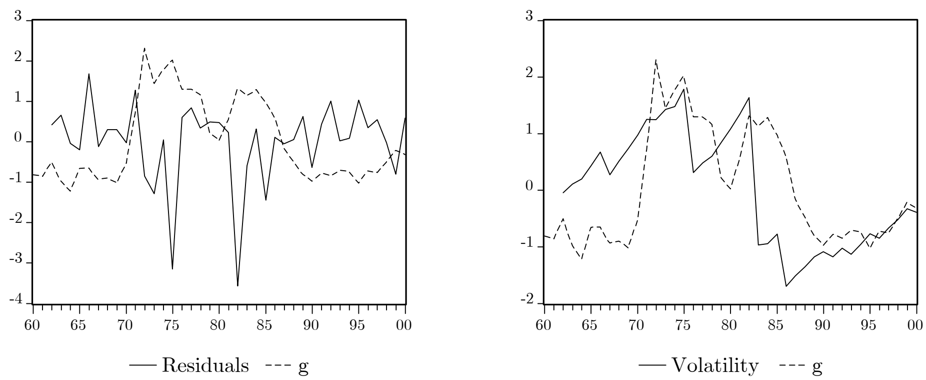

Figure 14: Residuals, volatility, and distortions (Normalized figures)

Concluding, even though our specification is consistent with distortions having transitory effects on the level of GDP, they provide important information that is relevant to characterize the series. In particular, increased distortions tend to precede reductions on the innovations of GDP (and thus TFP) and they can also be associated with increased conditional volatility. Given that distortions may play a prominent role on describing the evolution of GDP, next we quantify their importance as determinants of TFP.

5.2 Factors Behind TFP

In Section 4 we obtained several estimates for TFP. Next, we consider a set of variables that may be associated them. Among them we have time series for terms of trade, variables that intend to capture the evolution of distortionary policies (such as tariffs and fiscal expenditure over GDP), and relative prices of equipment and investment goods with respect to consumption goods.[17]

Our econometric formulations begins with over-parameterized models. After careful reductions and reparameterizations we end up with models for series of TFP (in

[17] The last variables are considered taking into account the derivations of Greenwood and Jovanich (2000). Thus, if either of these relative prices appears as significant, we could substract their participation from the TFP series given that, in the spirit of that paper, movements of relative prices would be related to the quality of the capital stock and not directly to TFP per se. Nevetheless, a case could be made for associating the evolution of these relative prices to modifications in distortionary policies; making of these prices a combination of the effects of increases in the quality of capital and reduced distortions.

logs) that can be expressed as:

$$f_t = a_0 + a_1 t + a_2 f_{t-1} + a_3 f_{t-2} + a_4 p_t + a_5 p_{t-2} + a_6 T_t + a_7 T_{t-1} + a_8 g_{t-1} + e_t \quad (13)$$

where a_i are coefficients to be determined, f is the log of each TFP series, p is the log of the relative price of equipment goods with respect to consumption goods, T is the log of terms of trade, and g is the ratio between fiscal expenditures and GDP.

	TFP α=0.507	TFP α=1/3	$TFPH$ α=0.507	$TFPH$ α=1/3
a_1	0.008 (0.001)	0.010 (0.004)	0.005 (0.001)	0.006 (0.001)
a_2	0.349 (0.135)			
a_3	-0.269 (0.116)	-0.405 (0.182)	-0.501 (0.155)	-0.377 (0.156)
a_4	-0.220 (0.038)	-0.303 (0.033)	-0.259 (0.032)	-0.283 (0.035)
a_5		-0.141 (0.068)	-0.197 (0.061)	-0.210 (0.065)
a_6	0.083 (0.026)	0.082 (0.038)	0.164 (0.033)	0.116 (0.039)
a_7		0.083 (0.030)		0.072 (0.033)
a_8	-0.571 (0.119)	-0.410 (0.139)	-0.852 (0.113)	-0.576 (0.114)
R^2	0.940	0.963	0.913	0.915
DW	2.199	1.895	2.015	1.858
Q	0.115	0.199	0.241	0.793
Q^2	0.741	0.109	0.159	0.467
JB	0.629	0.572	0.852	0.365
Ra	0.174	0.286	0.081	0.167

Table 8: Results of TFP regressions. R^2=Adjusted R^2. DW=Durbin-Watson statistic. Q=Minimum p-value of the Ljung-Box test for white noise on the residuals. Q^2=Minimum p-value of the Ljung-Box test for white noise on the squared residuals. JB=P-value of the Jarque-Bera normaility test. Ra=P-value of the Ramsey test. Standard errors in parenthesis

Table 8 shows the results of the estimations (only statistically significant variables included). Given the close association between the measures of TFP, the characteristics and even the coefficients associated with each variable are remarkably similar; finding in all cases that reductions on the relative price of equipment goods with respect to consumption goods, improvements on terms of trade, and reductions on the participation of government expenditures to GDP, are positively associated with our measures of TFP. Furthermore, consistent with our results from Section 3, we also find that TFP can be characterized as trend stationary. Thus, every transitory shock on the variables included in the regressions would have only transitory effects on the levels of our TFP estimates.

