Abstract

The per capita growth rate of Chile from 1984 to 1997 was among the highest in the world. During the last three years however, per capita growth dropped significantly. This paper discusses the role of factor accumulation and factor productivity growth within a simple neoclassical growth model framework to explain the evolution of output in Chile for the past 20 years, including the decline in the rate of growth. In contrast to the experience of the 1980s and early 1990s, in the last three years the driving force has not been total factor productivity growth (or the lack thereof), but a severe fall in employment. This fall, in turn, could be due to a higher hiring cost of labor associated with labor code reform, which was debated during the 1999-2001 period. Using a calibrated dynamic general equilibrium model we conclude that a 6.75% tax on labor hiring replicates the observed fall in employment.

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1 The authors are grateful for the efficient assistance of Facundo Piguilen. This paper was finished while Morandé was a Visiting Fellow at CREDPR, Stanford University, during the Winter Quarter of 2002.
1. Introduction

From 1984 until a couple of years ago, the Chilean economy was growing at a rate of 5.4% per capita, placing it among the world’s most successful economies in the past twenty years. The growth can undoubtedly be attributed to the liberally oriented structural reforms that took place during the 1970s and 1980s, and continued into the early 1990s. At first, however, this path was far from easy. In fact, the substantial growth since 1984 began with a profound crisis in the early 1980s that led to an accumulated decline in per capita output of around 20% for 1982-1983. Chile then grew steadily, and in 1990 it had recovered to its trend level. In the years that followed, the growth rate held steadily at around 6%, bringing output per capita 30% higher than its 1980 trend level by 1998.

In the past three years, however, the growth of the Chilean economy has dropped. From 1998 to 2001, the per capita growth rate averaged around 1.2% per year. Different hypotheses have arisen to explain this period of stagnant growth. In particular, analysts speak of external factors associated with the decline in the terms of trade and reduced access to external capital flows. The recent recession affecting the world economy (which further deteriorated after the September 11th terrorist attack) has also 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 adopted by the Central Bank since mid-1998 to mitigate the impact of the Asian crisis emerging 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 expansive monetary approach applied for several quarters till now.

Meanwhile, others have argued that the country’s difficulties in achieving growth rates of the past decade go beyond the explanations of a normal business cycle. Moreover, they suggest that recent results reveal a decline in the Chilean economy’s potential to grow at more than 4% annually. Furthermore, the economy has proven unable to create new jobs at rates comparable to those for output. Both phenomena – stagnant growth and little job creation – have coincided not only with a complex external environment for emerging economies but also with a range of policy proposals affecting production, some of which already implemented in the form of legal reforms. Among these, the so-called “labor reform” stands out. Discussions began in the political arena during the presidential election in late 1999 and it took almost two years of parliamentary debate before the law was finally passed in October 2001. This debate concluded that the reform would raise the cost of hiring labor. Earlier, towards the end of 2000, reforms to reduce tax evasion were 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, which should reduce investment and capital costs in the future.

This article focuses on the third of these hypotheses, that is, the decline in growth and problems with job creation are linked to changing production costs, mainly higher labor costs. With Bergoeing et al. (2002) as our starting point, we analyze the role of factor accumulation and efficiency in utilization during the past 20 years in Chile to understand output trends in the context of a simple neoclassical growth model. The analysis suggests that during the crisis in the early 1980s and the subsequent recovery and growth phase through 1998, the efficiency of factor utilization was the main determining factor of economic activity. In addition, the past three years, the fall in employment has been the main element behind declining growth.

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

3 For the purposes of this study we will use output per population of working age to analyze growth processes in the Chilean economy and the 2% annual rate as trend. Output per population of working age, that is, population from 16 to 64 years of age, is the appropriate indicator for per capita output in the context of the neoclassical growth model used in this study. Finally, the 2% rate used as a proxy for trend growth corresponds to average annual growth in this variable from 1960-2001 in Chile.
2. Growth Accounting

In the context of the neoclassical model, slower growth can be due to a decline in labor factor accumulation, or changes in implicit or explicit taxes that make labor more expensive to hire and affect the relative prices of production factors. Evidence in Kehoe and Prescott (2002) shows that most crises during the 20th century were the consequence of falling efficiency of factor utilization 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, trends in activity levels have resulted fundamentally from changes in employment.

