The Chilean pension reform: A model to follow?

Rodrigo A. Cerda

Economics Department, Pontificia Universidad Católica de Chile,
Vicuña Mackenna 4860, Macul, Santiago, Chile

Received 1 March 2006; received in revised form 1 September 2006; accepted 1 December 2006
Available online 30 March 2007

Abstract

One of the major economic reforms in the Chilean economy was the 1981 pension reform. In that year, Chile transformed its Pay-as-you-go social (PAYG) security system to an individual account social security system (IA). This paper discusses the impacts of the social security reform. To do so, we construct a counterfactual scenario of the Chilean economy under the PAYG system using simulations methods and we compare it with the effective data occurred under the IA system. We discuss the fiscal impacts, plus pension coverage on the elderly and the PAYG system’s macroeconomics impacts by comparing them with the actual evolution of the Chilean economy under the IA system. Our simulations show significant fiscal deficits in the PAYG plus relatively lower pension coverage and modest benefits compare to the IA system. Finally, we show that the pension reform might have had significant macroeconomic impacts.

© 2007 Society for Policy Modeling. Published by Elsevier Inc. All rights reserved.

JEL classification: C6; E6; H5; P5

Keywords: Social security reform; Chile

1. Introduction

The Chilean social security system faced a radical transformation in 1981. Since 1925–1981, the Chilean social security system was a Pay-as-you-go (PAYG) system. In 1981, the PAYG system was replaced by an individual account system (IA). In the latter system, individuals save a constant fraction of their labor income in an individual account managed by private firms, which invest and accumulate these funds until retirement, when these funds are used as source of retirement income (pensions).
The impacts of this pension reform on different sectors of the Chilean economy have been extensively studied. For instance, among other studies, Hachette (1998) studied the impacts on savings rate while Edwards and Cox-Edwards (2002) studied the impact on the labor market. Corbo and Schmidt-Hebbel (2003) studied the effects on macroeconomics variables.

However, it has not been compared the situation of the Chilean economy and its pension system in the actual IA system vis-à-vis the situation if the social security reform would not have been implemented. If this comparison is possible, there might be interesting policy discussions and potential recommendations to be made. In one hand, we may compare the fiscal situation under both regimes. In fact, note that one of the main reasons of the 1981 social security reform was the expected negative impact of the demographic transition on the financial situation of the PAYG system which would be expected to cause significant fiscal deficits in the near future. The implementation of the alternative IA system effectively produces these fiscal deficits to disappear in the long run. However, the reform required substantial transition costs related to recognition bonds the Chilean government must issue to individuals that had already contributed to the PAYG system but switched to the IA system. Those bonds are paid upon retirement and therefore the transition cost subsists until all the individuals that had contributed to the PAYG system retire. Therefore, from the Chilean experience one of the discussions that can be made is the one concerning the comparison between the permanent financial situation of the PAYG system vis-à-vis the transition costs of transforming the social security system towards an IA based system.

There are two other dimensions that might be interesting to analyze. In one hand, the analysis may allow us to compare the observed pension benefits on the IA system with the projected benefits of the PAYG system. This would give us an idea of the welfare of the elderly under both social security systems. This is of course a highly relevant question: Are individuals better off by reforming the social security system? Finally, we may also evaluate the macroeconomics impacts of the social security reform. The literature has stressed the potential negative impacts of the PAYG system on capital stock accumulation and the macroeconomics variables. The comparison would allow us to provide estimates or to discard these potential impacts.

There is a large literature on the impacts of social security on the economy since the seminal contribution of Feldstein (1974). There are both empirical and computing applications of dynamic general equilibrium models in this line of research. Our paper is related to the second line of research which initial contributions are Kotlikoff (1979) and Auerbach and Kotlikoff (1987). These papers, dynamic general equilibrium models applied to the US economy, confirmed Feldstein’s ideas related to the negative impact of the PAYG system on national savings and therefore on long run capital stock. Hubbard and Judd (1987) analyze the impact of capital market imperfections while Arrau and Schmidt-Hebbel (1993) analyze the macroeconomic impact of a transition from PAYG to fully funded social security scheme. Similarly, other topics such as the importance of demographics, earning uncertainty, the political economy of the transition and the use of a negative income tax are discussed on Cooley and Soares (1999a, 1999b), De Jager, Graafland, and Gelauff (1996), Fougere and Merette (2000, Chap. 11), Hubbard, Skinner, and Zeldes (1994a, 1994b, 1995), Huggett and Ventura (1999), Imrohoroglu, Imrohoroglu, and Joines (1995, 1999), Kotlikoff (1996), Kotlikoff, Smetters, and Walliser (1998a, 1998b, 1999), Naudé and Coetzee

---

1 Schiller (2005) provides a similar exercise for the US. However, that paper emphasizes the risk management of the portfolio of individual accounts over the life-cycle while in our paper we emphasize the macroeconomics impacts of PAYG system and its welfare implications.
(2004) and others. This paper differs vis-à-vis the rest of the literature because we allow for a large informal sector which is a characteristic of developing economies such as Chile.