This does not mean that policies are not important; it only means that even though they have effects on the level of the series, transitory policy shocks do not have permanent effects. As expected, a_4 and a_5, when significant, are negative; if these variables measure the quality of capital, a reduction on the relative price of equipment with respect to consumption goods signals an improvement on the quality of capital stock. In this regard, this variable intends to capture the exclusion of the adjustment for quality of the capital stock in our growth accounting exercise as well as possible reductions on distortions. Also of interest is the positive effect of terms of trade on TFP and the negative and statistically significant effect of the size of the government as a fraction of GDP. It may be argued that this last variable can not be considered as exogenous given that it may have been used to conduct countercyclical policies. We find evidence that g is weakly exogenous to the parameter of interest (in Hendry's, 1995 sense); thus conditioning our estimates of TFP on g is a valid econometric practice.

After removing the trend and persistence component, Figure 15 presents the contribution of each variable to TFP. We find that almost all of the variation of TFP (excluding the trend component) can be accounted for the evolution of terms of trade and that the negative effect of our measure of distortions more than offsets the improvements in the quality of the capital stock.

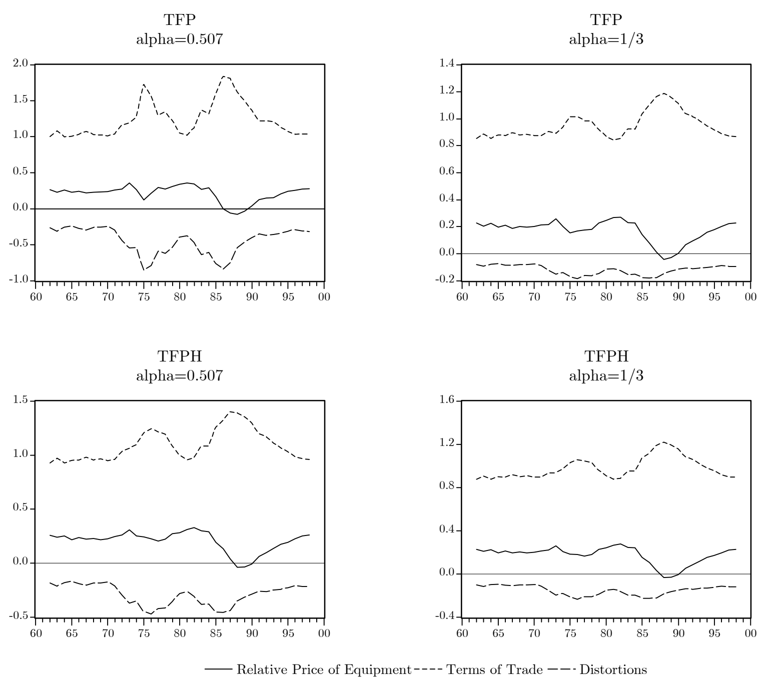

Figure 15: Effect on TFP

Given that all of our estimates of TFP are robustly associated with these three variables, we estimate a simple model for the level of (log) GDP that associates it with them. Next, we use the impulse-response functions of the innovations of these variables on GDP as a metric with which to compare the theoretical model developed on the next section.

While simple, our econometric formulation is able to provide well behaved residuals and successfully passes all of our specification tests. It is given by:

$$y_t = b_0 + b_1 t + b_2 y_{t-1} + b_3 p_t + b_4 T_t + b_5 g_t + e_t \tag{14}$$

where b_i are coefficients to be determined, y is the log of GDP, and all the other variables are as defined in (13).

	y
b_1	0.017 (0.005)
b_2	0.615 (0.106)
b_3	-0.163 (0.064)
b_4	0.107 (0.051)
b_5	-0.634 (0.174)
R^2	0.990
DW	1.817
Q	0.262
Q^2	0.150
JB	0.099
Ra	0.257

Table 9: Results of GDP regressions. R^2=Adjusted R^2. DW=Durbin-Watson statistic. Q=Minimum p-value of the Ljung-Box test for white noise on the residuals. Q^2=Minimum p-value of the Ljung-Box test for white noise on the squared residuals. JB=P-value of the Jarque-Bera normaility test. Ra=P-value of the Ramsey test. Standard errors in parenthesis

As Table 9 shows, we find that the relative price of equipment with respect to consumption goods and our proxy for distortions are negatively associated with GDP, while improvements on terms of trade have positive effects on GDP. Consistent with our previous findings, we model y as a trend stationary series, thus all the regressors included have only transitory effects over the scale variable. Furthermore, weak exogeneity conditions are satisfied by p, T, and g.

Next, we estimate laws of motion for p, T, and g as univariate time series models. These simple specifications provide good statistical approximations for the processes of each variable and are able to account for most of their dynamic characteristics.[18]

[18] VAR models were also considered for obtaining the multivariate representation of these variables. Our results do not change significantly if a VAR(1) representation is considered instead of simple univariate representations.