To determine the contribution of factor accumulation and how efficiently the factors are used to the changes in output per working age population, we break down the changes in the latter by changes in total factor productivity (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,

\[ Y_t = A_t K_t^\alpha L_t^{1-\alpha} \]  

(1)

where \( Y_t \) is output, \( K_t \) is capital, \( L_t \) total hours worked and \( A_t \) total factor productivity. In this context,

\[ A_t = \frac{Y_t}{K_t^\alpha L_t^{1-\alpha}} \]  

(2)

Labor and output series are directly available from national accounts. To obtain \( A_t \), however, we must choose a value for the capital share in output, \( \alpha \), 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 \( 1-\alpha \), 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 \( \alpha \) 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 and their families are underestimated, labor’s contribution rises significantly, converging to 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. In any case, and as the sensitivity exercise that appears in Appendix 2 shows, the results of this study would not be substantially different if we assumed that \( \alpha \) 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 three 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:

\[ \log\left(\frac{Y_t}{N_t}\right) = \frac{1}{1-\alpha} \log A_t + \frac{\alpha}{1-\alpha} \log\left(\frac{K_t}{Y_t}\right) + \log\left(\frac{L_t}{N_t}\right) \]  

(3)

\(^4\) If \( \alpha = 0.45 \), for example, the before-tax rate of return on capital would average 23% from 1960-2001. With \( \alpha = 0.30 \), however, this rate is 15%.
where \( L_t / N_t \) is the number of hours available for work per person of working age. 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:

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

(4)

The first term on the right hand side of the equation represents TFP’s contribution 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 person of working age. In the long run, empirical evidence reveals that both the capital-output ratio and employment remain constant. In the short run, however, factor accumulation can be very important for 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 three 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. This variable explains an average annual decline in per capita output of around 2.8%. Per capita output, however, rose 0.85% per year on average during this period, due to the fact that total factor productivity growth was 2.07%, with the capital-output ratio contributing 1.57% during this period. In previous years, however, TPF appears to have been the main determinant of growth. As mentioned above, consistent with the situation observed in Chile, Kehoe and Prescott (2002) provide evidence that during the 20th century, most major depressions were explained by the decline in either the efficiency of factor utilization or total hours worked.

Table 1
Growth Accounting in Chile

<table>
<thead>
<tr>
<th>Period</th>
<th>Change in Y/N</th>
<th>Contribution from PTF</th>
<th>Contribution from K/Y</th>
<th>Contribution from L/N</th>
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<tbody>
<tr>
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<td>1998-2001</td>
<td>0.85</td>
<td>2.07</td>
<td>1.57</td>
<td>-2.79</td>
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</table>

3. Deterministic Growth Model

In this section, we will use a 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:

\[ 5 \text{ N}_t \text{ 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 \text{ 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.}

\[ 6 \text{ During the crisis in the early 1980s, employment and total factor productivity account for similar percentage drops in per capita output.}

\[ 7 \text{ Note that we are using a logarithmic approximation for growth. This allows us to carry out an additive decomposition of growth factors.} \]
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, \( \tau^l_t \) is the labor tax rate, \( \tau^k_t \) 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 \( \delta \) is the depreciation rate.

The representative firm solves the problem:

\[
\max \Pi_t = A_t K_t^{\alpha} L_t^{1-\alpha} - r_t K_t - w_t L_t
\]  

(6)

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

\[
T_t = r^l_t w_t L_t + \tau^k_t (r_t - \delta) K_t
\]  

(7)

Finally, the equilibrium requires market clearing:

\[
C_t + K_{t+1} - (1 - \delta) K_t = A_t K_t^{\alpha} L_t^{1-\alpha} = Y_t
\]  

(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:

\[
\frac{c_{t+1}}{Bc_t} = 1 + \left(1 - \tau^k_{t+1} \right)(L_{t+1} - \delta)
\]  

(9)

\[
\frac{C_t(1-\gamma)}{\gamma} = w_t (1 - \tau^l_t)(N_t - L_t)
\]  

(10)

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

\[
r_t = \alpha A_t K_t^{\alpha-1} L_t^{1-\alpha} = \frac{Y_t}{K_t}
\]  

