Labor Market Distortions, Employment and Growth: The Recent Chilean Experience[1]

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Abstract

The per capita growth rate of Chile from 1984 to 1997 was among the highest in the world. During recent years, however, per capita growth dropped significantly. This paper discusses the role of factor accumulation and the efficiency with which factors are used, measured as total factor productivity (TFP), to explain the evolution of output in Chile during the past 20 years. In contrast with the experience of the 1980s and early 1990s, in recent years the primary determinant of the drop in output growth has not been a decline in TFP, but a severe fall in employment. Using a calibrated dynamic general equilibrium model based on the neoclassical growth model, with fluctuations in factor inputs induced by changes in TFP and relative input prices, we conclude that a 6.17% increase in the cost of labor hiring replicates the observed fall in employment. This fall, in turn, could be attributed to a perceived higher cost of labor services associated to both the significant increase in the minimum wage observed between 1998 and 2000, and a labor code reform, intensively debated during the 1999-2002 period.

JEL Classification: E13, E24.

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1. Introduction

From 1984 to 1998, the Chilean economy grew at a rate of 5.4% per capita, that is, among the world's most successful economies in the past twenty years. This result can undoubtedly be attributed to the market oriented structural reforms that took place during the 1970s, 1980s, and early 1990s. At first, however, this route was far from easy. As a matter of fact, this substantial growth was preceded by a profound crisis in the early 1980s that led to an accumulated decline in per capita output of around 20% for 1982-1983.[2] Chile then grew steadily and, in 1990, it had once again reached its trend level.[3] In the years that followed, the growth rate held steady at around 6%, bringing output per capita 30% higher its 1980 trend level by 1998.

In the past few years, however, the Chilean economy has experienced a sharp drop in its growth rate. Indeed, from 1998 to 2002, the per capita growth rate averaged a mere 0.63% per year. Different hypotheses have been argued to explain this period of stagnating growth. In particular, analysts mention external factors associated with the decline in the terms of trade and reduced access to external capital flows that started with the Asian crisis. The recent recession affecting the world economy (which deteriorated further after the 11 September 2001 terrorist attack) is said to have contributed to worsening the outlook for the terms of trade and dampening investor's appetite for risk. Others argue that this fall could be the result of the excessively restrictive monetary policy stance applied by the Central Bank in mid-1998 to reduce the impacts of the Asian crisis that were just becoming apparent at the time. The effects of this policy, combined with the direct impact of the Asian crisis itself, may have proven more lasting and harder to turn around than originally foreseen, even with the openly expansionary monetary policy applied for several quarters now.

Meanwhile, however, others have argued that the country's difficulties with returning to growth rates like those of the past decade go beyond the explanations of a normal cycle. In contrast, they suggest that recent results reveal a decline in the economy's potential for growing at more than 3 to 4% annually. Furthermore, until very

[2] The Chilean crisis of 1982-83 is considered one of the worst in the 20th century. Kehoe and Prescott (2002) provide evidence of this.

[3] In this study we use output per working age population to analyze growth processes in the Chilean economy and a 2% annual rate as trend. Output per working age population, that is, population from 16 to 64 years of age, is the appropriate indicator for per capita output in the context of the theoretical economy we use. In this economy the entire working age population is capable of working. Finally, the 2% rate

recently, the economy had proven unable to create new jobs at rates comparable to those previously observed. Both phenomena, stagnant growth and low job creation, have coincided not only with an external scenario that is extremely complex for emerging economies but also with a range of policy actions, some of them legal reforms, which affect production costs. Among these, two stand out: the 30% increase in the minimum wage implemented between 1998 and 2000, and the so-called “labor code reform”. The latter was passed in October 2001, but its discussion began in the political sphere during the presidential election campaign in late 1999 and it took almost two years of parliamentary debate. This debate left the impression that the reform would make labor hiring costs much higher. Earlier, toward the end of 2000, reforms to reduce tax evasion had been passed, and a little later, in mid-2001, reforms to reduce the tax burden on individuals but gradually increase the burden on companies were also approved. In an opposite direction, in late 2001 reforms to liberalize the capital market were also passed that should, in the future, reduce investment and capital costs.