6 Back to Fundamentals

The empirical counterpart of the model described on section 3 was able to replicate key features of Chilean GDP but not all of them. In particular, as Table 4 and the analysis of Section 5.1 confirm, there is evidence of omitted non-linearities, departures of normality, and possibly conditional heteroskedasticity in the innovations of this representation. Furthermore, variables such as the relative price of equipment to consumption goods, terms of trade, and our measure of distortions, not only have predictive power with respect to the innovations of the univariate model, but can also account for the variability of our TFP estimates and the level of GDP itself. Thus, the model introduced on Section 3 has several flaws that can make us question its validity as a good approximation for the Chilean economy.

This section presents a dynamic stochastic general equilibrium model in which we explicitly introduce the theoretical counterparts of p, T, and g. Next, we parameterize our model and choose its deep parameters in order to replicate the impulse-response function of shocks to each variable reported on Table 9. Thus, we force our model to replicate not only the first moments, but also the dynamic interactions of the variables that are considered as determinants of the growth dynamics.

6.1 The Model

The dynamic stochastic general equilibrium to be used has to explicitly consider the introduction of variables that capture the relative price of equipment to consumption goods, terms of trade, and government expenditures dynamics. In order to incorporate the dynamics of p we consider a variant of Greenwood et al (2000) that introduces technological change specific to new investment goods. Their model, however, does not explicitly consider government expenditures nor allows for terms of trade shocks as it models a closed economy.

6.1.1 The Economic Environment

The economy is inhabited by a representative agent who maximizes the expected value of lifetime utility as given by

$$\mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t u\left(c_t, l_t\right)$$

with

$$u\left(c_t, l_t\right) = \theta \ln c_t + (1-\theta) \ln\left(1-l_t\right), \quad 0<\theta<1 \tag{15}$$

where c_t and l_t represent period-t consumption of an importable good and labor. There are two goods produced in this economy; good 1 is not consumed domestically, while the second (the importable good) is produced domestically and can be imported from abroad. We assume that the output of the exportable good (y_1) is constant and can be sold abroad at a price (expressed in terms of the importable good) of T_t. Thus, in our economy, T_t represents terms of trade. The production technology for the importable good is described by

$$y_{2,t} = e^{z_t} k_t^{\alpha} l_t^{1-\alpha} \tag{16}$$

where α is the compensation for capital as a share of output of sector 2. As before, production in this sector is also affected by a stationary productivity shock z_t that follows an AR(1) process.[19]

The resource constraint of the economy is given by

$$c_t + i_t + g_t = T_t y_1 + y_{2,t} \tag{17}$$

where the investment (i) and government expenditures (g) are expressed in units of consumption of importables.

The capital accumulation equation is

$$k_{t+1} = (1-\delta) k_t + i_t q_t \tag{18}$$

where, following Greenwood et al (2000), q denotes the current state of technology for producing investment goods and represents investment specific technological change. Given that i is expressed in consumption units, q determines the amount of investment in efficiency units that can be purchased for one unit of consumption. Thus, a higher realization of q directly affects the stock of new capital that will be active in production next period. We assume that $\ln q$ follows an AR(1) process.

As discussed in Greenwood et al (2000) the relative price for an efficiency unit of newly produced capital, using consumption of the importable good as numéraire is the inverse of q. This $1/q$ is our theoretical counterpart to p of section 5.

Finally, the government of this economy levies taxes on labor and capital income at the rates τ_l and τ_k. Part of the revenue raised by the government in each period is rebated back to agents in the form of lump-sum transfer payments (F), and part of it is "lost" in government expenditures that do not provide services to the representative agent. The government's budget constraint is then

$$F_t + g_t = \tau_k r_t k_t + \tau_l w_t l_t$$

where r and w represent the market returns for the services provided by capital and labor. Finally, we also assume that $\ln g$ follows an AR(1) process.

6.1.2 Competitive Equilibrium

Here we briefly describe the competitive equilibrium of this economy, noting that the aggregate state of the world is given by $s = (k, T, z, q, g)$.

[19] We could also include labor-augmenting exogenous technological progress as in Section 3. This would only be needed for comparing the results of the model with the coefficient b_1 of Table 9. Of course, one can always calibrate the techological progress parameter to exactly match it.

The Household The dynamic program problem facing the representative household is

$$V(s) = \max_{c,k',l} \{u(c,l) + \beta \mathrm{E}[V(s')]\} \tag{19}$$

subject to

$$c + k'/q = (1-\tau_k) rk + (1-\tau_l) wl + (1-\delta) k/q + F + \pi_1 + \pi_2$$

and $s' = S(s)$. Here, π_j denotes the profits of sector j.

The Firms The maximization problem of the firms that produce the importable good is

$$\max_{\widetilde{k},\widetilde{l}} \left[\pi_2 = e^z \widetilde{k}^\alpha \widetilde{l}^{1-\alpha} - r\widetilde{k} - w\widetilde{l}\right] \tag{20}$$

where due to the constant-returns-to-scale assumption, firms make zero profits in each period.