(11)

\[
w_t = (1-\alpha) A_t K_t^{\alpha} L_t^{-\alpha} = \frac{(1-\alpha) Y_t}{L_t}
\]  

(12)

Equations (7)-(12) are necessary and sufficient to completely characterize the equilibrium. To simulate the model, we must provide the required parameters. 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, \( \gamma \), was calibrated according to equation (13), assuming zero labor tax and considering an average value for the 1960-1988 period consistent with data for consumption, employment and output. Therefore this parameter also 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 et al. (2001) 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 reform, the labor tax for equation (13) is calibrated so as to replicate employment’s behavior during the 1998-2001 period in Chile. Finally, the capital tax is calibrated in equation (14), given $\beta$ and $\delta$.

$$\gamma = \frac{C_{t+1}}{C_t + w_t(N_t - L_t)(1 - \tau_t^I)}$$  \hspace{1cm} (13)

$$\beta = \frac{C_t}{C_{t-1} \left[1 + \left(1 - \tau_t^I \right)(\tau_t^I - \delta) \right]}$$  \hspace{1cm} (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 the relevance of changes in factor prices resulting from distorting tax policies were to determining Chile’s economic growth over the past three years. To do so, we carry out five simulation exercises. Each consists of simulating the model from 1980 to infinity using actual values for total factor productivity and different values for taxes, associated with unexpected reforms. Thus, we report the impact of total factor productivity, the capital-output ratio, and the employment-population-of-working-age ratio on growth for the 1980-2001 period, in a manner consistent with the breakdown presented in the previous section.

Specifically, the first simulation exercise consists of solving for an equilibrium in the absence of taxes. The second simulation incorporates a capital tax of 49%, for the entire period under analysis. The third simulation takes into consideration the income tax reforms implemented in Chile in the mid-1980s. This is simulated assuming the capital tax falls from 49% to 15% starting in 1987. These values have been calibrated for the periods 1960-1980 and 1987-2001, respectively, according to the consumption-investment decision implicit in the data using equation (14). By assuming that the decline in the capital tax rate is unexpected, the equilibrium for the first six years of 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 fourth exercise is perhaps the most interesting for the purpose of this article: it assumes that the debate about changes to labor legislation that started in 1999 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 three years and is maintained from then on. A final exercise consists of calibrating the capital tax for the 1998-2001 period so as to replicate the observed decline in employment.

Results indicate that: (1) the taxless model and the unreformed capital tax model significantly underestimate output growth from 1983 to 1998 and over-estimate it for the next three years. The main reason for this underestimation from 1983 to 1998 is that the drop in the capital-output ratio and

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8 From 2002 on, it is assumed that total factor productivity grows at the same average rate as it did from 1960-2001.
9 Although the reform started in 1985, it wasn’t completely implemented until 1989.
employment is overestimated. During the past three years, however, the opposite occurs: the model underestimates the increase in capital and the drop in the fraction of total hours worked. The drop in employment is so dramatic that it ends up overestimating output growth by about 1.6% during this period; (2) by incorporating the capital tax reform, results for the 1983-1998 period improve significantly. Now, capital falls by almost the same amount as the data and employment is underestimated by 40% less than before. However, for the 1998-2001 period the increase in output is overestimated, mainly because the model doesn’t capture the fall observed in employment. Because of this, exercises 4 and 5 apply increases in employment and capital taxes, respectively, to replicate the behavior observed in employment. These exercises support the hypothesis that higher production costs may be responsible for the lower growth observed in Chile during the past three years. These simulations demonstrate that a 6.75% (up from zero) labor tax or a 32.6% (up from 15%) capital tax can produce this effect. The second tax, however, while it does provide a closer approximation of output’s performance 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 the higher capital tax worsens the model simulation even more in this regard. Because of this, the labor tax appears to be the most probable 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 the debate concerning labor reforms. By raising the relative price of labor, this perception, while it may be mistaken in practice, is enough to generate a significant drop in short-term growth in Chile.10

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
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</table>

Notes: Model 1 corresponds to the economy without taxes presented in section two of this study. Model 2 introduces a fixed 49% capital tax. Model 3 includes a capital tax reform reducing it to 15% as of 1987. Model 4 adds to Model 3 a labor tax of 6.75% as of 1999. Finally, model 5 adds to Model 3 a capital tax increase to 32.6% as of 1999.