The present article focuses on the third of these hypotheses, that is, that the decline in growth and job creation are linked to changing production costs, mainly associated with more expensive labor. With Bergoeing et al. (2002) and Bergoeing and Morandé (2002) as our starting point, we go on to analyze the role of factor accumulation and efficiency with which these factors are used during the past 20 years in Chile to understand output fluctuations in the context of a simple neoclassical growth model. The analysis shows that, unlike events during the crisis in the early 1980s as well as during the recovery and strong economic growth phase that followed and lasted through 1998, in which the efficiency of factor use was the main engine driving economic activity, in recent years the fall in employment has been the primary determinant of the observed decline in growth.

2. Growth Accounting

In the context of the neoclassical model, lower growth may be the result of a decline in labor factor accumulation, due to changes in implicit or explicit taxes that make hiring labor more expensive and thus, increase production costs. Evidence in Kehoe and Prescott (2002) shows that most crises during the 20th century were the

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used as a proxy for trend growth corresponds to average annual growth in this variable from 1960-2002 in Chile.

consequence of drops in the efficiency of factor use or labor contribution. In Chile from 1981 to 1998, the main source of growth was the efficiency with which labor and capital were used; since then, fluctuations in activity levels have resulted fundamentally from changes in employment.

To determine the contribution of factor accumulation and how efficiently these are used to the change in output per working age population, we break down the change in the latter by changes in total TFP, the capital to output ratio, and hours worked per person of working age. This break down is based on a Cobb-Douglas aggregate production function, that is,

$$Y_t = A_t K^{\alpha}_t L^{1-\alpha}_t \tag{1}$$

where Y_t is output, K_t is capital, L_t is total hours worked and A_t is TFP. In this context,

$$A_t = Y_t / (K^{\alpha}_t L^{1-\alpha}_t) \tag{2}$$

When TFP grows at a constant rate, that is, when $A_t = Ag^{(1-\alpha)t}$, the neoclassical growth model is characterized by a unique balanced growth path in which output and capital per worker grow at the same constant rate, g-1. In this study we analyze the behavior of output relative to this trend. The 2% trend in output per working age person used for Chile also fits the United States data very well during most of the 20th century. As argue by Kehoe and Prescott (2002), we consider this trend growth as representing the world stock of useable knowledge growing smoothly over time and being not country specific: countries differ in their institutional structures.

Labor and output series are available directly from national accounts. To obtain A_t, however, we must choose a value for the capital share in output, α, and generate aggregate capital series, K_t. Information from national accounts indicates that the labor compensation share of Chile’s output is almost 0.50. This, in a competitive context, corresponds to 1-α, so the capital share is 0.50. This fraction is stable over time and among many developing countries. In developed countries, however, labor’s share is much higher, with α fluctuating at around 0.30. Gollin (2002) shows that if we correct for labor’s share in developing countries, to allow for the fact that independent workers are underestimated, labor’s contribution rises significantly, tending toward levels observed in developed countries, that is 0.70. A second reason for using this labor's share and not the information from national accounts is that in this case, the growth model predicts a marginal productivity for capital that is unrealistically high.[4] In any case, and as the sensitivity exercises that appear in Appendix 2 show, the results of this study would not be substantially different if we assumed that α is close to the value arising from national accounts, for example, 0.45. The fraction of output accorded to the labor factor only affects the distribution of changes in output between TFP and capital, but does not affect the labor factor's contribution, which is the main element behind output's behavior in the past four years. Because of this, and given that this article centers precisely on the changes to production costs due to legal reforms, particularly to labor laws, from now on we assume that $\alpha = 0.3$.