On the other hand, the firm that produces the exportable good does not hire inputs to produce y_1; thus, profits expressed in terms of the importable good are:

$$\pi_1 = Ty_1$$

Definition of Equilibrium A competitive equilibrium is a set of allocation rules $c = C(s)$, $k' = K(s)$ and $l = L(s)$, and a set of pricing functions $r = R(s)$ and $w = W(s)$, such that

- Households solve the problem (19), taking as given s and the form of the functions $W(s)$, $R(s)$ and $S(s)$, with the equilibrium solution to this problem satisfying $c = C(s)$, $k' = K(s)$ and $l = L(s)$.
- Firms of the importable sector solve the problem (20), taking as given s and the form of the functions $W(s)$, $R(s)$ and $S(s)$, with the equilibrium solution to this problem satisfying $\widetilde{k} = k$, $\widetilde{l} = l$, $k' = K(s)$ and $l = L(s)$.
- The economy-wide resource constraint (17) holds each period.

6.2 Calibration and Results

Once the model is specified, we fix the deep parameters that describe preferences and technology. Some of these parameters are calibrated in order to match several first moments of relevant variables. Such is the case of θ which is set in order to reproduce a steady state participation rate of l equal to 0.35. The depreciation rate is calibrated to match the average investment rate in steady state. Finally, the constants for the production function of sector 2, p, g and T are set to match the first moments of their empirical counterparts.

The persistence and volatility of p, T, and g are made consistent with AR(1) estimates obtained with observed data of the relative price of equipment with respect to investment, terms of trade, and government expenditures (in this case we include a time trend that is absent in the model). Finally, the persistence and volatility of the technology shocks are estimated by simulation in order to match as closely as possible the results of Table 9. The base configuration of the parameters is presented in Table 10.

Preference			
$\beta = 0.98$	$\theta = 0.43$		
Technology			
$\alpha = 1/3$	$\delta = 0.06$		
Shocks			
$\rho_z = 0.73$	$\sigma_z = 0.04$	$\rho_p = 0.844$	$\sigma_p = 0.1$
$\rho_T = 0.892$	$\sigma_T = 0.14$	$\rho_g = 0.895$	$\sigma_g = 0.024$

Table 10: Parameters

Once the values of the parameters are set, we solve the model, simulate artificial realizations from it, and compare the impulse-response functions of several shocks. According to our specification, the policy functions of the control variables can not be obtained analytically and we have to resort to numerical methods. We use a second-order approximation to the policy function using perturbation methods. This method has the advantage of explicitly incorporating in the decision rule the volatility of shocks and has been proven superior to traditional linear-quadratic approximations (Schmitt-Grohé and Uribe, 2001).

Figure 16 presents the results of comparing the impulse-response functions of shocks on the innovations of the equation that describes y in (14), and innovations on p, T, and g from their univariate representations. Along with the impulse-response functions and the 95% confidence intervals obtained from the data, the figure shows the impulse-response function obtained from a long simulation of the model. Our results evidence an almost perfect match between the impulse-response functions of the model and the data, and suggest that technology shocks do not have to be as persistent as needed on Section 3.

Analyzing the results of the impulse-response functions, we observe that a positive shock of 10% on the relative price of equipment with respect to investment has a negative (but transitory) effect on GDP of almost 3% after 3 years. On the other hand, a positive shock of 14% on terms of trade has a positive effect on GDP that on average reaches its peak of almost 3% after 3 years. Finally, a transitory increase of 2.4% on the share of government expenditures over GDP has an exactly offsetting

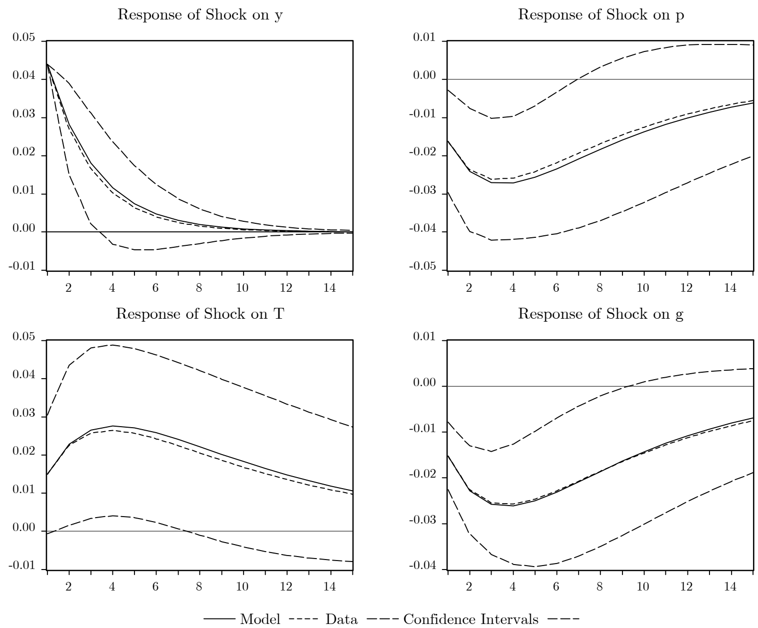

Figure 16: Impulse-Response Functions: Model and Reality

effect on GDP (decline of 2.4%) after three years.

Thus, our theoretical model is not only able to capture the first moments of key variables of the Chilean economy but matches almost perfectly the impulse-response functions of the dynamic characterization of GDP; showing that a model that incorporates the relative price of equipment with respect to consumption goods, terms of trade and distortions (measured as the share of government expenditures on GDP) predicts the same qualitative and quantitative responses of GDP to transitory shocks.