The figures at the end of the text show annual trends affecting the elements resulting from the breakdown of output in our data and simulations using a fixed capital tax, tax reforms in 1987, and a labor tax as of 1999 for the whole period under analysis.

The model 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 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 “total factor productivity”, that is, the residual that remains after considering the accumulation of labor and

10 Beyer (2001) finds that the expected cost of lay-off associated with the new labor structure would rise by about 16%.
What the data for the past three years show, however, is that the decline in employment, rather than total factor productivity, was the dominant element behind trends in per capital 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.

5. Conclusions

This study suggests that the decline in economic activity in Chile during the past three years may have been the result of the hiring expenses of labor perceived by economic agents as a result of a proposed labor code reform and the debate surrounding it. This reform was finally approved by Congress in October of 2001. In our model, the increased cost of hiring can be approximated using a higher labor tax of 6.75% promulgated as of 1999. This, however, does not mean that the labor reform actually made hiring labor more expensive. Whether or not this is true could only be determined through a specific study of the reform itself.

Therefore, the main conclusion of this study is that such institutional changes as new rules and regulations can seriously affect short-term economic growth, through changes in the relative prices of production factors. If these changes persist, they may eventually affect long-term economic trends.

References


\[11\] Mendoza (1995) demonstrates that in a neoclassical model using a closed economy, such as the one used in this study, fluctuations in the terms of trade are captured by the total factor productivity parameter, $A$. If fact, by comparing 1983-1998 with the past three years, we see that TFP’s contribution 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.
Appendix 1: Description and data sources

The Gross Domestic Product series were obtained from 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 all series used, figures for 2001 came from actual third quarter figures and a linear interpolation for the fourth quarter.
Appendix 2: Alternative Simulation

Table 3 provides the results of growth accounting for the data and for each of the five simulation exercises presented in Table 2, assuming $\alpha = 0.45$. Simulations were carried out using $\beta = 0.98$, $\delta = 0.05$ and $\gamma = 0.33$. Capital tax rates, calibrated in equation (14), were in this case $\tau_k^t = 0.72$ until 1986 and $\tau_k^t = 0.51$ from 1987 on. The labor tax that replicates employment’s contribution (fall) in the past three years is $\tau_l^t = 0.0665$. Finally, the capital tax that replicates employment’s contribution during this period is $\tau_k^t = 0.605$.

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 1998-2001 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 3 do not differ from those presented in Table 2. The sole difference lies in the relevance of capital and total factor productivity in each case. Nonetheless, and as mentioned above, $\alpha=0.45$ isn’t just implausible from the empirical perspective according to Gollin (2001), but moreover suggests an annual before-tax return on capital averaging 23% from 1960-2001. This rate of return is too high.

Table 3
Growth accounting in Chile: Simulations with $\alpha = 0.45$

<table>
<thead>
<tr>
<th></th>
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<td>0.62</td>
<td>0.50</td>
<td>1.12</td>
<td>1.12</td>
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</tr>
<tr>
<td>98-01</td>
<td></td>
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<td></td>
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<tr>
<td>Change in Y/N</td>
<td>0.85</td>
<td>1.36</td>
<td>1.47</td>
<td>2.26</td>
<td>1.15</td>
<td>0.47</td>
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<tr>
<td>Due to PTF</td>
<td>0.64</td>
<td>0.64</td>
<td>0.64</td>
<td>0.64</td>
<td>0.64</td>
<td>0.64</td>
</tr>
<tr>
<td>Due to K/Y</td>
<td>3.00</td>
<td>1.62</td>
<td>1.63</td>
<td>2.63</td>
<td>3.30</td>
<td>2.61</td>
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<tr>
<td>Due to L/N</td>
<td>-2.79</td>
<td>-0.92</td>
<td>-0.81</td>
<td>-1.01</td>
<td>-2.79</td>
<td>-2.79</td>
</tr>
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</table>

Notes: Model 1 corresponds to the economy presented in Section 2 of this study, without taxes. Model 2 incorporates a fixed capital tax of 71%. Model 3 includes a capital tax reform reducing it to 51% in 1987. Model 4 adds a 6.6% labor tax to Model 3 as of 1999. Finally, Model 5 adds to Model 3 a 60.5% reform to the capital tax as of 1999.
Figures: