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Abstract[*]

This paper constructs time series data on savings per type of agent for Chile during the period 1960-2012. It is found that the economy's average savings rate increased by 11 percentage points in the period 1985-2012 compared to 1960-1984, with particularly pronounced growth in corporate savings. The evidence suggests that this increase was driven largely by the following measures: i) pension reform that introduced mandatory savings and private sector management, ii) banking reform, iii) tax reform, iv) capital markets reform and v) privatizations.

JEL classifications: E21, N16
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1. Introduction

Funding is one of the main constraints on increasing investment in less developed economies. Most of these economies do not have full access to international capital markets and thus rely on their domestic savings capability. While evidence shows that saving rates are highly correlated with the level of per capita income, there might be policies that help increase domestic savings. Policies related to fiscal budget management, tax incentives to company savings and household savings are on the first line of possible policies to boost savings. However, the implementation of these policies might be offset by the agent's reaction. As a matter of fact, substitution effects across agents might be important, i.e., tax incentives may raise private savings while reducing fiscal savings or a pension fund reform that increases mandatory savings may replace voluntary savings, etc.

One of the main contributions of this paper is the construction of a time series data on savings per type of agent for Chile during the period 1960-2012. This updates previous studies by Bennett, Schmidt-Hebbel and Soto (1999), including changes in the methodology to adapt it to institutional changes. By using this new dataset, this paper illustrates the type of policies that could raise domestic savings in an emerging economy.

In the evolution of savings rates in Chile, two important facts require an explanation. First, the economy increased the average savings rate by 11 percentage points in the period 1985-2013 compared to 1960-1984 mainly due to a large change in the level (10 percentage points) of private savings, and an additional 1 percentage point from the public sector. While voluntary savings have been generally negative in Chile, they became even more negative after the 1981 pension reform that established a mandatory savings scheme. In addition, corporate savings increased significantly after the second half of 1980s. The replacement of voluntary savings by mandatory savings was established during the 1981 pension reform that changed from a pay-as-you-go system to an individually-funded system managed by the private sector and had an important effect on savings and investment (Corbo and Schmidt-Hebbel, 2003; Fuentes, 2013)

The boost in the savings rate took place in 1985, a time when the economy was coming out of the largest financial and sovereign debt crisis since the Great Depression, characterized by the bankruptcy of several financial institutions and the intervention of many others, no access to international capital markets and low future growth expectations. At that time, Chile was implementing many important institutional reforms such as the private pension fund system, the

capital markets reform (1986), the reform of the banking legislation (1984) and an important tax reform (1984) that lowered corporate tax rate and avoided double income taxation, significantly simplifying the tax regime. In addition, there was a large wave of privatizations. In the following 12-years (1986-1997) the economy experienced its highest sustained growth in history. These reforms and sustained growth scenario may have had effects on household savings (part of the increase of growth was transitory) and on corporate savings (probably due to the increase in the marginal productivity of capital).

The second fact to be explained is related to the change in composition of private savings. After several years of almost no corporate savings, this component became an important part of total savings, reaching an average of almost 10 percent of GNDI during the period 1986-2012. Several policies might have influenced the change in corporate savings, mainly the privatization process of the 1970s and 1980s of previously nationalized companies and changes to the tax system during the same period that provided incentives to corporate reinvestment.

Our results show that the 1984 tax reform, the boost in the marginal productivity of capital and the deepening of the financial market were the main drivers of the dramatic increase in corporate savings. In addition, both mandatory savings and the fiscal system positively contributed, though to a lesser extent than the tax reform and the deepening of the financial market. We also found that tax incentives for retained earnings explained the changes in the composition of private savings. In fact, before 1984, there was double income taxation from corporate profits, with a large total burden (49 percent). The tax reform changed this system to a full imputation tax system that lowered corporate tax on accrued profits and delayed personal tax due to the distribution of profits to stockholders. Moreover, personal income tax was applied when dividends were received. The reform also cut personal tax rates.

The paper proceeds as follows. Section 2 summarizes relevant literature to our case study. Section 3 describes a theoretical model that provides a setup to our empirical work. Section 4 focuses on methodological issues to build our macro saving data per institutional agent. Section 5 shows a glimpse of the data and documents the main facts related to our two questions. Section 6 presents the empirical analysis per type of agent using our macro data. In addition, we also include micro evidence on corporate savings due to their relevance in explaining the increase in savings since the mid-1980s. Using empirical evidence, Section 7 analyzes the policy implications of the results. Finally, Section 8 presents our conclusion.

2. Related Literature

Several studies attempt to analyze the determinants of private savings at the international level. Table 1 shows the results obtained in these studies, classifying them according to determinants following Loayza, Schmidt-Hebbel and Servén (2000) and Grigoli, Herman and Schmidt-Hebbel (2014). Edwards (1996) examines why saving ratios have been so uneven across countries, using panel data for 36 countries from 1970 to 1992. He found that the main determinants are i) per capita income growth, which is one of the most important determinants of both private and public savings; ii) an incomplete crowding-out effect from public to private savings; iii) a negative effect of government-managed social security systems on private savings, iv) a positive effect of financial development on private savings; and v) a negative correlation between foreign and domestic savings. Dayal-Gulathi and Thimann (1997) examine the empirical determinants of private savings for several economies in Southeast Asia and Latin America over the period 1975-1995. The results show that social security systems, macroeconomic stability and financial deepening have been important in accounting for differences in the behavior of private savings between the two regions. Using a panel of 150 countries for the period 1965-1994, Loayza, Schmidt-Hebbel and Servén (2000) find positive effects of income and macroeconomic stability on private savings, and negative effects of higher interest rates and larger private domestic credit flows. Also, they find a negative effect of the dependency ratio and a negative but incomplete compensation effect between public and private savings.

In relation to the pension system, Attanasio and Rohwedder (2003) and Attanasio and Brugiavini (2003) analyze the cases of the United Kingdom and the Italian reforms, respectively. They find a substitution effect between pension wealth and private savings.

In a recent study, Grigoli, Herman and Schmidt-Hebbel (2014), using a panel data for 165 countries from 1981 to 2012, find a positive effect of income and macroeconomic uncertainty on private savings, where uncertainty is associated with precautionary savings. In contrast, there was a negative effect on the dependency ratio and the real interest rate. Public savings had a negative but small effect on household savings, while corporate savings had a larger negative effect.

Table 1. Determinants of Private Savings Analyzed in International Empirical Studies

Variable Category	Specific Variable	Expected Sign	Empirical Findings
Income	Income level Income growth Transitory Income Terms of Trade	Ambiguous Ambiguous (+) (0 or +)	0 (5, 6, 13, 14) ; + (1, 2, 3, 4, 7, 16, 17); 0 or + (9) 0 (16); + (7, 9, 12, 14, 15, 17) 0 (7) 0 (14, 16, 17); + (2, 4, 6, 7, 12, 13)
Rate of return	Real interest rate	Ambiguous	- (7, 12); 0 (1, 3, 5, 6) ; + (2, 15, 17); 0 or + (16)
Uncertainty	Inflation, other measures of macroeconomic instability	(+)	- (4) ; 0 (1,2,3, 6, 12, 13, 16); + (7, 14, 17)
Domestic borrowing constraints	Private credit flows, broad money flows	(-)	- (7); + (3); + o - (15)
Foreign borrowing constrains	Current account deficit Foreign savings Capital flows restrictions	(-) (-) (+)	- (1, 2) - (14) 0 (7)
Financial depth	Bank credit stock Broad money stock	Ambiguous Ambiguous	- (5); 0 (7) 0 (7, 16); + (1, 3, 4, 13, 14)
Demographics	Old-age dependency Young-age dependency Urbanization	(-) (-) Ambiguous	- (2, 3, 4, 7, 12, 15, 16, 17) ; 0 (5, 6, 14) - (7, 15, 16); 0 (9) - (3, 16, 17)
Income distribution	Income concentration	Ambiguous	- (14); 0 (3, 9)
Fiscal Policy	Public sector saving Public sector budget balance Public consumption	(-) (-) Ambiguous	- (1, 3, 7, 12, 13, 16, 17) - (2, 5, 6, 8, 14) ; 0 (4) - (2, 6); 0 (8)
Pension System	Pay-as-you-go pension transfers to old Mandatory fully-funded pension system contributions	Ambiguous (+)	- (3, 4, 5, 10, 11) + (4)
Households and firms	Corporate saving effect on household saving	0 or (-)	- (16, 17)

Studies: 1. Corbo and Schmidt-Hebbel (1991); 2. Masson, Bayoumi and Samiei (1995); 3. Edwards (1996); 4. Dayal-Gulathi and Thimann (1997); 5. Bailliu and Reisen (1998); 6. Haque, Pesaran and Sharma (1996); 7. Loayza, Schimdt-Hebbel and Servén (2000); 8. López, Schimdt-Hebbel and Servén (2000); 9. Schimdt-Hebbel and Servén (2000); 10. Attanasio and Rohwedder (2003); 11. Attanasio and Brugiavini (2003); 12. De Serres and Pelgrin (2003); 13. Agénor and Aizenman (2004); 14. Gutiérrez (2007); 15. Horioka and Terada-Hagiwara (2012); 16. Bebczuk and Cavallo (2014); 17. Grigoli, Herman and Schmidt-Hebbel (2014).

Research on trends and determinants of national savings for Chile can be divided into macroeconomic and microeconomic approaches. The main studies for Chile are summarized in Table 2.

The first group of information related to Chile is a set of studies that built a "Chilean savings history." This is the case of Morandé (1998), Hachette (1998), Agosin, Crespi and Letelier (1997), Agosin (2001) and Bennett, Schmidt-Hebbel and Soto (1999). Agosin, Crespi and Letelier (1997) found a partial compensation effect between voluntary and mandatory household savings, between household and company savings, and between household and public savings. According to Morandé (1998), foreign savings were relevant for the evolution of private savings in the mid-1980s, while thereafter national savings were supported by domestic savings.

Hachette (1998) found evidence for the Life Cycle Theory and the Permanent Income Hypothesis while finding partial compensation between public and private savings. This group of studies also contributed to the creation of a new series on disaggregated savings. Hachette (1998) gathered quarterly data of private, public, voluntary and mandatory savings from 1974 to 1995. Agosin, Crespi and Letelier (1997) presented annual data from 1940 to 1995 for household, firm and public savings. Finally, Bennett, Schmidt-Hebbel and Soto (1999) built an even more disaggregated annual dataset on savings for private and public companies, government and households (voluntary and mandatory) from 1960 to 1997.

In an effort to build the "Chilean savings history," other investigations surfaced in a second wave of macroeconomic studies related to savings in Chile. Most of them were summarized in the 2001 book *Análisis empírico del ahorro en Chile* (Empirical Analysis of Savings in Chile), edited by Felipe Morandé and Rodrigo Vergara.

Bennett, Loayza and Schmidt-Hebbel (2001) discovered that the Ricardian Equivalence is partially discarded and that financial deepening growth is negatively correlated with private savings. The same study also found that a reduction in the corporate tax rate can increase private savings, while national per capita income and copper prices are positively related to public savings. On the other hand, using quarterly data, Vergara (2001) found that the 1990 tax reform that increased corporate taxes, among other tax hikes, had a negative impact on savings, and transitory income and interest rate have significant positive impacts on private and voluntary household savings. Finally, Agosin (2001) concluded that corporate savings accounted for the main part of the so-called Chilean "savings miracle."

Among microeconomic studies that focused on household savings, Butelmann and Gallego (2000 and 2001), using the Family Budget Survey, found that transitory income and age profiles had significant positive impacts on voluntary household savings, thus supporting the Life Cycle Theory and the Permanent Income Hypothesis. Also, education and access to credit seems to be important determinants explaining household savings behavior in Chile. Gallego, Morandé and Soto (2001) found a positive relation between household savings and the business cycle when consumption of durable goods is considered as saving.

The latest reports on Chile are aimed at assessing the macroeconomic effects of the pension system reform on the economy. Using annual data between 1960 and 2001, Corbo and Schmidt-Hebbel (2003), estimated that the domestic savings rate experienced an average

increase between 1981 and 2001 of 2.3 percent of GDP due to the pension system reform, where the old pay-as-you-go system managed by the government was replaced by a new system of individual contributions handled by private managers. In a more recent report, Fuentes (2013) found an average increase of 2.7 percent of GDP for domestic savings between 1981 and 2012 due to the pension reform.

A line of research related to corporate savings involves evidence of the relationship between taxation and investment for companies. There are two approaches in the literature on Chile: studies concerning the impact of corporate taxation on i) company investment and ii) capital stock. The first study in the first approach, Medina and Valdés (1998), used publicly owned company data and estimated the impact on the company's investment of taxation by using an empirical model that included a Tobin's q plus a measure related to company cash flow as explanatory variables. Their result showed that a larger corporate tax decreased the company's cash flow and consequently depressed the company's investment. Cerda and Larraín (2005) estimated a dynamic data panel using small companies' data from the manufacture industry from 1981 to 1996. They found that an increase in the corporate tax rate reduces the company's investment and the impact differed depending on the size, being larger for small and medium sized firms. Hsieh and Parker (2007) used data on small Chilean manufacturing companies and focused on the impact of the 1984 tax reform, which considerably decreased corporate tax at that time. They found that large part of the increase of investment since the mid-1980s was due to the tax reform. Cerda and Saravia (2009) revisited the evidence on small companies' data but included a correction for self-selection bias and found a large impact of corporate taxation on investment due to the intensive margin effect (investment in firms) and the extensive margin effect (firms exiting the market due to different factors but including larger corporate taxes). Vergara (2010) used both macro data and publicly held data and found consistent evidence with that of Hsieh and Parker (2007).