In this paper, we use simulation methods to obtain a contra-factual of the Chilean economy after 1981 if there has been no social security reform. Using these simulations, plus the effective data of the Chilean economy under the IA system, we compare both scenarios in the lines we sketched above.

This paper has the following sections. Section 2 describes the situation and the main characteristics of the old PAYG social security system before the 1981 pension reform. Section 3 describes the model used to simulate the pension system and the evolution of the Chilean economy in absence of the 1981 reform. Section 4 is the main section of the document. It presents the main results of the simulation. Finally, Section 5 discusses the policy implications and concludes.


Since the end of the 19th century, improvements on economic opportunities in the Chilean urban centers produced a large migration towards cities. In cities, socioeconomic conditions of migrants – sanitary conditions, housing, health services – were poor, which provoked in 1924 the approval of the first social security law by the Chilean congress. The social security law was focused on health coverage and retirement income coverage.

Since the beginning of the social security system, there were differences on benefits between blue collar and white collar workers. As a result, there were different public institutions providing social security benefits. One of the most important institutions was the “Social security administration” (SSA), which accounted for almost 65% of workers in 1979 and was composed mainly by blue collar workers. Since its creation in 1924 until the 1981 social security reform, the PAYG system increased considerably the number of retired individuals receiving social security benefits: at the beginning of the 1980s was almost 1.2 million, and this number grew at a 5% rate. Large part of this increased of social security benefit’s receivers was due to the increase on the SSA, which accounted for almost half of the receivers in 1981.

Since 1952, there were introduced considerable reforms on the PAYG social security system. Most of them consisted on increasing or creating benefits such as maternity subsidy or increases on retirement income. Those elements, more beneficiaries and larger benefits per-capita, are key to understand the evolution of the social security payroll tax rate. In 1924, the payroll tax rate was 5% of labor income. However, social security payroll tax rates increased considerably over time. In fact, the payroll tax rate charged by the SSA reached approximately 30% in 1952 and was larger than 40% on the 1960s and closed to 50% on the 1970s.

Therefore, there was an increased on the number of people receiving benefits and on per capita benefits, which were financed by means of large increases on the social security payroll tax rate. Further, there was an increasing trend on expenditure on pensions (measured as fraction of GDP): expenditure on pensions measured as fraction of total revenue grew from almost 52% in 1975 to 70% in 1981. Similarly, this variable measured as fraction of total expenditure (which included other social expenditures such as health) rose from 45% to 55% in that period.

As a result on the increasing trend on social security expenditure, the Chilean PAYG system suffered a partial parametric reform in 1979 which was aimed to alleviate the fiscal burden. The parametric reform consisted basically on:

---

2 For a good discussion on this topic see Arellano (1985) and Cheyre (1988).
(a) Increasing retirement age to 65 years in the case of men and 60 years old in the case of women.
(b) Reduction of the payroll tax rate, to almost half of its 1977 by the beginning of the 80s (see Wagner, 1983, Vol. I, p. 32, note 4).

In fact, before 1979 a large part of individuals affiliated to the PAYG system could retire and receive social security pensions if they had contributed to the system for 35 years. This characteristic produced that individuals entering to the labor force at age 20 could retire at age 55 and receive benefits during a large part of their life. Hence, increasing retirement age decrease considerably fiscal expenditure. In another hand, the decrease on the PAYG social security payroll tax rate was implemented due to two reasons. Firstly, the PAYG system had so large payroll tax rates that there was considerably evasion on the system. Hence, the implementation of lower payroll tax rates should alleviate the evasion’s problem. Secondly, the radical pension reform involving the privatization of the Chilean social security system would occur in 1981. However, some individuals could choose to remain on the old PAYG system if they were already affiliated to the PAYG system at the moment of the 1981 reform. If they choose to switch to the IA system, social security payroll tax should around 17% (including contribution for obligatory health insurance). Hence, the decrease on the PAYG social security payroll tax rate also aimed to decrease the distortion on social security tax rates between social security systems.

In summary, the PAYG social security system had an explosive financial evolution since 1924 due to the decisions of the political authorities – as increments of per capita benefits – but also to the large increase on the number of beneficiaries of the system. By the beginning of the 1980s, there was some evidence of large increase of expenditure on pensions, which probably could continue to rise over time. As a result, the Chilean government introduced initially a partial parametric reform to the PAYG social security system in 1979 and later introduced a radical reform, in which the PAYG system was replaced by an obligatory individual account system for the individuals entering the labor force after 1981 and voluntary for individuals affiliated to the PAYG system before 1981.

3. The simulation model

3.1. General description of the model

We will next present the simulation model to be used on this paper. The aim of the simulation model is to project the evolution of the Chilean economy and the pension coverage if the 1981 social security reform would have not occurred. The results of this exercise will allow us latter to compare these simulations with the effective data observed under the individual account system.

In this simulation model, we use the demographic and economic conditions of the Chilean economy since 1950. In the model, every year a new cohort of individuals is born. Each cohort has an associated life-expectancy. For instance, the cohort born in 1980 has a size of 235,000 individuals – adjusted by infant mortality rate – and an associated life expectancy of 75 years.