Using logarithms for the production function, we have:

$$\log\left(\frac{Y_t}{N_t}\right) = \frac{1}{1-\alpha}\log A_t + \frac{\alpha}{1-\alpha}\log\left(\frac{K_t}{Y_t}\right) + \log\left(\frac{L_t}{N_t}\right) \tag{3}$$

where L_t / N_t is the number of hours available for work per person of working age.[5] We can break this expression down to separate out changes in real output per working age population for the period t and $t+s$, this way:

$$\frac{\log\left(\frac{Y_{t+s}}{N_{t+s}}\right) - \log\left(\frac{Y_t}{N_t}\right)}{s} = \frac{1}{1-\alpha}\frac{\log A_{t+s} - \log A_t}{s} + \frac{\alpha}{1-\alpha}\frac{\log\left(\frac{K_{t+s}}{Y_{t+s}}\right) - \log\left(\frac{K_t}{Y_t}\right)}{s} + \frac{\log\left(\frac{L_{t+s}}{N_{t+s}}\right) - \log\left(\frac{L_t}{N_t}\right)}{s} \tag{4}$$

The first term on the right hand side of the equation represents the contribution of TFP to growth, while the second term is the contribution from changes in the capital-output ratio, and the third term is the contribution from changes in hours worked per

[4] If $\alpha=0.45$, for example, the before-tax rate of return on capital would average 23 % from 1960-2002. With $\alpha=0.30$, however, this rate is 15%.

[5] N_t is obtained by multiplying the population aged from 16 to 64 years by the number of hours available for work in the year, assuming 100 hours per week for 52 weeks. L_t corresponds to the number of people working in Chile for the average number of hours worked in Greater Santiago. This breakdown is based on Hayashi and Prescott (2002). The complete description of the data used and sources appears in Appendix 1.

person of working age. In the long term, the empirical evidence reveals that both the capital-output ratio and employment remain constant. In the short term, however, factor accumulation can be very important to growth.

Table 1 provides the breakdown described above of output per working age population – referred to, from now on, as per capita output – for the Chilean economy from 1980 to date –. These data reveal that for the past four years, unlike during the period of sustained growth from 1983 to 1998, employment has been the most relevant factor behind the level of economic activity.[6] This variable explains an average annual decline in per capita output of around 2.31%.[7] Per capita output, however, rose 0.63% per year on average during this period, due to the fact that TFP was 1.51%, with the capital-output ratio contributing 1.42% during this period. In previous years, however, TPF appears to have been the main determinant of growth.

Alternative calculations for the growth accounting shown in Table 2 confirm our main finding, namely, that during the last four years the drop in output per capita is mostly explained by a fall in the contribution of labor. This result is robust to different specification for capital and labor. In effect, if we use capital utilization instead of capital stock or number of workers instead of hours worked, our results remain qualitatively unchanged.

3. Deterministic Growth Model

In this section, we will use a simple deterministic version of the neoclassical growth model. This model considers a single good that is consumed or used in investment.

The representative household solves the following problem:

$$\begin{aligned} &max \sum_{t=1980}^{\infty} \beta^t \left[\gamma \log C_t + (1-\gamma)\log(N_t - L_t)\right] \\ &\text{s.a.} \quad C_t + K_{t+1} - K_t = (1-\tau_t^l) w_t L_t + (1-\tau_t^k)(r_t - \delta) K_t + T_t \end{aligned} \qquad (5)$$

[6] During the crisis in the early 1980s, employment and TFP account for similar percentage drops in per capita output.
[7] Note that we are using a logarithmic approximation for growth. This allows us to carry out an additive decomposition of growth factors.

where C_t is consumption, N_t - L_t is leisure, r_t is the real return on capital before taxes, w_t is the real wages, τ_t^l is the labor tax rate, τ_t^k is the tax on net capital minus depreciation and T_t is a transfer that the government pays the consumer. Moreover, $\beta \in (0,1)$ is the discount factor and δ is the depreciation rate.