The second approach focuses on the long run impact on capital stock. Bustos, Engel and Galetovic (2004), using data on publicly held companies from 1985 to 1995, found no significant impact of taxes on capital stock. As a contrast, Cerda and Larraín (2010), using small companies' data, found a negative and significant impact, and Cerda and Llodrá (2015) revisited the evidence on publicly held firms and found an important negative impact on company investment.

Summarizing the main findings for Chile, both macro and microeconomic lines of research found empirical evidence to support the Life Cycle Theory and the Permanent Income Hypothesis. On the other hand, several macroeconomic studies have found a partial Ricardian Equivalence, estimating to less than one a compensatory effect between public and household savings, as well as a partial compensatory effect between company and household savings. In relation to taxes, there are studies that had estimated a negative impact of larger corporate taxes on company savings. Finally, the literature for Chile found a partial compensatory effect between mandatory and voluntary household savings, which implies that the pension system reform might have a positive impact on household savings. However, there was no study that focused on the reason why private savings increased or why the composition of savings in Chile shifted from households to companies as of the mid-1980s.

Table 2. Empirical Evidence for the Chilean Economy

Paper	Objective	Data and Methodology	Results
Agosin 1997	To analyze the determinants of the national savings increment exhibits in Chile between 1985 and 1997.	- National account annual data 1960-1995. - VAR and VECM	Companies and government were the agents that contributed to the national savings increment for this period. Households did nott present positive net savings for this period, even after the implementation of the pension system reform. However, mandatory savings did negatively impact households' voluntary savings. The compensation coefficients between household and public savings and between household and company savings are less than one.
Hachette 1998	To analyze Chilean private savings using a model based on the Life Cycle Theory and the Permanent Income Hypothesis.	Quarterly and annual data were constructed for the periods 1985-1995 and 1975– 995, respectively.	There is a partial compensation between voluntary and mandatory savings. Growth, financial increase and temporary income are important to stimulate private voluntary savings. Partial Ricardian Equivalence is found.
Morandé 1998	To analyze why national savings were so high between 1985 and 1995.	- National account annual data 1960-1995	Foreign saving was relevant for the evolution of private savings in the mid-1980s, while national savings were later supported by domestic savings.
Agosin 2001	To analyze the determinants for national savings in Chile.	- National account annual data 1940-1996 - VAR	Most of the increase in private savings since the mid-1980s is due to business savings. Household saving turns out to be a stationary variable with zero mean, and households do not seem to take the savings of firms into account when making their own saving decisions. Business saving is unaffected by public saving, but in the long run business saving and foreign saving seem to be perfect substitutes. In the long run, policies that stimulate investment are likely to lead to an increase in private savings, as well as policies aimed at increasing public savings.

Table 2., continued

Bennett, Loayza and Schmidt-Hebbel 2001	To analyze the determinants for savings in Chile by aggregate agents: households (voluntary), firms and government.	- National account annual data 1960-1997 - Pesaran (1997) and Pesaran and Shin (1997)	Partial Ricardian Equivalence is found (coef. 0.5). Financial deepening increase is negatively correlated with private saving. A decrease of the corporate tax rate can increase private saving. There is a compensation effect between household savings and company savings (coef. 0.5) and between voluntary household savings and mandatory savings (coef. 0.36 – 0.8). National per capita income and copper prices are positively related to public savings.
Butelmann and Gallego 2001	To analyze the determinants of voluntary household savings using microeconomic data.	Family Expenditure Survey data for two cross section period 1987 and 1996-1997.	Transitory income and age have significant positive impacts on voluntary household savings, providing evidence giving support for the Life Cycle Theory and the Permanent Income Hypothesis. Also, education and access to loans credit access seem to be determinants explaining household saving behavior in Chile.
Gallego, Morandé and Soto 2001	To analyze the relation between household savings and the business cycle using microeconomic data.	- Data from Gallego and Soto (2000) for the period 1977- 1999	There is a positive relation between household savings and the business cycle, when consumption of durable goods is considered as saving.
Vergara 2001	Determinants of private savings and voluntary private savings	- National account quarterly data 1988:1-2000:3 - OLS	Partial Ricardian Equivalence is found (coef. 0.7). Interest rate and transitory incomes have significant positive impacts on private and voluntary private savings. The tax reform implemented in 1990 had a negative impact on saving.
Corbo and Schmidtt-Hebbel 2003	To analyze the macroeconomic effects of the pension system reform on the Chilean economy.	- Annual data for the period 1960-2001.	The domestic saving rate had an average increase between 1981 and 2001 of 2.3 percent of GDP due to the pension system reform, while investment increased by 1.2 percent of GDP.
Fuentes 2013	To assess the effect of the pension reform on the long-term macroeconomic balance of the Chilean economy.	- Annual data 1960-2012.	For domestic savings, an average increase of 2.7 percent of GDP between 1981 and 2012 is estimated due to the pension reform.

3. The Model Economy

In order to model savings, and its different components, we set up a production agent model where individuals determine their consumption profile and savings composition by choosing whether they will save via companies (by increasing their capital stock) or via the capital market using financial assets. The former represents corporate savings, while the latter is household savings. We also allow for mandatory savings at the household level (to mimic the Chilean pension legislation) and introduce the government in order to include tax distortions and government savings.

Generally, it is assumed that decisions at company level are separate from consumer decisions. In that setup, companies maximize the present value of cash flows to their owners

(Jorgenson, 1963) and thus the path of the stream of dividends is chosen by the company instead of their owners. In our setup, we modify this interpretation by allowing owners to choose the amount and the timing of dividends. We do so as this setup allows the company owner to choose their savings instruments, either through real assets in the company or through financial assets in the capital market.