4 The new IA system has been obligatory for individuals entering the labor force since 1981. However, individuals working in 1981 had the choice between remaining in the old PAYG system or switching to the new IA system. Individuals could switch at any time after 1981, but they could switch just once between systems. Thus, if an individual enrolled in the PAYG system in 1981 chose to switch to the IA system, they could not go back to the old one. Almost 75% of individuals enrolled in the PAYG system in 1981 switched to the new system immediately when the law was enacted.
In this period, there is a large change on demographic conditions. In fact, cohort’s size was approximately 150,000 by 1950 and reached almost 300,000 by 1990. Thereafter, cohort’s size decreases considerably reaching 250,000 by 2000. Similarly, life expectancy was approximately 61 years old by 1950 and reach almost 79 years old by 2000. See Díaz, Luders, and Wagner (in press) and Comisión Económica para América Latina and el Caribe (2001).

Each cohort is decomposed in 10 groups differing on their human capital endowment. Given the human capital endowment, each group solves a problem to determine optimal consumption, savings and labor supply paths. If individuals decide to work, they pay the social security tax rate. Once their age is equal to the retirement age, they may retire and obtain social security benefits (pensions) if they satisfy some requirements established by the social security law.

We will suppose that each year is born a new cohort of individuals, who must decide how much to work, save and consume. Labor income depends on human capital. We will assume that in each cohort there are born 10 human capital groups. Human capital in the \( s \)th cohort will be denoted as \( e^i_s \), \( i = 1, \ldots, 10 \), where we will assume \( e^1_s < e^2_s < \ldots < e^{10}_s \).

Eq. (1) is the utility function of individual born on year “s”. Those individuals have life expectancy \( T_s \), and retire at age \( R \), where \( R < T_s \). Utility between \( s \) and \( s + R - 1 \) depends on consumption \( (c_t) \) and leisure \( (h_t) \) while between \( s + R \) and \( s + T_s \), the individual retires, and its time endowment, \( \bar{H} \), is allocated to leisure. Therefore, an individual utility function is:

\[
\begin{align*}
\sum_{t=s}^{s+R-1} \beta^t (\gamma \ln c_t + (1 - \gamma) \ln h_t) + \sum_{t=R}^{s+T_s} \beta^t (\gamma \ln c_t + (1 - \gamma) \ln \bar{H})
\end{align*}
\]  

where \( \beta < 1 \) is a discount factor. Consumption and leisure decision are restricted by the following budget constraints:

\[
A_{t+1} + b_{t+1} = (1 + r_t)A_t + (1 + i_t)b_t + \max[w_t e^i_t (1 - \tau_t)(\bar{H} - h_t); w^R_t (\bar{H} - h_t)] - c_t, \quad \forall t \leq R
\]  

\[
A_{t+1} + b_{t+1} = (1 + r_t)A_t + (1 + i_t)A_t + \Phi_t - c_t, \quad \forall t > R
\]

where \( A_{t+1} \) are private financial assets to be carried over to \( t + 1 \), while \( (1 + r_t)A_t \) is financial assets return in \( t \). Also \( b_t \) are government issued bonds held by households, which pays a return \( i_t \), and \( b_{t+1} \) denotes savings on government bonds. Before retirement age, individuals also obtain labor income. There are two options: in one hand, individuals could go to the formal sector and work \( (\bar{H} - h_t) \). In that case, their after tax labor income is \( w_t (1 - \tau_t)(\bar{H} - h_t) e^i_t \), where \( w_t \) is the wage rate per effective hour of labor provided, and \( \tau_t \) is the payroll social security tax. In another hand, there is an alternative occupation which provides \( w^R_t \) as effective wage rate. This wage rate can be rationalized as the opportunity cost of staying at home or working in an informal sector providing this exogenous return. In that case, individuals do not pay the social security tax rate. Eq. (3) is the budget constraint after retirement. In that case, individuals do not receive labor income, but benefits from the social security system which are denoted as \( \Phi_t \).

Finally, we will describe the social security benefits to be received upon retirement in the PAYG social security system. After 1979,\(^5\) people do not receive pension by antiquity but upon a fix retirement age (65 years old for men and 60 years old for women). In that case, pensions are

\(^5\) see http://www.inp.cl/inicio/benmefici_menu_excajas.php.
set according to the following rule:

\[
\Phi_{is}^{t} = \begin{cases} 
0 & \text{if years contributed } < 10 \\
\max \left\{ 0.7^{s+R-1} \sum_{t=s+R-6}^{s+R-1} w_i e^i_s (1 - \tau_i) (\bar{H} - h_i) / 5; \Phi_{t}^{\text{MIN}} \right\} & \text{if years contributed } \geq 10 
\end{cases}
\]  

(4)

There is a representative firm endowed with production function with constant return to scale on capital, \(k_t\), and labor \(N_t\). The production function has a technology level, \(Z_t\), which is subject to exogenous shocks. The technology of the representative firm is:

\[
Y_t = Z_t (k_t)^\alpha (N_t)^{1-\alpha} 
\]  