7 Concluding Remarks

The objective of this study was to better understand the factors that are behind the growth dynamics in Chile. Its study is of interest because it has experienced deeper recessions than most Latin American countries when faced to a external shock (Great Depression, Oil Shock and External Debt), but at the same time it has experienced an impressive and stable growth in the past 16 years.

The main conclusions at which we arrive can be summarized as follows:

- Using two different data sets, that span the periods 1810-1995 and 1960-2000; we find that both per capita GDP and GDP per worker can be better characterized as trend stationary random variables. This evidence alone suggests that exogenous and not endogenous growth models are better suited to match the data.

- Building on that observation, we construct a simple exogenous growth model that roughly captures key features of the univariate representation for per capita GDP and GDP per worker. This representation can also be used to recover parameters such as the capital share on GDP and the persistence of technology shocks. Our best estimates suggest that the first of these parameters is closer to 1/3 (the share that is often used in the international literature) while the technology shocks are persistent, with an autocorrelation coefficient close to 0.9.

- Looking at the evolution of GDP over the last four decades, we distinguish three periods of continuous growth: 1960-1971, 1975-1981 and 1985-1998. The first period corresponds to a moderately inward oriented economy; the second is the period of the major trade liberalization and market reforms; while the third is the period where many of the reforms from the previous decade were consolidated. Two other characteristics are worth highlighting: the periods of growth had different lengths, and the growth rates were different. While during the sixties the economy grew at less than 5%, in the other two periods the growth rate was above 7%.

- But, why is the recent growth period so different from the one of the sixties? We consider that this question can be answered by analyzing the behavior of TFP growth. As no reliable measures of the quality of capital stock are available, we used series for human capital along with different capital shares to estimate TFP.[20] Our results suggest that in the sixties physical capital and human capital accumulation were the most important factors behind growth. While in the other two periods, TFP played a major role (specially in the 1975-1981 period). In the 1985-1998 period, both capital accumulation and TFP growth account for growth.

- Following the literature of growth and distortions, we analyzed if distortions have anything to do with the evolution of the level of TFP after controlling for good luck (positive external shocks measured by terms of trade), exogenous technological progress and a proxy of the quality of capital. We used the relative price of equipment with respect to consumption as a proxy for the latter variable (Greenwood and Jovanic, 2000). We found that exogenous technological shocks, terms of trade, the relative price of equipment to consumption and distortions account for a good deal of the evolution of TFP. It is important to notice that terms of trade and distortions are the variables with the largest impact on the level of TFP.

[20] We extensively used two values: 0.507 (that comes from pure growth accounting) and 1/3 (that comes from the univariate analysis).

- What policy implications can be drawn from the Chilean experience that can help other countries and Chile itself? Good policies matter; the most robust measure of distortions that we found in this document is captured by the share of fiscal expenditures on GDP. We find that this variable not only offsets the positive effects of the improvements of the quality of capital goods, but also that it has detrimental effects on the level and volatility of the Solow residuals. External shocks are off course important, but among the variables that can be controlled by the authority, distortionary policy can help to explain several of the episodes of mediocre growth that Chile experienced.

- The previous findings provide guidelines with respect to the features that a theoretical model should have in order to account for the dynamics of our TFP estimates and the dynamics of GDP itself. Building on these observations, we calibrate, solve and simulate a small open economy model that incorporates terms of trade shocks, includes the relative price of investment to consumption goods, and distortionary taxes that help finance government expenditure. This model is able to replicate (almost exactly) the impulse-response functions of several shocks on the trajectory of GDP. We find that a 1% transitory increase in the share of government expenditures on GDP has a detrimental effect on GDP of the same order of magnitude (a decrease of 1% in GDP) by the third year. Transitory increases of 1% on terms of trade or decreases in the relative price of investment goods have positive and temporary effects on GDP, which however are not as important as the quantitative effects of increased distortions.

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A The Data

Year	GDP (Millions Pesos, 1995)	Per Capita GDP	GDP Per Worker	Year	GDP (Millions Pesos, 1995)	Per Capita GDP	GDP Per Worker	Year	GDP (Millions Pesos, 1995)	Per Capita GDP	GDP Per Worker
1810	103594	139277	362690	**1872**	548973	273873	685502	**1934**	2450763	528866	1531044
1811	104046	137462	357963	**1873**	585615	287633	717665	**1935**	2591791	551093	1582243
1812	104501	135672	353301	**1874**	561303	271423	675037	**1936**	2719185	569702	1622143
1813	104957	133907	348705	**1875**	607865	289385	717348	**1937**	3091761	638398	1802308
1814	105415	132167	344175	**1876**	601489	281913	692523	**1938**	3127338	636285	1781443
1815	105875	130453	339711	**1877**	582251	268668	654951	**1939**	3192984	638214	1777354
1816	106338	128765	335314	**1878**	617621	280574	679654	**1940**	3320871	652046	1806429
1817	106802	127102	330985	**1879**	711524	318227	766945	**1941**	3325636	641519	1777704
1818	108649	127080	330927	**1880**	799554	352065	845169	**1942**	3434744	650889	1805348
1819	106340	122248	318345	**1881**	827655	358805	858923	**1943**	3539563	659014	1830430
1820	108611	122724	319585	**1882**	896645	382711	914529	**1944**	3631995	664349	1848969
1821	106222	118038	307382	**1883**	902188	379138	905292	**1945**	3911196	702820	1961146
1822	109252	119397	310920	**1884**	910175	376603	899401	**1946**	4246618	749624	2098386
1823	111317	119640	311553	**1885**	883030	359754	860095	**1947**	3789701	657136	1846317
1824	111111	117443	305831	**1886**	920355	369205	896316	**1948**	4421476	753233	2124896
1825	117030	121653	316794	**1887**	984758	388989	958947	**1949**	4299028	719503	2038974
1826	120590	123282	321037	**1888**	945816	367896	920993	**1950**	4536778	745935	2124495
1827	123846	124519	324258	**1889**	970315	371669	944870	**1951**	4733552	761634	2189530
1828	125682	124281	323639	**1890**	1040697	392566	1013487	**1952**	5038005	793262	2302826
1829	129215	125670	327257	**1891**	1125627	419352	1096348	**1953**	5418214	834984	2448933
1830	130009	124363	323852	**1892**	1103117	405971	1074632	**1954**	5243356	790734	2343588
1831	132636	124793	324972	**1893**	1157916	421052	1128302	**1955**	5437749	802501	2403669
1832	137232	127001	330722	**1894**	1138859	409270	1110077	**1956**	5532086	797590	2418578
1833	139572	127056	330864	**1895**	1218785	432950	1188422	**1957**	6098588	858956	2637227
1834	145521	130310	339340	**1896**	1225655	430467	1176520	**1958**	6433534	885308	2751985
1835	151831	133748	348291	**1897**	1198501	416254	1132392	**1959**	6094300	819347	2578868
1836	153744	133235	346956	**1898**	1343775	461613	1249558	**1960**	6574564	863484	2752399
1837	160514	136851	356372	**1899**	1352168	459512	1237316	**1961**	6888990	883430	2862130
1838	164377	137883	359059	**1900**	1317525	443016	1186266	**1962**	7215434	903510	2971784
1839	167858	138536	360761	**1901**	1350518	448528	1196336	**1963**	7671894	937999	3129119
1840	179912	146104	380467	**1902**	1409507	462437	1228317	**1964**	7842600	936206	3164474
1841	183615	146727	382089	**1903**	1330297	431075	1140372	**1965**	7905992	921552	3152765
1842	189171	148757	387377	**1904**	1439241	460705	1213542	**1966**	8787602	1003495	3460085
1843	196396	151987	395787	**1905**	1437785	454564	1192366	**1967**	9072898	1015093	3524092
1844	200684	152847	398028	**1906**	1550183	484129	1264351	**1968**	9397725	1030113	3597737
1845	208191	156065	406407	**1907**	1632141	503436	1309152	**1969**	9747397	1046869	3674842
1846	216707	159897	416385	**1908**	1805404	550093	1437793	**1970**	9947831	1046699	3690442
1847	222881	161879	421548	**1909**	1814522	546049	1435105	**1971**	10838683	1119699	3934827
1848	233632	167043	434995	**1910**	2019654	600373	1586738	**1972**	10707192	1086694	3799321
1849	251877	177292	461685	**1911**	1965049	576938	1533959	**1973**	10111334	1008813	3503009
1850	266564	184726	481043	**1912**	2043105	592548	1585063	**1974**	10209865	1002048	3449970
1851	275731	188202	490096	**1913**	2080553	595976	1604544	**1975**	8891755	859107	2927814
1852	285848	192173	500436	**1914**	1758134	497069	1348160	**1976**	9204565	875958	2950908
1853	281420	186354	485283	**1915**	1701537	474759	1297615	**1977**	10112037	948507	3153979
1854	291402	190070	497834	**1916**	2085824	574449	1582319	**1978**	10942976	1011833	3318407
1855	306692	197049	515879	**1917**	2130720	579157	1608235	**1979**	11849219	1079655	3491379
1856	312324	197668	517092	**1918**	2157838	578819	1620850	**1980**	12790636	1147657	3660019
1857	324559	202349	528745	**1919**	1851344	490162	1384217	**1981**	13585241	1199580	3773486
1858	340944	209401	546394	**1920**	2091289	546457	1556745	**1982**	11739268	1019476	3163949
1859	354282	214362	558382	**1921**	1812565	467517	1344255	**1983**	11410329	974159	2984257
1860	368530	219681	571098	**1922**	1878871	478328	1386749	**1984**	12081876	1013920	3065609
1861	370900	217827	565005	**1923**	2263107	568620	1660557	**1985**	12319699	1016393	3032094
1862	371821	215151	556670	**1924**	2433730	603454	1773422	**1986**	13009137	1055166	3105176
1863	388298	221384	571233	**1925**	2539686	621558	1835960	**1987**	13866995	1105997	3209725
1864	411281	231052	594423	**1926**	2328128	562350	1668005	**1988**	14880851	1167309	3339871
1865	427723	236778	607234	**1927**	2285899	544910	1621549	**1989**	16452304	1269370	3580378
1866	439452	239728	612804	**1928**	2800122	658852	1964811	**1990**	17060640	1295122	3599938
1867	424609	228268	581495	**1929**	2946600	684301	2043327	**1991**	18420357	1378769	3768817
1868	448291	237511	602838	**1930**	2474841	566325	1694546	**1992**	20682012	1526348	4103248
1869	495871	258930	654691	**1931**	1949730	439723	1304892	**1993**	22126912	1610050	4157397
1870	509179	262058	659952	**1932**	1647453	366101	1077629	**1994**	23389943	1678022	4284814
1871	510469	258662	649441	**1933**	2030071	444509	1297759	**1995**	25875727	1830308	4706903

Table 11: Series 1810-1995. Source: Braun et al (1999)

Year	GDP (Millions Pesos, 1986)	Per Capita GDP (pesos 1986)	GDP Per Worker (pesos, 1986)
1960	1786346	234798	786197
1961	1871778	240187	815978
1962	1960474	245458	837403
1963	2079680	254115	867549
1964	2130879	254282	867221
1965	2148103	250595	852007
1966	2387641	272531	925935
1967	2465158	275467	923911
1968	2553415	279551	940657
1969	2648423	284257	963101
1970	2702882	284634	957981
1971	2944932	304543	1010951
1972	2909205	295651	988896
1973	2747307	274539	951205
1974	2774078	272717	961855
1975	2415940	233718	889304
1976	2500932	238207	882349
1977	2747498	257787	932201
1978	2973269	274845	960720
1979	3219500	293242	997208
1980	3475288	311769	1045550
1981	3691184	326105	1055616
1982	3189633	277528	1031686
1983	3100242	265614	964124
1984	3282732	276884	1036396
1985	3238018	268782	960380
1986	3419209	279187	911220
1987	3644106	292605	935433
1988	3911354	308783	948568
1989	4323180	335572	993318
1990	4483756	342284	1007576
1991	4842127	363531	1071736
1992	5435017	401257	1150569
1993	5815243	422276	1164846
1994	6148042	439323	1220765
1995	6800454	478554	1334648
1996	7304487	506592	1409562
1997	7844753	536490	1493954
1998	8152816	550059	1518410
1999	8059767	536682	1532830
2000	8493402	558361	1598931

Table 12: Series 1960-2000. Sources: Central Bank of Chile and National Bureau of Statistics (INE)

Year	Labor (Th. People)	Index of Human Capital	Capital (Millions Pesos, 1986)	TFP capital share = 0.507	TFP capital share = 1/3	TFPH capital share = 0.507	TFPH capital share = 1/3	Capital Share form National Accounts
1960	2272	89.01	4322081	100.00	100.00	100.00	100.00	0.48387
1961	2294	95.52	4563561	101.45	102.25	97.98	97.54	0.49707
1962	2341	94.29	4845995	102.04	103.55	99.19	99.65	0.50891
1963	2397	93.63	5185473	103.38	105.72	100.83	102.21	0.54294
1964	2457	93.01	5481467	101.74	104.60	99.56	101.58	0.55202
1965	2521	92.42	5735683	98.97	102.10	97.15	99.56	0.52199
1966	2579	91.88	5995017	106.37	110.15	104.72	107.85	0.51699
1967	2668	95.50	6254534	105.70	109.61	102.09	104.58	0.51901
1968	2715	97.04	6550662	106.04	110.52	101.62	104.34	0.50400
1969	2750	97.78	6862491	106.74	111.90	101.91	105.10	0.51401
1970	2821	100.00	7198803	104.98	110.49	99.13	102.23	0.47700
1971	2913	104.08	7507890	110.22	116.21	102.05	104.70	0.38300
1972	2942	106.17	7686043	107.08	113.16	98.17	100.61	0.37200
1973	2888	104.90	7828736	101.09	107.52	93.23	96.36	0.52800
1974	2884	99.91	8050714	100.71	107.66	95.14	99.68	0.49057
1975	2717	103.19	8143540	89.81	97.20	83.50	88.08	0.45359
1976	2834	106.70	8172203	90.88	97.70	83.12	86.58	0.47490
1977	2947	110.63	8253498	97.45	104.23	87.54	90.16	0.46655
1978	3095	111.31	8401410	102.02	108.54	91.38	93.51	0.48499
1979	3229	112.76	8622975	106.78	113.27	95.03	96.74	0.53539
1980	3324	111.78	8956543	111.45	118.41	99.62	101.73	0.51351
1981	3497	112.21	9389590	112.72	119.69	100.56	102.56	0.47726
1982	3092	115.12	9505285	102.86	111.82	90.61	94.19	0.43880
1983	3216	115.19	9543686	97.86	105.73	86.18	89.03	0.49866
1984	3167	117.92	9658075	103.76	112.64	90.33	93.38	0.51072
1985	3372	118.51	9851564	98.25	105.87	85.33	87.47	0.51091
1986	3752	121.76	10051302	97.43	103.40	83.49	83.91	0.53666
1987	3896	125.68	10370448	100.33	106.37	84.65	84.52	0.56915
1988	4123	121.54	10778025	102.69	108.53	88.08	88.17	0.60142
1989	4352	128.71	11413869	107.35	113.52	89.51	88.77	0.58700
1990	4450	133.61	12051421	107.13	113.92	87.70	86.90	0.56147
1991	4518	132.74	12662047	111.99	119.80	91.97	91.78	0.55856
1992	4724	126.57	13508966	119.00	127.75	100.05	101.02	0.54221
1993	4992	134.69	14563899	119.27	128.48	97.25	97.48	0.51783
1994	5036	131.85	15675493	120.95	131.77	99.66	101.40	0.52729
1995	5095	132.03	17138920	127.13	140.38	104.68	107.93	0.54473
1996	5182	136.58	18730304	129.46	144.75	104.83	108.80	0.50676
1997	5251	138.51	20519712	131.88	149.48	106.06	111.31	0.50262
1998	5369	140.20	22342207	129.83	148.78	103.80	109.90	0.48940
1999	5258	141.72	23636454	126.03	146.37	100.22	107.35	0.48940
2000	5312	142.47	24972419	128.51	150.42	101.93	109.93	0.48940

Table 13: Series used for construction of TFP. Sources: Central Bank and authors calculations

Year	Equipment Price / Cons Price	Inv Price / Cons Price	Implicit Tariff	Terms of Trade	CPI	Fiscal Expenditures over GDP	Real Exchange Rate
1960	0.5982	0.6599	0.2356	173.1039	0.0001	0.1973	78.5699
1961	0.5988	0.7118	0.2588	172.0979	0.0001	0.1951	71.3936
1962	0.6059	0.6669	0.2799	164.7476	0.0001	0.2125	60.9674
1963	0.6693	0.6403	0.2462	161.4526	0.0002	0.1893	68.6777
1964	0.6101	0.6490	0.1970	164.5876	0.0002	0.1776	62.8776
1965	0.6423	0.6985	0.2221	185.1957	0.0003	0.2049	67.1388
1966	0.6304	0.7499	0.1790	207.2860	0.0004	0.2052	75.0250
1967	0.6732	0.7593	0.1716	168.0531	0.0004	0.1914	78.4004
1968	0.6467	0.7412	0.1813	184.0746	0.0006	0.1931	84.8185
1969	0.6353	0.7238	0.1745	210.4687	0.0007	0.1869	90.1158
1970	0.6290	0.7229	0.1854	199.2614	0.0010	0.2109	88.2961
1971	0.6217	0.7997	0.1855	155.0018	0.0013	0.2722	76.4206
1972	0.6431	0.9171	0.3259	145.3525	0.0044	0.3497	35.2836
1973	0.5543	0.8307	0.2557	189.6262	0.0314	0.3076	32.1531
1974	0.6772	0.9766	0.1050	153.3119	0.1471	0.3235	61.1290
1975	0.8853	0.9970	0.1239	93.0749	0.6523	0.3358	88.9100
1976	0.7911	0.9347	0.1350	102.3468	1.9526	0.3003	82.6239
1977	0.6773	0.8930	0.1305	92.5891	3.5956	0.3001	78.5350
1978	0.7084	0.9232	0.0939	89.1006	4.9323	0.2938	90.7121
1979	0.6450	0.8576	0.0642	105.4809	6.8510	0.2475	86.4808
1980	0.5729	0.8500	0.0623	99.1267	8.9911	0.2384	78.6979
1981	0.5569	0.8530	0.0749	86.2541	9.8489	0.2638	78.3695
1982	0.6042	0.9004	0.0629	78.6859	11.8909	0.3012	86.5691
1983	0.7199	0.9368	0.1187	85.7260	14.6367	0.2924	110.2281
1984	0.6965	0.9271	0.1475	79.4944	18.0089	0.2999	114.6302
1985	0.8423	0.9364	0.1546	76.1480	22.7662	0.2845	147.3909
1986	1.0000	1.0000	0.1220	73.8110	26.7174	0.2665	146.2106
1987	1.0562	1.0210	0.1234	84.6464	32.4488	0.2292	140.5564
1988	1.0915	1.0694	0.0878	114.5706	36.5643	0.2134	144.8546
1989	1.0406	1.0481	0.0862	116.2828	44.3932	0.1976	136.3573
1990	0.9559	0.9970	0.0951	102.0097	56.5254	0.1895	126.7014
1991	0.8363	0.9152	0.0977	94.7164	67.0720	0.1990	122.5884
1992	0.8105	0.9178	0.0912	93.9359	75.5870	0.1958	113.5566
1993	0.8049	0.9184	0.0919	92.6648	84.8338	0.2025	114.4775
1994	0.7249	0.8911	0.0864	105.0498	92.4226	0.2008	110.6494
1995	0.6702	0.8396	0.0848	116.1238	100.0000	0.1872	100.0000
1996	0.6540	0.8453	0.0839	101.5886	106.6321	0.2017	99.6595
1997	0.6310	0.8412	0.0747	104.6471	113.0775	0.2001	95.5769
1998	0.6341	0.8535	0.0709	92.9259	118.3526	0.2123	97.7442
1999			0.0695	88.7641	121.0866	0.2265	106.4988
2000			0.0562	90.6593	126.5663	0.2214	111.6861

Table 14: Series used in Multivariate Analysis. Sources: Central Bank and authors calculations