The representative firm solves the problem:

$$\max \ \Pi_t = A_t K_t^{\alpha} L_t^{1-\alpha} - r_t K_t - w_t L_t \tag{6}$$

The government's problem is to balance its budget, that is,

$$T_t = \tau_t^l w_t L_t + \tau_t^k (r_t - \delta) K_t \tag{7}$$

Finally, the equilibrium requires market clearing:

$$C_t + K_{t+1} - (1-\delta) K_t = A_t K_t^{\alpha} L_t^{1-\alpha} = Y_t \tag{8}$$

The consumer problem is characterized by a condition requiring intertemporal optimization for consumption and an intratemporal consumer-leisure optimization condition represented, respectively, by the following equations:

$$\frac{c_{t+1}}{\beta c_t} = 1 + \left(1 - \tau_{t+1}^k\right)\left(r_{t+1} - \delta\right) \tag{9}$$

$$\frac{C_t (1-\gamma)}{\gamma} = w_t (1 - \tau_t^l)(N_t - L_t) \tag{10}$$

The problem of firms is characterized by conditions of equality between marginal productivity and factor prices,

$$r_t = \alpha A_t K_t^{\alpha-1} L_t^{1-\alpha} = \alpha \frac{Y_t}{K_t} \tag{11}$$

$$w_t = (1-\alpha) A_t K_t^{\alpha} L_t^{-\alpha} = (1-\alpha) \frac{Y_t}{L_t} \tag{12}$$

Equations (7)-(12) are necessary and sufficient to completely characterize the equilibrium. To simulate the model, we must parameterized our theoretical economy. The parametric specification used is given by $\beta = 0.98$, $\delta = 0.05$ and $\gamma = 0.28$. The discount factor and the depreciation rate have been specified using the values typically assigned in the literature. The parameter for labor disutility, γ, was calibrated according to equation (13), assuming zero labor tax and considering an average value for the 1960-1998 period consistent with data for consumption, employment and output. Therefore, this parameter implicitly includes distortions associated with the labor market. This parameter is consistent, moreover, with those reported by McGrattan (1994) for the United States and Bergoeing and Soto (2002) for Chile. In the next section, in order to evaluate the plausibility of an increase in distortions in the consumption-leisure decision, associated with the labor market policies, the labor tax for equation (13) is calibrated so as to replicate employment's behavior during the 1998-2002 period in Chile. The capital tax is calibrated in equation (14), given β and δ.

$$\gamma = \frac{C_{t+1}}{C_t + w_t\left(N_t - L_t\right)\left(1-\tau_t^l\right)} \tag{13}$$

$$\beta = \frac{C_t}{C_{t-1}\left(1+(1-\tau_t^k)\left(r_t-\delta\right)\right)} \tag{14}$$

Finally, note that in our model, C_t corresponds to total private and governmental consumption and exports.

4. Simulations

This section uses the growth model described above to analyze how relevant changes in factor prices resulting from distorting tax policies were in determining Chile's economic growth over recent years. To do so, we carry out five simulation exercises. Each consists of simulating the model from 1980 to infinity using actual values for TFP and different values for taxes, associated with unexpected reforms. Thus, we report the impacts of TFP, the capital-output ratio, and the employment-population of working age ratio on growth for the 1980-2002 period, in a manner consistent with the growth accounting breakdown presented in the previous section.[8] Specifically, the first simulation consists of solving the equilibrium incorporating a capital tax of 49%, for the entire period under analysis. The second simulation takes into consideration the income tax reforms implemented in Chile in the mid-1980s. This is simulated assuming that the capital tax falls from 49% to 18% starting in 1987.[9] These values have been calibrated for the periods 1960-1980 and 1987-2002, respectively, according to the consumption-investment decision implicit in the data, that is, using equation (14). By assuming that the decline in the capital tax rate is unexpected, the equilibrium for the first six years of the simulation remains unchanged. It is interesting to point out that income tax rates actually implemented in Chile consisted of reducing this tax from 45% to 10% in 1985 and than raising it to 15% in 1991. As a result, the capital tax rates calibrated from the data using equation (14), although they represent the set of distortions implicit in the consumption data, are surprisingly similar to the rates actually observed during this period.

The third exercise is perhaps the most interesting of all, for the purpose of this article: it assumes that the debate about changes to labor legislation that started in 1999 and the significant hike in the minimum wage increased the likelihood of labor becoming more expensive, which in the model is expressed as a hiring tax. This tax is calibrated so as to replicate the decline in employment's contribution to growth as observed in the previous four years and is maintained from then on.

Two final exercises consist of calibrating the capital tax and TFP for the 1998-2002 period respectively so as to replicate the observed decline in employment (and so assuming away the hiring tax of the third exercise).

Results indicate that:

(1) The simulation of an economy without capital tax reform significantly underestimates output growth from 1983 to 1998 and over-estimates it for the next four years. The main reason for this underestimation from 1983 to 1998 is that the drop in the capital-output ratio and employment is overestimated. During the past four years, however, the opposite occurs: the model

[8] From 2003 on, it is assumed that TFP grows at the same average rate as it did from 1960-2002.
[9] Although the reform started in 1985, it wasn't completely implemented until 1989.

underestimates the increase in capital and the drop in the fraction of total hours worked. The fall in employment is so dramatic that it ends up overestimating output growth by about 1.9% during this period.

(2) By incorporating the capital tax reform, results for the 1983-1998 period improve significantly. Now, capital falls almost as in the data and employment is underestimated by 0.7 percentage points less than before. However, for the 1998-2002 period the increase in output is overestimated, mainly because the model doesn't capture the fall observed in employment.

(3) Because of this, simulations 3 and 4 apply increases in taxes to employment and capital, respectively, to replicate the behavior observed in employment. These exercises seek to provide evidence of the plausibility of the hypothesis that higher production costs may be responsible for the lower growth observed in Chile in the recent past. These simulations demonstrate that a 6.17% (up from zero) labor tax or a 35,2% (up from 18%) capital tax can produce this effect. The second tax, however, while it does provide a closer approximation of output's performance, it does so at the cost of worsening the overall prediction. In particular, the unreformed model from 1999 overestimates the fall in the capital contribution, so that with a higher capital tax the model simulation worsens even more.

(4) Finally, we simulate our economy imposing a TFP during the 1998-2002 period as to replicate the observed fall in employment. The rationale for this exercise is that TFP may be missmeasured due to unobserved shocks to the economy. This simulation shows that a fall in TFP as the one considered generates a deep fall in output per capita, similar to that observed in 1981-1983, while the data show that, although slightly, output per worker actually increased during the period.

So, in the end, the labor tax option appears to be the most plausible explanation for what has occurred in Chile in recent years. This labor tax could be the result of higher hiring costs perceived by economic agents, as a result of both the large increase in the minimum wage between 1998 and 2000 and the debate surrounding labor reforms[10]. By raising the relative price of labor, this perception was apparently enough to generate a significant drop in short-term growth in Chile.[11] In 1992, labor markets had also being reformed in Chile, mostly by raising the cost of firing, as the number of monthly wages required to be paid to a fired worker were increased. Labor did not fall, however, as it did during the last four years. The macroeconomic scenario, however, was dramatically different, as the economy was growing at a much faster rate and capital inflows were booming.

We have modeled the higher cost of labor hiring as a result of several labor market distortions associated with the observed debate on the labor code and actual increases in minimum wages occurred in Chile during the 1999-2002 period. Our simulations incorporate the higher cost of labor fully as in 1999 however. Next, we show that if we simulate this policy distortion as perceived to happen some periods into the future, the needed increases in the cost of labor to replicate the observed fall in employment are smaller. Table 4 shows the required tax to replicate the observed fall in employment when agents expect in 1999 that the labor code reform is implemented at different periods in the future. This simulation is intended to capture the timing of the discussion generated in Chile during the period and the uncertainty with respect to the period in which the authority would implement the labor reform. Our results show, however, that the further away in the future the labor reform is expected, the lower is the labor tax required to match the fall in employment. In a dynamic general equilibrium model with no frictions, agents substitute intertemporally to optimize. Since the reform is expected to start being binding in the future, firms decide to temporally increase their hiring of labor until their labor costs effectively increases.

Figure 1 shows the equilibrium paths of employment for alternative scenarios with respect to the date when the reform is expected to be fully in place. The thin continuous line reflects the actual data for the proportion of hours worked between 1998 and 2002, while the thick line indicates the simulated path in the economy without labor taxes. The remaining lines show the employment paths calibrated for labor reforms implemented at alternative dates in the future. The figure shows that if the reform is expected to be binding in the future, the simulated economies with the required taxes, although matching the average fall in employment for the period, generate a reduction

[10] The effect of the minimum wage on the employment fall in 1999 and 2000 is also documented in Cowan et. al (2003) using a very different approach.

[11] Beyer (2001) finds that the expected cost of lay-off associated with the new labor structure would rise by about 16%.

in employment that occurs later that it actually occurred. Moreover, and consistent with Table 4, the further away the reform is expected the lower is the required increase in the cost of labor needed to match the fall in employment.

These results crucially depend on the assumption of fully flexibility of labor markets until the reform is effectively implemented. Another possibility is that labor markets have frictions – as a result of firing costs, for instance – so that even though the reform is expected several years in the future, the fall in employment is observed in the present. This possibility is not considered here since our simulations shown in Table 3, where the reform is assumed to be expected immediately and markets are fully flexible, generate the same equilibrium than the one obtained in an economy with reforms expected in the future but rigidities binding in the present.

The model used simplifies reality in several dimensions, one of which is potentially relevant to our analysis. By using a closed economy for our model, we do not explicitly take into account the effect of changes in the terms of trade or other external variables that may be relevant in the case of a small, open economy like Chile's. These variables, however, mainly affect what is referred to here as TFP, that is, the residual that remains after considering the accumulation of labor and capital (i.e., al other input factors).[12] What the data for the past four years show, however, is that the decline in employment, rather than TFP, was the dominant element behind trends in per capita output. Moreover, our exercises include actual TFP, thus capturing the impact of the terms of trade on output. In this context, the relationship between growth and employment is not dependent on the assumption of a closed economy. Finally, the last simulation shown in Table 3 indicates that generating the observed fall in employment assuming as the only source of declining a fall in TFP, induces changes in output per capita and capital to output that are inconsistent with the observed patterns. The model simulates a fall in either variable while the data show that both of them increased.

[12] In Appendix 3 we demonstrate that in our closed economy model fluctuations in the terms of trade are captured by the TFP parameter, A_t. As a matter of fact, by comparing 1983-1998 with the past three years, we see that contribution of TFP to per capita growth fell by almost 50%. This fall is undoubtedly the result, among other factors, of the lower terms of trade apparent since 1998.

5. Conclusions

This study suggests that the decline in economic activity in Chile during recent years may have been the result of the greater cost of hiring labor perceived by economic agents, here simulated as a labor tax of 6.17%. An interpretation of this result is that the perception of a higher cost of hiring was due to a combination of both the substantive increase in the minimum wage between 1998 and 2000 and the debate surrounding the labor code reform that started in 1999. The final bill passed in Congress in October 2001 did include provisions that actually increase the cost of hiring.

Although to establish a connection between the recently observed fall in employment in Chile and the perception of an increase in the hiring cost of labor needs to be analyzed further, this study shows that small expected changes in relatives input prices may generate large substitution of inputs used, causing a detriment in short-term economic growth. If the expected increases in input prices remain in time, the fall in economic activity may end up reducing long-run growth.

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Appendix 1: Description and data sources

For the 1981-2002 period: The source for the Gross Domestic Product series was the Central Bank of Chile. The investment series used came from gross capital formation and inventory changes in the International Monetary Fund's International Financial Statistics. Capital was generated using the investment series corrected for the assumed depreciation rate. The working age population corresponds to people from 16 to 64 years of age, as reported by the World Development Indicator. Employment series are from the National Statistics Bureau (INE). Finally, total hours worked were calculated using employment per average hours worked in urban Santiago, according to results from the employment and unemployment survey carried out by the University of Chile's economics department.

For the 1998-2002 robustness simulations in Table 2: we use employment from INE and capital utilization form the Central Bank of Chile.

Appendix 2: Alternative Simulation

Table 54 provides the results of growth accounting for the data and for each of the five simulation exercises presented in Table 3, assuming α = 0.45. Simulations were carried out using β = 0.98, δ = 0.05 and γ = 0.33. Capital tax rates, calibrated in equation (14), were in this case τ_t^k = 0.71 until 1986 and τ_t^k = 0.53 from 1987 on. The labor tax that replicates employment's contribution (fall) in the past three years is τ_t^l = 0.0469.

As with the previous case, simulations 1 and 2, that is, those without tax reforms, considerably underestimate growth in output per adult of working age during the period of sustained growth and overestimate this output during the period beginning in 1998. The capital tax reform that began in 1987 allows us to replicate the factor accumulation process observed in the data with greater accuracy. Finally, the labor tax rate necessary to replicate actual employment trends from 1998-2002 is almost equal to the result of the simulation exercise reported in Table 1.

From the qualitative point of view, therefore, the results reported in Table 5 do not differ from those presented in Table 3. The sole difference lies in the relevance of capital and TFP in each case. Nonetheless, and as mentioned above, α=0.45 isn't just implausible from the empirical perspective according to Gollin (2002), but moreover suggests an annual before-tax return on capital averaging 23% from 1960-2002. This rate of return is too high.

Appendix 3: Terms of trade and TFP in a closed economy growth accounting.

Assume a small open economy that produces two types of goods: exportable and importable. The aggregate production function in terms on importable goods would be:

$$Y_t = A_t^M KM_t^{a_M} LM_t^{1-a_M} + P_t^X A_t^X KX_t^{a_X} LX_t^{1-a_X} \qquad (15)$$

where KM_t and LM_t are employment and capital in the importable sector while KX_t and LX_t are the same for the exportable sector. P_t^X is the exportable – importable relative price (terms of trade) which is exogenously determined since the economy is assumed to be small. To calculate TFP as in equation (2) , that is, assuming that there is only one good, the actual production function is given by equation (15). Thus, we obtain:

$$A_t = \frac{Y_t}{K_t^a L_t^{1-a}} = \frac{A_t^M KM_t^{a_M} LM_t^{1-a_{;M}}}{K_t^a L_t^{1-a}} + \frac{P_t^X A_t^X KX_t^{a_T} LX_t^{1-a_X}}{K_t^a L_t^{1-a}} \qquad (16)$$

where $K_t = KM_t + KX_t$ is aggregate capital stock measured in terms of the importable good and $L_t = LM_t + LX_t$ is total employment expressed in hours of work. Then, equation (16) can be presented as:

$$A_t = A_t^M w_t^M + A_t^X w_t^X P_t^X \qquad (17)$$

where $w_t^M = \frac{KM_t^{a_M} LM_t^{1-a_M}}{K_t^a L_t^{1-a}}$ and $w_t^X = \frac{KX_t^{a_X} LX_t^{1-a_X}}{K_t^a L_t^{1-a}}$

Equation (17) shows that the changes in TFP estimated under this assumption does not only include the actual changes in the productivity level in the economy (given by A_t^M and $A_t^{X)}$, but also: (a) the efficiency gains or losses due to input reallocations (measured by w_t^M and w_t^X); and (b) the changes in terms of trade.

Table 1
Growth Accounting in Chile

Period	Change in Y/N	Contribution from PTF	Contribution from K/Y	Contribution from L/N
1981-1983	-10.93	-7.81	5.26	-8.38
1983-1998	4.76	3.36	-0.34	1.73
1998-2002	0.63	1.51	1.42	-2.31

Table 2
Growth Accounting in Chile 1998-2002: Robustness to Alternative Measures

Period	Change in Y/N	Contribution from PTF	Contribution from K/Y	Contribution from L/N
Base case	0.63	1.51	1.42	-2.31
Number of people	0.63	1.04	1.06	-1.61
Capital utilization and number of people	0.63	1.29	0.81	-1.61

Table 3
Growth accounting in Chile: Simulations with $\alpha = 0.30$

		Data	Simulation 1 Base case	Simulation 2 Only capital tax reform (1987)	Simulation 3 Capital and labor reform	Simulation 4 Two capital tax reforms	Simulation 5 TFP
81-83	Change in Y/N	-10.94	-9.20	-9.20	-9.20	-9.20	-9.20
	Due to TFP	*-7.81*	*-7.81*	*-7.81*	*-7.81*	*-7.81*	*-7.81*
	Due to K/Y	5.25	5.60	5.60	5.60	5.60	5.60
	Due to L/N	-8.38	-6.98	-6.98	-6.98	-6.98	-6.98
83-98	Change in Y/N	4.76	2.80	4.05	4.05	4.05	4.05
	Due to TFP	*3.36*	*3.36*	*3.36*	*3.36*	*3.36*	*3.36*
	Due to K/Y	-0.34	-1.12	-0.33	-0.33	-0.33	-0.33
	Due to L/N	1.73	0.56	1.02	1.02	1.02	1.02
98-02	Change in Y/N	0.63	2.53	1.81	0.74	0.20	-6.72
	Due to TFP	*1.51*	*1.51*	*1.51*	*1.51*	*1.51*	*-8.02*
	Due to K/Y	1.42	1.11	1.28	1.54	0.99	3.60
	Due to L/N	-2.31	-0.72	-0.98	-2.31	-2.31	-2.31

Notes: Simulation 1, our base case, considers a capital tax and no reforms. Simulation 2 includes a capital tax reform reducing it to 18% as of 1987. Simulation 3 adds to simulation 2 a labor tax of 6.17% as of 1999. Simulation 4 adds to simulation 2 a capital tax increase to 35.16% as of 1999. Finally, simulation 5 replicates the exercise in simulation but imposing a TFP during the 1998-2002 period as to replicate the observed fall in employment. The annual fall in TFP that replicates the observed fall in employment is 5.6%.

Table 4

Future Taxes and Labor Fall: 1998-2002 (%)

	Reform in 1999	**Reform in 2000**	**Reform in 2001**	**Reform in 2002**
Tax	6.17	5.80	5.58	5.21

Table 5
Growth accounting in Chile: Simulations with $\alpha = 0.45$

		Data	Simulation 1 Base case	Simulation 2 Only capital tax reform (1987)	Simulation 3 Capital and labor reform	Simulation 4 Two capital tax reforms	Simulation 5 TFP
81-83	Change in Y/N	-10.94	-10.15	-10.15	-10.15	-10.15	-10.15
	Due to TFP	*-12.58*	*-12.58*	*-12.58*	*-12.58*	*-12.58*	*-12.58*
	Due to K/Y	10.03	10.20	10.20	10.20	10.20	10.20
	Due to L/N	-8.38	-7.76	-7.76	-7.76	-7.76	-7.76
83-98	Change in Y/N	4.76	2.08	3.86	3.86	3.86	3.86
	Due to TFP	*3.66*	*3.66*	*3.66*	*3.66*	*3.66*	*3.66*
	Due to K/Y	-0.64	-2.19	-0.99	-0.99	-0.99	-0.99
	Due to L/N	1.73	0.60	1.18	1.18	1.18	1.18
98-02	Change in Y/N	0.63	1.12	1.46	0.80	0.26	-8.02
	Due to TFP	*0.22*	*0.22*	*0.22*	*0.22*	*0.22*	*-13.60*
	Due to K/Y	2.71	1.66	2.53	2.88	2.34	7.90
	Due to L/N	-2.31	-1.04	-1.29	-2.31	-2.31	-2.31

Notes: Simulation 1, our base case, considers a capital tax and no reforms. Simulation 2 includes a capital tax reform reducing it to 53% as of 1987. Simulation 3 adds to simulation 2 a labor tax of 4.69% as of 1999. Simulation 4 adds to simulation 2 a capital tax increase to 60.35% as of 1999. Finally, simulation 5 replicates the exercise in simulation 4 but imposing a TFP during the 1998-2002 period as to replicate the observed fall in employment.

Figure 1
Future Taxes and Labor Fall: 1998-2002