(5)

The firm chooses optimally capital and labor. Further, those production inputs have the following prices \(r_t, y\). The government collects revenue from current working generations and pays contributions to retired individuals, that have satisfy the requirements to obtain social security benefits. Fiscal deficits are financed by issuing bonds, \(b_t\), that pay the interest rate \(i_t\). Therefore, the government has the following budget constraint:

\[
b_{t+1} + \tau_t \sum_s \sum_i w_i (H - h_{is}^t) e^i_s = \sum_s \sum_i \Phi_{is}^t + (1 + i_t) b_t 
\]  

(6)

Finally, there are three markets that must be cleared as follows:

\[
\sum_s \sum_i (\bar{H} - h_{is}^t) = N_t 
\]  

(7)

\[
b_t + \sum_s \sum_i A_{is}^t = k_t 
\]  

(8)

\[
\sum_s \sum_i (c_{is}^t + i_{is}^t) = Y_t 
\]  

(9)

Adding up the labor supply and assets of each cohort we get total supply in the labor and capital market. These quantities supplied are demanded by firms. The prices in this economy are the result of the interaction between supply and demand, such that the net excess demand in each market is zero.

To solve the equilibrium of this economy and provide the simulations of our interest, we use the Guass-Jacobi algorithm (see Judd, 1998, pp. 540–545). We start with an initial sequence of prices (wages and rental rates) for the whole time horizon we look to solve. In our case, the time horizon will be 1950–2050. Given the price sequences, individuals must solve their problems which allow us to calculate their optimal sequences of consumption, labor supply and financial asset allocations. The sum of these optimal decisions provides total labor supply, total asset supply and consumption demand. Similarly, given the same sequence of prices, the representative firm solves its problem and determines its demand for capital and labor.

Once solved the firm and the household problems, we verify if total supply coincides with total demand in each market. If there is an excess of demand, we proceed to increase prices while there is excess of supply, we proceed to decrease the associated relative price in that market. With the new prices, household and firm problems are solved and we recheck the excess demand and excess supply conditions. We proceed in this fashion until market clears. To solve the algorithm, we use the software Matlab 6.5.
3.2. Calibration

Data concerning cohort size were obtained from Díaz et al. (in press). The data on cohort size corresponds to size of the cohort born in each year adjusted by neonatal mortality. These data are available until 2005. From 2006 onwards, we assume a 1.2% growth rate on the cohort size. Life expectancy data correspond to data obtained from the demographic yearbook of the Comisión Económica para América Latina and el Caribe (2001). From 2005 onwards, we assume that life expectancy growth at its historical growth rate until converging to 85 years old.

Following Bergoeing and Morandé (2002) and Cerda and Vergara (in press), we proceed to set $\beta = 0.98$, and $\gamma = 0.28$. The capital share in the firm’s production function, $\alpha$, was set at 0.4. The technology level $Z_t$, was estimated from national accounts using the Solow residual approach. After 2005, we assume a 1.9% growth rate on $Z_t$, which is similar to the growth rate of $Z_t$ in the 1990s (see Bergoeing & Morandé, 2002).

To calibrate the parameters concerning human capital, we proceed to use labor income as a proxy of human capital and we estimate the following Mincer equations, using data from the 1998 Casen survey (survey of socioeconomic characteristics realized every 2–3 years by the Chilean government since 1985). Using these cross sectional data, we estimated:

$$\ln(y_{id}^d) = \beta_0 + \beta_1^d \text{age}_i + \beta_2^d \text{age}^2_i + u_i \quad d = 1, \ldots, 10$$

where $y_{id}^d$ is labor income of the $i$th individual on the $d$th decile. Also following Bernstein, Larraín, and Pino (2005), the parameter $w_t^R$, was set such that 30% of the economically active population contribute to the social security system (this is approximately 55% of the labor force). This is consistent with the evidence reported on Arellano (1985) that indicates that “contributors to the system represented a small proportion of the labor force: 61% in 1974 and 47% in 1980”.6

The social security payroll tax rate corresponds to the payroll tax rate reported by Arellano (1985). However, there are two factors to consider. Firstly, Wagner (1983) showed that only a 66% of these revenues corresponded to pensions, while the rest was related to others benefits. Secondly, as Coeymans (1980) showed, the evasion tax on the system was considerable. Similar evidence provided Wagner (1983). Hence, we set tax evasion on 30%.7 We proceed to adjust the payroll tax rate by both factors.

The minimum pension (the pension an affiliated will receive if she retires and satisfies the requirements to obtain social security benefits, but her calculated pension is smaller than the minimum pension) is set at 80% of the minimum wage.8 According to the CASEN survey,9 minimum wage is obtained by people in the 6th income decile, therefore we set minimum pension as an 80% of labor income of that group. Following BLP (2005), we will assume that the minimum pension follows the average wage growth rate. Finally, the payroll tax rate after 1981 is set at 19% (which is similar to the 18.8% of the SSA). We will fix retirement age at 63 years old.10

---

7 This is an average value of Wagner (1983) and Coeymans (1980).
8 Concerning minimum pensions, see http://www.inp.cl/inicio/menu_montos.php.
9 Cross sectional survey on socioeconomic characteristics of the Chilean individuals.
10 Average retirement age between women and men.
4. The evolution of the Chilean economy in the PAYG social security system

4.1. The financial situation of the PAYG system

Columns 1 and 2 of Table 1 show the projected evolution of PAYG revenues and expenditures between 1960 and 2050 in absence of the 1979 parametric reform. As it can be seen on the table, revenues as fraction of GDP stabilize around 8% of GDP. This is not surprising since labor income as fraction of GDP is approximately 60%, while the payroll tax rate is around 20%. Therefore, if we consider tax evasion, we get the reported figure which remains stable over time—labor share of income is stable in a Cobb-Douglas production function. The simulations also show that pension benefits as fraction of GDP were smaller than revenues until the end of the 1970s, which coincides with the evidence reported in Section 2. Further, by the end of the 20th century, pension benefits as fraction of GDP fluctuates but remains relatively stable. However since 2000, those expenditures grew considerably reaching almost 12% of GDP in 2020. The increase in pension benefits, here measured, coincides with the retirement of cohorts with larger size and larger life expectancy. Column 3 of Table 1 shows the evolution fiscal deficits that fluctuate between 4% and 8% of GDP since 2015. The present value of these deficits is a 20% of GDP in 1981 (assuming an arbitrary 5% interest rate). Therefore, demographic transition produces an explosive impact on the financial sustainability of the PAYG system.

Columns 4–6 of Table 1 show the evolution of the same variables, if we assume as scenario the 1979 parametric reform. In this case, fiscal expenditures are considerably lower before 2020 due to setting the retirement age later on the individuals’ lifecycle. Further fiscal deficits are a major problem since 2025. In this case, the present value of fiscal deficits is near 9% of GDP in 1981 (using again an arbitrary 5% interest rate).

Columns 7–10 of Table 1 present the effective fiscal costs occurred since 1981 to finance the transition from the PAYG system to the individual account system. There are at least three sources of fiscal expenditure that produce the transition costs. Firstly, the government must continue paying benefits to individuals already retired in 1981 (column 7 of Table 1). Secondly, the government pays a recognition bond to individuals retiring in the IA system if they had contributed to the old PAYG system but switched to the IA system. The recognition bond consists basically in paying back contributions to individuals that switched to the individual account system but contributed to the old PAYG system (column 9 of Table 1). Finally, the government finance minimum pensions to individuals that would obtain otherwise very low pension benefits upon retirement but satisfy requisites established by law. These minimum pensions are paid to individuals in both the PAYG and the IA system (column 8 of Table 1).

Comparing both financial situations (PAYG vis-à-vis IA system), we may conclude that in both cases the fiscal burden is considerable. In one hand, due to demographic transition, the PAYG system would have face complicated financial situation in the long run while concerning the near future, the 1979 parametric reform would have been enough to alleviate the financial situation of the PAYG system. In the case of the implementation of the reform that replaced the PAYG system by the IA system, the evolution of the deficits is the converse: initially large (almost reaching 5% of GDP) but decreasing over time.

In summary, both the 1981 social security reform and the PAYG social security would have produced a large fiscal burden. In the case of the PAYG system, the fiscal deficits appear later

---

11 This subsection relates to the literature on projections of fiscal expenditures on social security, see Warshawsky (1999).
Table 1
Expenditure and revenues on the PAYG system and annual fiscal cost of the 1981 social security reform, % GDP

<table>
<thead>
<tr>
<th>Year</th>
<th>PAYG, no parametric reform</th>
<th>PAYG, 1979 parametric reform</th>
<th>Transition costs to IA system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Revenue (%GDP)</td>
<td>Expenditure (%GDP)</td>
<td>Superavit (%GDP)</td>
</tr>
<tr>
<td>1981</td>
<td>6.8</td>
<td>5.7</td>
<td>1.1</td>
</tr>
<tr>
<td>1995</td>
<td>6.8</td>
<td>5.9</td>
<td>0.9</td>
</tr>
<tr>
<td>1996</td>
<td>6.8</td>
<td>5.9</td>
<td>0.9</td>
</tr>
<tr>
<td>1997</td>
<td>6.8</td>
<td>5.9</td>
<td>0.9</td>
</tr>
<tr>
<td>1998</td>
<td>6.8</td>
<td>6.2</td>
<td>0.6</td>
</tr>
<tr>
<td>1999</td>
<td>6.8</td>
<td>6.6</td>
<td>0.2</td>
</tr>
<tr>
<td>2000</td>
<td>6.8</td>
<td>6.9</td>
<td>−0.1</td>
</tr>
<tr>
<td>2005</td>
<td>6.8</td>
<td>8.6</td>
<td>−1.9</td>
</tr>
<tr>
<td>2010</td>
<td>6.8</td>
<td>9.1</td>
<td>−2.3</td>
</tr>
<tr>
<td>2015</td>
<td>6.8</td>
<td>11.5</td>
<td>−4.7</td>
</tr>
<tr>
<td>2020</td>
<td>6.8</td>
<td>12.1</td>
<td>−5.3</td>
</tr>
<tr>
<td>2025</td>
<td>7.2</td>
<td>12.8</td>
<td>−5.6</td>
</tr>
<tr>
<td>2030</td>
<td>7.4</td>
<td>13.4</td>
<td>−6.0</td>
</tr>
<tr>
<td>2035</td>
<td>7.6</td>
<td>13.8</td>
<td>−6.1</td>
</tr>
<tr>
<td>2040</td>
<td>7.1</td>
<td>10.6</td>
<td>−3.4</td>
</tr>
<tr>
<td>2050</td>
<td>7.1</td>
<td>14.2</td>
<td>−7.1</td>
</tr>
</tbody>
</table>