3.1 Corporate Income, Dividend Payments and Corporate Savings

The company has available strictly increasing, concave and continuously differentiable production $Y(k_t, l_t)$ where k_t is capital and l_t is labor. Capital is accumulated within the firm and follows the usual law of motion $k_{t+1} = (1-\delta)k_t + I_t$, where I_t is investment and δ is the depreciation rate. The firm pays corporate taxes at rate τ_t^c. The tax base is the value of sales minus wage payments. The remaining cash flow might be withdrawn from the firm as dividends, d_t , or it can be reinvested. The relative price of investment is p_t^I. Therefore dividend payments can be written as:

$$d_t = (1-\tau_t^c)(Y(k_t, l_t) - w_t l_t) - p_t^I(k_{t+1} - (1-\delta)k_t) \quad (1)$$

Corporate savings, S_t^c, are defined as non-distributed cash flow. Hence they represent corporate investment as in:

$$S_t^c = (1-\tau_t^c)(Y(k_t, l_t) - w_t l_t) - d_t = p_t^I I_t \quad (2)$$

3.2 Government

The government collects tax revenues to finance an exogenously given path of government expenditure denoted by the sequence $\{g_t\}_{t=0}^{\infty}$. Tax revenues are collected through taxes on corporate income, τ_t^c , on labor income, τ_t^l, on dividend payments, τ_t^d, and on capital gains, τ_t^k. It also has available financial assets b_t^g to save or borrow from the capital market. To rule out Ponzi games, we assume $\lim_{t\to\infty} \frac{b_t^g}{(1+r(1-\tau_t^k))^t} = 0$. The financial asset interest rate is the capital market interest rate, r_t. The government sequential budget constraint is:

$$\tau_t^c(Y(k_t, l_t) - w_t l_t) + \tau_t^l w_t l_t + \tau_t^k r_t + b_{t+1}^g = g_t + \left(1 + r_t\left(1-\tau_t^k\right)\right) b_t^g \quad (3)$$

3.3 The Household

We assume a unique representative household with preferences represented by the discounted infinite stream of instantaneous utility flows that depends on consumption, c_t:

$$\max \sum_t \beta^t u(c_t)$$

The household discount rate is $\beta \leq 1$ and the instantaneous utility function is strictly increasing, concave and continuously differentiable. The household is endowed with L units of time in each period which are inelastically supplied to the labor market. In addition, the household owns an initial stock of corporate shares, $s_0 = 1$, and we assume households do not trade shares over time. This is a simplifying assumption that does not alter our results, as in equilibrium representative households must hold 100 percent of the shares in each period of time. Each period, the household spends on consumption, buy financial assets to be carried to next period, b_{t+1}^p, and save a mandatory amount, M_{t+1}. Income is obtained from labor income, $w_t l_t\left(1-\tau_t^p\right)$; dividend income, $d_t\left(1-\tau_t^d\right)$; return from financial assets savings, $\left(1+r_t\left(1-\tau_t^k\right)\right) b_t^p$ and return from mandatory savings, $\left(1+r_t\left(1-\tau_t^k\right)\right) M_t$.

3.4 Characterization of Savings

The problem of the household is

$$\max_{c_t, b_{t+1}, k_{t+1}} \sum_t \beta^t u(c_t)$$

$$\begin{aligned} c_t + b_{t+1} + M_{t+1} \\ &= w_t l_t\left(1-\tau_t^p\right) + \left(1-\tau_t^d\right)[(1-\tau_t^c)(Y(k_t, l_t) - w_t l_t) - p_t^I(k_{t+1} - (1-\delta)k_t)] \\ &+ \left(1+r_t\left(1-\tau_t^k\right)\right) b_t + \left(1+r_t\left(1-\tau_t^k\right)\right) M_t \end{aligned}$$

where we have replaced dividends by its definition. Let λ_t be the time t Lagrange multiplier associated with the time t budget constraint. The optimality conditions are the following:

$$[k_{t+1}]: 0 = -\lambda_t p_t^I\left(1-\tau_t^d\right) + \lambda_{t+1}\left[\left(1-\tau_{t+1}^d\right)\left((1-\tau_{t+1}^c) Y_k(t+1) + p_{t+1}^I(1-\delta)\right)\right] \quad (4)$$

$$[b_{t+1}]: 0 = -\lambda_t + \lambda_{t+1}\left[1 + r_{t+1}\left(1 - \tau^k_{t+1}\right)\right] \quad (5)$$

$$[c_t]: 0 = \beta^t u_c(c_t) - \lambda_t \quad (6)$$

$$[c_{t+1}]: 0 = \beta^{t+1} u_c(c_{t+1}) - \lambda_{t+1} \quad (7)$$

Using equations (4) and (5), we get:

$$(1 - \tau^c_{t+1}) Y_k(t+1) = \upsilon_{t+1} \quad (8)$$

where $\upsilon_{t+1} \equiv \frac{[1+r_{t+1}(1-\tau^k_{t+1})](1-\tau^d_t)p^I_t - (1-\tau^d_{t+1})(1-\delta)p^I_{t+1}}{(1-\tau^d_{t+1})}$ is the user cost, similar to the formulation in Hall and Jorgenson (1967). Equation (8) states the consumer chooses how much to save through capital stock accumulation by equalizing the marginal product of capital with its user cost. If we assume a Cobb-Douglas production function, where α is the capital share, corporate savings as fraction of output can be written as in:[1]

$$\frac{S^c_t}{Y_t} = \left[\frac{(1+\gamma)}{v_{t+1}}\frac{(1-\tau^c_{t+1})}{(1-\tau^c_t)} - \frac{(1-\delta)\alpha}{(1-\tau^c_t)Y_k(t)}\right] p^I_t = \quad (9)$$

where γ is the growth rate of output. Equation (9) indicates that corporate savings increases the larger the after- tax marginal product of capital, while it decreases with the user cost of capital.

From the household problem and assuming $\beta\left(1 + r_t\left(1 - \tau^k_t\right)\right) = 1$, we obtain the following expression for consumption:

$$c_t = r_0\left(1 - \tau^k_t\right)b^P_0 + \frac{r}{1+r}\left[\sum_{j=0}^{\infty} \frac{w_j L\left(1-\tau^p_j\right) + d_j\left(1-\tau^d_j\right) + M_j}{\left(1 + r_j\left(1-\tau^k_j\right)\right)^j}\right] \quad (10)$$

Thus consumption corresponds to a fraction of permanent income –defined as the present value of future income streams.

[1] The marginal product of capital is $Y_k = \alpha\left(\frac{K_t}{Y_t}\right)^{-1/\sigma}$, with substitution elasticity (σ) equal to one in a Cobb-Douglas production function, in addition equation (2) can be written as in $\frac{S^c_t}{Y_t} = p^I_t\left[(1+\gamma)\frac{K_{t+1}}{Y_{t+1}} - (1-\delta)\frac{K_t}{Y_t}\right]$

Savings within the household are:[2]

$$\frac{S_t^h}{Y_t} = 1 + \frac{r_t(b_t^p + b_t^g + M_t)}{Y_t} - \frac{S_t^c}{Y_t} - \frac{S_t^g}{Y_t} - \frac{c_t}{Y_t} - \frac{G_t}{Y_t} \qquad (11)$$

where $G_t \equiv \left(g_t + r_t\left(1 - \tau_t^k\right)b_t^g\right)$. Equation (11) is not surprising. Note that if we add up corporate and government savings to its left-hand side, we obtain total savings (as fraction of national income), which are a function of consumption and government expenditure decisions.

4. Data Construction: Methodological Issues

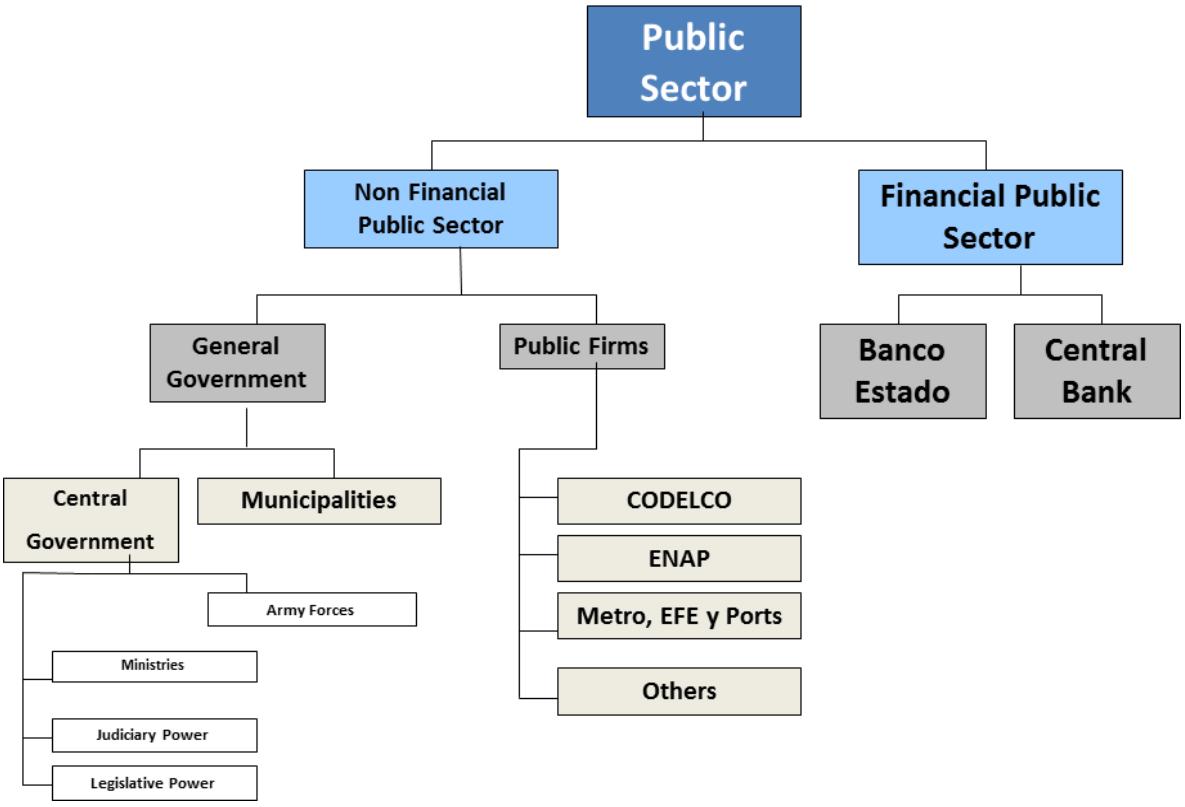
4.1 Public Savings

The public sector in Chile is usually classified into two main branches: the financial public sector and the non-financial public sector. The financial public sector includes the Central Bank and Banco Estado, one of the largest banks in the banking system. In fact, in 2013 it had 30.5 percent of total credits financing tertiary education and 20 percent of total mortgage loans (BancoEstado, 2013). The non-financial public sector has two main branches: i) the general government and ii) public firms. The general government consists of the central government, which includes ministries, armed forces and civil services that depend on the government such as the Budget Office (Spanish acronym: Dirección de Presupuestos, Dipres),the Internal Revenue Service (Spanish acronym: Servicio de Impuestos Internos, SII) or the National Custom Services (Spanish acronym: Servicio Nacional de Aduanas, SNA). The central government includes regional governments, public universities and local councils. In addition, there are currently 33 public firms in Chile according to information provided by the Ministry of Finance (Dipres[3]) that employed 49,455 workers in 2013. Their before-tax profits were 1.2 percent of GDP in 2013. Figure 1 shows the way the public sector is organized in Chile.

[2] We obtain the result by using the definition of household savings:
$S_t^h \equiv \left(b_{t+1}^p + M_{t+1}\right) - \left(b_t^p + M_t\right) = w_t l_t\left(1 - \tau_t^p\right) + (1 - \tau_t^d)d_t + r_t(1 - \tau_t^k)\left(b_t^p + M_t\right) - c_t$
And we replace the definitions of government and corporate saving to finally obtain the result in (11). The definitions of government and corporate savings are:
$S_t^g \equiv b_{t+1}^g - b_t^g = \left(g_t + r_t(1 - \tau_t^k)b_t^g\right) - \tau_t^c(Y(k_t, l_t) - w_t l_t) - \tau_t^l w_t l_t - \tau_t^k r_t\left(b_t^p + M_t\right) - \tau_t^d d_t$
$S_t^c = (1 - \tau_t^c)(Y(k_t, l_t) - w_t l_t) - d_t$

[3] http://www.dipres.gob.cl/596/articles-64217_recurso_1.pdf

Figure 1. Public Sector in Chile



Public savings will be calculated as the sum of the savings on the three big branches of the public sector (general government, public firms and central bank[4]). We next explain how we calculate savings in each of those three branches.

4.1.1 General Government Savings

General government savings include those from the central government (ministries, armed forces, and civilian dependent institutions), regional government, local governments and public universities. This definition is the same used by Bennett, Schmidt-Hebbel and Soto (1999) who provide savings estimates from 1960 to 1997. Similarly, the same definition is available in the National Accounts by institutional sector compiled by the Central Bank of Chile from 1996 to

[4] Next, we include BancoEstado as part of public firms.

2013. Thus we use data from Bennett, Schmidt-Hebbel and Soto (1999) and complement it with data since 1998 data published by the Central Bank of Chile.

4.1.2 Public Firms' Savings

According to Dipres, Chile had 33 public firms in 2013. Banco Estado is the single firm in the financial sector. Codelco, which produces 32 percent of Chilean copper production, accounted for 85 percent of total profits of public companies, while BancoEstado and ENAP accounted for 11.8 percent and 6.5 percent of total profits, respectively. The remaining public companies have negative profits, accounting for -0.04 percent of GDP.

To obtain savings series from public firms, we used data from Dipres' Annual Report on Public Finances (Spanish acronym: Informe de Estadísticas de las Finanzas Públicas). The report provided data related to before-tax profits π_t^{PF}, depreciation Dep_t^{PF}, transfers from the central government to public firms ($Tr_t^{G,PF}$), and transfers from public firms to the central government ($Tr_t^{PF,G}$). We were able to obtain data back to 1994 and we constructed public firm savings as non-distributed after tax profits plus depreciation and transfers from the government minus transfers to the government. Thus, public firms' savings is calculated as in:

$$S_t^{PF} = \pi_t^{PF} + Dep_t^{PF} + Tr_t^{G,PF} - Tr_t^{PF,G} \qquad (12)$$

From 1960 to 1993, we used the data from Bennett, Schmidt-Hebbel and Soto (1999). That data followed similar methodology.