Source: Mesa-Lago (2000) and Arenas de Mesa (1999). Data from 1981 to 1999 correspond to effective. Since 2000, it corresponds to projected data. This table excludes expenditure on pensions corresponding to army forces.
but they are larger while the 1981 transformation of the social security system had significant transition costs. Therefore, whatever would have been the social security system chosen in 1981, the fiscal burden was considerably large. This is a consequence of the irruption of the demographic transition which causes the deficit in the PAYG system. However, if we decide to switch to the IA system to avoid those deficits, we must consider that some of the individuals have already contributed to the PAYG system and the government must recognize this implicit debt. Also, there are some individuals that remain in the old PAYG system (many of them are already retired in that system) and these are transition costs that disappear only when those cohorts die. Therefore, whatever is the final decision (switching to an IA system of reforming the PAYG system) there are considerably fiscal costs involve.

4.2. Pension benefits and pension coverage

In this subsection, we center the analysis on pension coverage in the old PAYG system and later we will compare the results with the effective pension coverage on the individual account system. We will define pension coverage as the ratio of number of individuals receiving pension benefits over total number of eligible individuals. When we analyze the case of the 1979 parametric reform, eligible individuals are individuals aged 60 years old in the case of women and 65 years old in the case of men. When we analyze, the case with no parametric reform, people can retire early. In that case, we define the set of eligible individuals as individuals aged 55 years old or more.13

Fig. 1 shows the evolution of pension coverage. In both cases, with parametric reform and with no parametric reform, the evolution of pension coverage on the PAYG system is quite similar. Between 1970 and 1990, it is quite stable at 30%: since the end of the 1990s it rises reaching almost 40% due to the increase in real wages occurred during the 1990s (see Table 2 below) which provides more incentives to contribute to the system: this characteristics allows a larger fraction of individuals to satisfy the requirement concerning the minimum number of months contributed to the PAYG and therefore allows a larger fraction of individuals to obtain pensions upon retirement. Pension coverage finally stabilizes around 35% by the end of 2030.14

The levels of pension coverage here reported are not surprising as there is almost 30% of the population economically active that is contributing to the PAYG system. Hence, the fraction of people that satisfy requirements to obtain pensions upon retirement is around this 30%.

Note that these figures concerning pension coverage are smaller than current pension coverage on the individual account system. In fact, according to the CASEN 2003, almost 42% of individuals aged 60 years or older receive currently pension benefits.15 Further, almost 50% of affiliated to the IA system will obtain a pension equal to or larger than minimum pension in 2025.

Fig. 2 shows the fraction of individuals receiving a minimum pension on the old PAYG system. As it can be seen on the graph, a large fraction of individuals will receive a minimum pension on

---

12 The data reported in this subsection concerning the IA system corresponds to data reported on Bernstein, Larraín and Pino (2005).

13 We set 55 years old because individuals could start working at 20 years old. In that case, they could satisfy the requirements to retire at 55 years old (35 years of antiquity on the system).

14 Pension coverage is somewhat larger in the case with parametric reform because individuals are obliged to retire alter and therefore spend more time on the labor force allowing them to satisfy the requirements concerning contributions to obtain a pension.

15 The 42% of pension coverage includes individuals in the individual account system and individuals that never switched to the individual account system (remained on the old PAYG system). It does not include other benefits provided by the central government.
Fig. 1. Evolution of pension coverage on the PAYG system.

Fig. 2. Evolution of minimum pension coverage on the PAYG system.
Table 2
Relative prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Simulated (w/r)</th>
<th>Effective (w/r)</th>
<th>Difference (w/r) (%)</th>
<th>Simulated (W)</th>
<th>Effective (w)</th>
<th>Difference (w) (%)</th>
<th>Simulated (R) (%)</th>
<th>Effective (r) (%)</th>
<th>Difference (r) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>1.00</td>
<td>1.00</td>
<td>0.0</td>
<td>100</td>
<td>100</td>
<td>0.0</td>
<td>11.8</td>
<td>11.8</td>
<td>0.0</td>
</tr>
<tr>
<td>1986</td>
<td>0.99</td>
<td>0.97</td>
<td>2.0</td>
<td>102.11</td>
<td>100.76</td>
<td>1.3</td>
<td>13</td>
<td>13</td>
<td>0.1</td>
</tr>
<tr>
<td>1991</td>
<td>0.91</td>
<td>0.97</td>
<td>-5.8</td>
<td>119.61</td>
<td>118.49</td>
<td>0.9</td>
<td>18</td>
<td>16</td>
<td>2.0</td>
</tr>
<tr>
<td>1996</td>
<td>0.98</td>
<td>1.17</td>
<td>-15.7</td>
<td>148.29</td>
<td>155.88</td>
<td>-4.9</td>
<td>19</td>
<td>17</td>
<td>1.3</td>
</tr>
<tr>
<td>2001</td>
<td>1.31</td>
<td>1.49</td>
<td>-11.7</td>
<td>169.98</td>
<td>178.90</td>
<td>-5.0</td>
<td>15</td>
<td>15</td>
<td>0.0</td>
</tr>
<tr>
<td>2004</td>
<td>1.53</td>
<td>1.60</td>
<td>-4.8</td>
<td>184.88</td>
<td>189.52</td>
<td>-2.4</td>
<td>14</td>
<td>15</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

The variables w and r are calculated from the firms’ optimality conditions.
the PAYG system—larger than 50% until 2020 and 30% or more in the long run. This result holds in the case of the 1979 parametric reform and in the case of absence of this parametric reform. This result might initially seem surprising as individuals contributing to the system are generally individuals with labor income larger than minimum wage. However, we should note that pensions are set according to the last 5 years of an individual’s labor income. Due to the inverted U-shape of labor income, pensions are then set on the decreasing part of the labor income profile, which produce that a significant part of calculated pensions are smaller than the minimum pension set by law. These figures contrast with the fraction of affiliates receiving minimum pensions on the IA system which will be around 5% by 2025.

Fig. 3 shows the evolution of the replacement rate of the system. In the graph, replacement rate is defined as average pension over average labor income of individuals aged 50–60 years old. Both in the case of the 1979 parametric reform as in the case of absence of parametric reform, the PAYG system shows a replacement rate smaller than 40% until 2010. In the long run, in the case of absence of parametric reform replacement rate reaches 50% while in the case of the 1979 reform, it reaches almost 40%. These replacement rates mean modest pensions: in December 2004, labor income per individual aged 50–60 was approximately US$680 which implies average pensions between US$220 (32% replacement rate) and US$340 (50% replacement rate). The IA system currently presents marginally larger replacement rates reaching 41% by December 2004.

An alternative way of evaluating the level of pensions is to define the replacement ratio for each group of human capital. We proceed to calculate for each of the human capital group, a replacement ratio defined as the level of pension of the specific human capital group over labor income during the last 10 years before retirement. The evolution of the replacement ratio by human capital group is shown in Fig. 4. In this figure, the 10th decile corresponds to the group
with larger endowment of human capital while the 7th decile corresponds with the group with lower human capital among individuals receiving pensions. In the figure, we omit the rest of human capital groups as they have zero replacement ratios. From the figure, we can see that the 7th and 8th deciles have high replacement ratios (larger than 150% from 1980 to 2010), but these replacement ratios decrease over time reaching levels around 90%. By contrast, the 9th and 10th deciles have replacement rate much smaller, converging to 70%—the replacement rate of the 10th decile is always around 70%. Further, in the figure we omit the cases of six human capital groups with have zero replacement ratios. These are the groups with lower endowment of human capital. Those results are obviously consistent with the results on coverage stated above (35% of elderly receive social security benefits).

Note that accordingly to the pension determination formulae, the replacement rate should be around 70%, since pension benefits are set as the 70% of the last 5 years of labor income—hence, if the last 5 years of labor income are on average equal to the last 10 years of labor income, replacement ratio should be 70%. Therefore, the replacement ratios of the 9th and 10th deciles are not surprising. However, the 7th and 8th deciles show much larger replacement ratio because those lower income groups receive mainly the minimum pension, producing “inflated” replacement ratios. Further, notice that the lower replacement ratios of the 7th and 8th deciles over time are related to the decrease of fraction of people receiving minimum pensions.

Our results show a redistributive income pattern within the groups of individuals receiving pensions: lower income groups have larger replacement rates as they receive minimum pensions. It must be notice that income redistribution occurs within that groups but do not affect groups that do not satisfy the requirements to obtain social security benefits upon retirement. Those are the groups with lower human capital endowment and therefore, lower income over their lifecycles.\textsuperscript{16}

\textsuperscript{16} Note that we report two different but consistent results concerning replacement rate. In one hand, we report replacement rates between 32% and 50% when we define replacement rate as average pension over average labor income of individuals
Table 3
Summary of cumulated macroeconomics impacts

<table>
<thead>
<tr>
<th></th>
<th>No parametric reform</th>
<th>Parametric reform</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP, p.c., US$</td>
<td>US$ 730, −10%</td>
<td>US$ 521, −8%</td>
</tr>
<tr>
<td>Capital stock</td>
<td>−11.7%</td>
<td>−9.70%</td>
</tr>
<tr>
<td>Employment</td>
<td>−10.1%</td>
<td>−6.30%</td>
</tr>
</tbody>
</table>

4.2.1. Macroeconomics impacts

We next discuss the macroeconomics impacts of the 1981 pension reform. To do so, we compare the simulations under the PAYG system with the effective evolution of the economy. As above, we provide simulations of the evolution of the economy under the PAYG system assuming the parameters of 1979 partial reform and later, in absence of the parametric reform. The discussion concerns the impacts on the capital stock accumulation, labor market and GDP.

One of the major impacts is the lower physical stock accumulation. Our calculations indicate that the growth rate of capital stock decrease in approximately 0.4% per year between 1981 and 2004, which adds up to 9.7%. The lower capital stock accumulation occurs because the household savings rate decreases (similar effects can be found in Auerbach & Kotlikoff, 1987). The result is not surprising and it obeys to two different transmission channels. In one hand, future benefits in the PAYG system lower individuals savings rate, as in any lifecycle model. In another hand, as this is a general equilibrium model, lower capital stock accumulation impacts relative prices. In fact, real wage decreases while the real rental rises over time (see Table 2). Lower wage rates decrease saving rates of young individuals while the increase on the saving rates should produce a substitution effect towards larger saving rates. However, as the rental rate almost do not change by the end of the horizon, it is possible that changes on relative price also lower capital stock accumulation, through the effect of wage rates. Adding up, both channels produce lower capital stock in about 9.7%.

As shown in Table 2, real wages decrease in almost 2.4% by 2004. These lower wages rates are due to a lower labor demand. Further, this lower labor demand also produces lower employment rates. In fact, our calculations show 6.3% lower employment by 2004. This result is somewhat larger than the findings on Corbo and Schmidt-Hebbel (2003)—they found an impact between 1.3% and 3.7% on employment, while the impact on labor in the formal sector is between 3.2% and 7.6%. Similarly, the impacts on real wages are a little larger than the ones computed by Edwards and Cox-Edwards (2002) who reported an impact near 2% on the informal sector of the economy and lower on the aggregate economy.

Once obtained the impacts on employment and physical capital stock, it is possible to evaluate the impacts on GDP. Table 3 summarizes our results and reports also the results in the case of no parametric reform. In this last case, there is a larger impact on the capital market (since individuals obtains larger social security benefits over their lifecycle), which produces a larger impact on labor market and GDP. These results on GDP are similar to the results in Corbo and Schmidt-Hebbel (2003) who reported an impact of 0.5% per year.

Aged 50–60 years old while in another hand we report replacement rates by human capital groups ranging from zero to value larger than 150%. Both measures are consistent because the first type of measure represents population average while the second measure allows heterogeneity among human capital groups.

Employment and physical capital allow obtaining GDP using (9).

It should be noted that those authors also include an additional impact of the pension reform on total factor productivity.
5. Discussion

The study of the implications of the Chilean social security reform might be interesting to other countries evaluating the implementation of a social security reform due to some characteristics of the Chilean case. In one hand, Chile was one of the first countries implementing such a large social security reform in 1981. In another hand, the reform implemented in Chile is based on individual accounts which is the principal scheme used around the world to reform social security systems. Therefore, Chile is one of the first countries from which we might draw some policy lessons after a significant time period since its implementation and those lessons might of interest to a large number of countries evaluating to reform their system by switching towards an individual account system.

What do we learn from the Chilean experience? Our simulations indicate that the incipient demographic transition would have produced significant financial problem on the fiscal budget by the end of the 20th century and during the first half of the 21st century. Parametric reforms on the PAYG system would have retarded the financial crisis, but in that case the financial crisis would occur by 2020. In this context, a social security reform based on individual accounts might seem a way of resolving the financial crisis faced by the government. However, the Chilean experience shows that the fiscal costs incurred in the transition to the new individual account system are considerable. These costs transition occur because of (1) the pensions paid to individuals already retired at the time of the reform and (2) the recognitions bonds paid to individuals that switched to the IA system but contributed to the PAYG system during their lifecycle. Hence, fiscal costs related to social security systems when a demographic transition arises seem to be inevitable.

There are other differences between social security systems. In one hand, we have shown there are significant impacts on the economy performance in a 25 year horizon. Capital stock is substantially depressed impacting labor demand and output growth. These results, obtained in an environment with large human capital heterogeneity and informal labor markets, are in line with results obtained for developed economies, but what seems more interesting are the order of magnitude of the effects: negative impacts around $-10\%$ in the capital stock, on the range of $-10\%$ to $-6\%$ on the labor market and around $-8\%$ on output.

On another hand, there are significant differences on pensions between social security systems: pension benefits on the PAYG system are smaller than on the IA system. The reason is that benefits are paid based on the average 5 year labor income before retirement which coincides with the decreasing part of the labor income lifecycle profile. As a result, pensions are lower on the PAYG system and a large fraction of benefit recipients obtain the minimum pension set by law. Welfare of elderly individuals is therefore an issue when considering pension reform. Obviously, as the PAYG benefits are set in similar ways around the world, this is a conclusion that might be of interest to a large number of economies.

References