4.1.2 Central Bank Savings

To construct Central Bank savings we obtained data from 1997 to 2013 from the Annual Financial Statements of the Central Bank. The data represent profits π_t^{CB} and depreciation Dep_t^{CB}. In addition, we obtained data on capital contributions provided by the Ministry of Finance to the Central Bank, $Tr_t^{G,CB}$, which were authorized by Law 20,128, approved in 2006. That legislation allowed a capital contribution up to 0.5 percent per year for five years. Those capital contributions effectively occurred in 2006, 2007, 2008 and 2009. Using that information, we constructed Central Bank savings according to:

$$S_t^{CB} = \pi_t^{CB} + Dep_t^{CB} + Tr_t^{G,CB} \qquad (13)$$

The savings series was completed with data from Bennett, Schmidt-Hebbel and Soto (1999) from 1960 to 1997.

4.2 Corporate Savings

Corporate savings are basically calculated as non-distributed after-tax profits plus depreciation minus the profits of foreign companies:

Corporate Savings = After-tax corporate profits – Distributed dividends + Private firms depreciation – Foreign firms profits.

To estimate after-tax corporate profits we start by obtaining data from publicly traded private firms (Spanish acronym: Sociedades Anónimas Abiertas, SAA). We have different sources of information on SAA. First, we were able to obtain the public Standardized Quarterly Financial Reports (Spanish acronym: FECUs) of those firms. These are financial statements sent by publicly held firms to the Chilean Stocks and Securites regulator (Spanish acronym: Superintendencia de Valores y Seguros, SVS). There are two problems with these data. First, we were only able to obtain data from 1985 to 2007. Second, the data on dividends in the FECUSs are available only beginning in 2001. On the other hand, we have at our disposal the Economatica database,[5] a system containing information on companies listed on the stock exchange market of the United States, Brazil, Argentina, Chile, Mexico, Peru and Colombia. The database provides many years of historical data on Quarterly Financial Statements, stock prices, corporate activities (dividends, splits, etc.) and most important shareholders. For Chile, Economatica has SAA data on stock prices, profits from 1990 to 2013 and dividends from 1997 to 2013.

We also used an alternative source of information to construct the SAA dividends, $div_{\mathrm{t}}^{\mathrm{SAA}}$, gathering information from the SVS Monthly Bulletin from 1985 to 2000 at the SVS library.

Between 1990 and 2007, SAA total profits data from the FECUs differ by only 0.3 percent per year, on average, from Economatica data. Similarly, the data on dividends from Economatica are consistent with data from FECUs or from the SVS Monthly Bulletin.

[5] See https://economatica.com/en_anac_base-de-dados.html

For the remaining private companies, we estimate total corporate profits from the aggregate corporate tax revenues from Dipres reports. For dividends and withdrawals from the remaining companies, we used SII data beginning in 2006; this information was obtained through the provisions of the Transparency Act[6]).

We also asked for the depreciation of privately owned companies which we obtain from Henríquez (2008), plus information from Dipres reports. Finally, we obtained information on foreign profits from capital accounts published by the Central Bank.

The SAA represent a small fraction of firms in the economy (on average, almost 763 different firms on our sample. According to the SII, in 2013 the total number of private companies was 1,014,482, which includes firms paying corporate taxes plus individuals engaged in economic activities.[7] While the number of SAA firms is small, the SAA' s impact is large. In fact, according to the SII, 0.2 percent of companies with the largest sales in 2013 (mainly SAA), accounted for 68.4 percent of total sales in the economy and 25.6 percent of total employed workers, and they paid 40.8 percent of total workers' compensation in that year. See Table 3 below.

Table 3. Sales, Workers and Worker Compensation, 2013

Sales	Number of firms	Sales (US$, millions)	Number of dependent workers	Worker compensation (US$, millions)
Large Firms	2.006	613,782	2,226,224	30,803
Total	1,014,482	897,372	8,709,993	75,494
Large firms as fraction of total firms		68.4%	25.6%	40.8%

4.3 Household Savings

Household savings are calculated by the difference between total private savings and corporate savings. In turn, household savings can be divided into mandatory savings and voluntary savings.

[6] Ley de Transparencia (Ley No. 20.285).

[7] Individuals are owner of small firm and they use their personal national identification number in the SII to identify their firms.

4.3.1 Mandatory Savings

Since 1981, the Chilean Pension System has been based on individual capitalization. Each member has an account in which his/her social security contributions are deposited. These are capitalized and earn the yield on the investments made by the administrators with the resources from the funds. When an individual retires, the fund is used to buy a pension, generally an annuity. If the fund owner dies, his/her surviving beneficiaries receive a pension. The amount of the pensions will depend on the amount of savings, thus there is a direct relation with personal effort, as well as with the return on the financial investment and the pension obtained. The Pension System is managed by private institutions known as Pension Fund Administrators (AFPs).

As in the methodology proposed by Bennett, Schmidt-Hebbel and Soto (1999), mandatory savings are constructed as follows:

Mandatory Savings = Payment of Mandatory Contributions + Other Increases – Management Fee – Total Benefits Paid – Other reductions + Assets Return

- *Payment of Mandatory Contributions* corresponds to the mandatory contribution made by the households to the individual pension fund as a fixed share of its labor income.[8]
- *Other Increases* include Compensation Saving Accounts [9] (CSA) and Additional Contributions.[10]
- *Management Fee* is the fee paid to the Pension Fund Manager.
- *Total Benefit Paid* is the payment received by the retiree from the individual pension fund. There are two possible retirement arrangements: Programmed Withdrawal, agreed with the Pension Fund Manager, and Life Annuity, contracted with an insurance company.

[8] It is a rate of 10 percent of labor income plus a fee for the fund manager.
[9] November 1990 marked the beginning of compensation savings accounts (CSA) in order to give domestic workers compensation benefits in case the work relationship ended.
[10] It is the contribution made by insurance companies to pension fund accounts for those workers who are declared impaired or deceased, and who are entitled to Disability Insurance. This contribution is equivalent to the amount resulting from the difference between the resources needed to finance the pension of reference and the amount accumulated in the pension fund account of the affiliate at the date of death or invalidity. If the difference is negative, the additional contribution will be zero.

- *Other Reductions* include withdrawals from the Compensation Saving Accounts and other obligatory decreases informed by the Pension Superintendent.
- *Assets Returns* includes the dividends and interests gained by the assets that form the pension fund but exclude capital gains from changes in asset pricing.

4.3.2 Voluntary Savings

Voluntary savings are estimated as a residual. They represent the difference between household savings and mandatory savings.

4.4 Other Variables

There are some explanatory variables that are not readily available and it was necessary to obtain. The three most relevant are taxes, marginal productivity of capital and the interest rate. We now describe the methodology used to construct these variables.

4.4.1 Taxes

The tax variables considered in this paper are the personal income tax, the reinvestment tax and the dividend tax. We built series of taxes from 1960 to 2012 with the information of the tax code from the National Library of Congress (acronym: BCN Biblioteca del Congreso Nacional).

The personal income tax is the tax levied on personal earnings including labor and capital income. In Chile, it is the "Impuesto Global Complementario" (IGC) that taxes the entire personal base income and is the only progressive tax in Chile. Generally, other taxes are flat rates. We used the top marginal rate of the IGC to construct a time series of the personal income tax. These are available from the tax code, which has changed many times since 1960.

By contrast, the reinvestment tax rate is built from the different tax levied on corporate profits but it corresponds to the tax rate the firm pays when it retains $1 of profits. Currently Chile has a unique corporate tax (the so-called first category tax or "impuesto de primera categoría") but throughout history there were at least three additional taxes on non-distributed profits in different periods (from 1960-1963, 1968-1969 and 1975-1985).

The dividend tax variable represents taxes on dividend income. Before the 1984 tax reform, corporate taxation was independent from the personal income tax, so the dividend tax was calculated similarly to a classical taxation system, i.e., as an additional tax on the cash flow

at the personal level. The 1984 tax reform allowed using the corporate tax paid as a withholding tax for the personal income tax. This is similar to a full imputation taxation system. Since 1984, the dividend tax corresponds to the IGC.

4.4.2 Marginal Productivity of Capital

We estimated a proxy for the marginal productivity of capital by using an estimation of the capital stock corrected by the unemployment rate to capture the intensity of use over the business cycle. This series is published by Dipres. Assuming a Cobb-Douglas production function, our estimation of the marginal productivity of capital (MPK) is given by:

$$MPK = \alpha \frac{Y}{K}$$

where α represents the capital share that we assume equal to 0.4, Y is GDP and K is the capital stock corrected by the business cycle.

4.4.3 Interest Rate

The real interest rate was built as the difference between the annual nominal interest rate of banking operations and the inflation reported on the period, divided by (1+inflation). Nominal interest rates series for the period 1960-1985 are those published by Chile's Central Bank entitled "Interés Corriente para Operaciones no Reajustables" (regular interest for non-readjustable operations), while for 1986-2012 the deposit interest rate for operations shorter than 90 days were used.

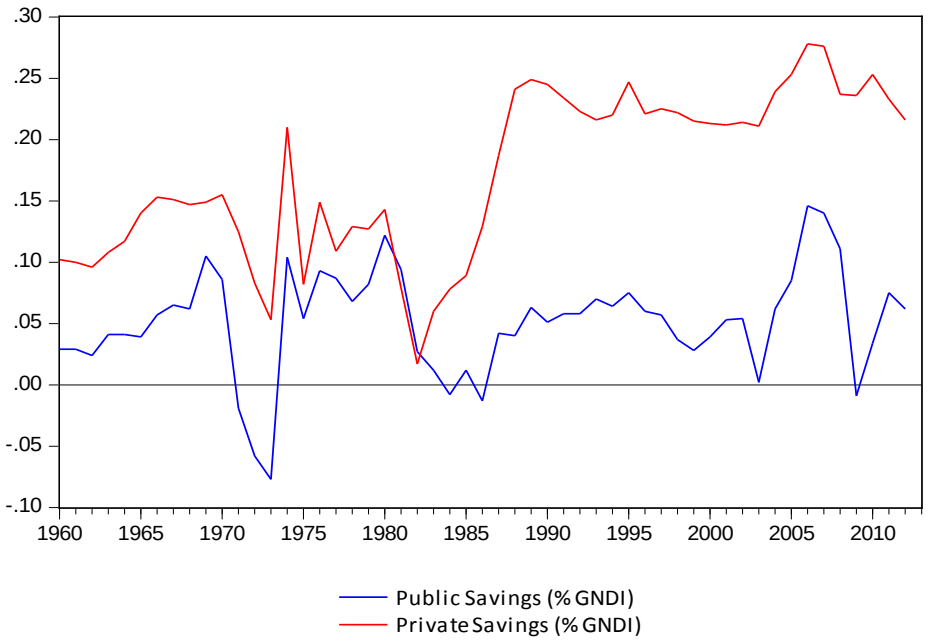
4.4.4 Financial Intermediate Ratio (FIR)

The financial intermediation ratio (FIR) series is constructed as the sum of total deposits, mortgage liabilities, internal public debt, corporate bonds, public bonds and market capitalization. For the period 1960-2000 the main source of information is Díaz, Lüders and Wagner (2010). For the period 2001-2012, the series are updated using data from Chile's Central Bank, the Superintendency of Banks and Financial Institutions, the Santiago Stock Exchange and Dipres.

5. A First Glance at the Data

The savings rate in Chile fluctuated between 10 percent and 15 percent of national income during the 1960s and 1970s. Savings decreased to levels lower than 5 percent during the crisis of 1982, but as of 1984 national savings recovered, reached close to 25 percent of national income in 1989. Savings again declined to close to 22 percent after the 1998 Asian crisis but rebounded again to reach 28 percent in 2006 and 2007. Savings have subsequently fluctuated at around 24 percent. Figure 2 illustrates the evolution of savings in Chile since 1960. We see the evolution of both private and government savings. The large increase in the national savings rate during the 1980s is called the "saving miracle" according to some authors (see Agosin, Crespi and Letelier, 1997 and Agosin, 2001). As it can be seen, the "saving miracle" was due to a large and sustained increase in private savings. In addition, Chile had also a temporary jump in the saving rate in the mid-2000s, which was the result of an increase in public savings.

Figure 2. National Savings Divided into Public and Private Savings as a Percentage of Disposable Income



A Quandt-Andrews test shows a structural break for the mean of the national saving rate in 1987, while in the case of private savings the break took place in 1986. In those periods, the average rate of public savings increased by 1.7 percentage points, while the private saving rate

increased from 7.1 percent in 1960-1986 to 17.2 percent in 1987-2012. Table 4 shows the descriptive statistics for both periods. Another important feature of the saving rate series is the drop in the standard deviation between the two periods. This change affected both private and public saving rates, the former decreasing from 4.2 percent to 2.7 percent and the latter from 4.9 percent to 3.4 percent.

Table 4. Comparison of Saving Rates, 1960-1985 versus 1986-2012

Statistics	**National Savings**		**Public Savings**		**Private Savings**	
	1960-1986	1987-2012	1960-1986	1987-2012	1960-1986	1987-2012
Mean	11.41	23.14	4.29	5.99	7.12	17.15
Median	11.70	22.90	4.10	5.80	7.20	16.80
Maximum	21.00	27.80	12.20	14.60	14.40	24.50
Minimum	1.70	18.70	-7.70	-0.90	-1.50	12.60
Std. Dev.	3.99	2.06	4.93	3.42	4.17	2.73
Skewness	-0.15	0.43	-0.62	0.72	-0.10	0.71
Kurtosis	3.36	3.21	2.95	4.22	2.74	3.53
Jarque-Bera	0.25	0.86	1.71	3.84	0.12	2.48
Probability	0.88	0.65	0.42	0.15	0.94	0.29

Source: Author's calculations.

Table 5. Correlations between Saving Aggregates 1960 - 2012

	Firms	Public	Households	Private	Voluntary
Firms	1.000	0.244	-0.333	0.118	-0.196
Public	0.244	1.000	-0.676	-0.599	-0.596
Households	-0.333	-0.676	1.000	0.897	0.972
Private	0.118	-0.599	0.897	1.000	0.931
Voluntary	-0.196	-0.596	0.972	0.931	1.000

One of the goals of this research is to explore alternative hypotheses that may explain the raise of savings rate. To do so, it is necessary to explain the increase in private savings. We will follow the literature reviewed in Section 2.

When looking at the composition of the private sector (Figure 3) we found that surge in private saving is related to an increase in compulsory household savings (which occurred as a

result of 1981's pension reform), combined with a reduction in voluntary savings (from -2.8 percent to -5 percent), plus a large increase in corporate savings from levels around 9 percent until 1985 to more than 17 percent since the mid-1980s. The contribution of private saving might be a key element to consider in the analysis of aggregate savings when looking at households. Similarly, due to its relevance in the increase of national savings, corporate private savings will need attention.

The distinction between mandatory and voluntary savings is very relevant in the case of Chile, due to the pension system prevailing in the country. In the early 1980s Chile experienced an exhaustive pension reform. That reform changed a pay-as-you-go system with no accumulated funds and managed by the government into an individually-funded system managed by the private sector. This reform had an impact on the labor market, the financial sector and the private and public saving rate. According to the work of Corbo and Schmidt-Hebbel (2003) and Fuentes (2013), due to this reform the domestic saving rate increased between 2 and 3 percentage points.

The pension fund reform had significant effects on the government's balance sheet, as it was required to fund the transition from one system to the other. It should also be noted that pension fund contributions under the new pension system constituted private savings.

The upsurge of corporate savings in Chile deserves a separate chapter. The data show a corporate savings rate stagnating at around 9 percent of national income from 1960 until the mid-1980s. After that, the corporate savings rate experienced a permanent increase of 8 percentage point of national income, reaching 17 percent. Several elements need to be considered in the evolution of corporate savings, such as changes in tax incentives plus variables that may have affected investment decisions. Corporate savings are retained earnings with the purpose of being reinvested in the firm or in related firms throughout corporate reorganization; thus corporate savings are an important source of funds for firms. This episode is interesting because since 1980 the domestic capital market has become more developed and one would expect that firms would have access to less expensive sources of financing, domestic and internationally, implying a larger debt holding. However, evidence indicates that this is not the case. Table 6 shows data on a panel survey of Chilean firms in 2007 and 2009 (source: National Institute of Statistics and Ministry of Economy). The table reports data on sources of funds to finance investment. Personal resources represent more than 62 percent of sources in 2007, increasing to 75.3 percent in 2009.

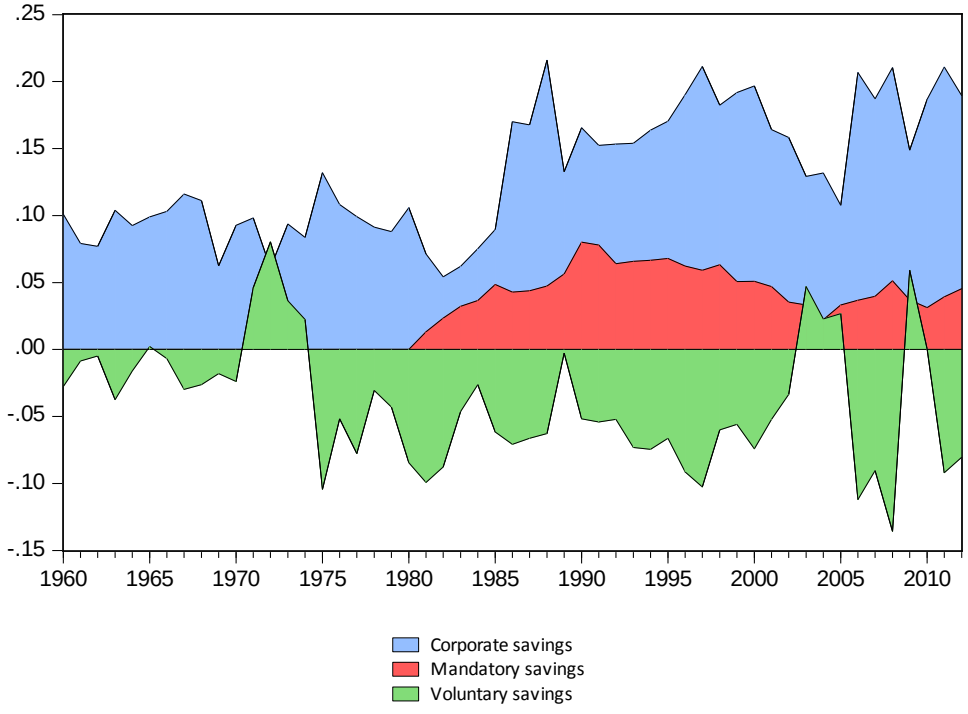
The increase in 2009 suggests that in a year of financial stress, when debt financing is usually credit constrained, personal resources become even more important in financing investment.

Table 6. Investment Financing at the Corporate Level (2007 and 2009)

How did you finance your investment? (Corporate)	2007	2009
Own resources	62.6%	75.3%
Loans	16.6%	12.7%
Leasing	8.3%	7.7%
Other	12.5%	4.2%

Source: Encuesta Longitudinal de Empresas, Ministerio de Economía.

Figure 3. Composition of Private Savings 1960-2012



Following the evidence in Table 6, we might theorize that the main causes for the increase in savings should be found in tax incentives and positive shocks that may have increased desired investment.

Between 1984 and 2014, the tax system in Chile was fully integrated: when people received dividends from firms, the corporate tax paid by them is deducted in the personal tax statement. So, if individuals defer the flow of dividends from firms, so is the personal tax, producing a tax deferral al the personal level. It follows that retained earnings paid a different tax rate than dividends. This difference is relevant for corporate savings: when the owners of the company decide to re-invest profit they will end up paying a lower tax rate at that time and a higher rate when they receive the returns of the re-investment, unless they keep re-investing the returns. That system is completely different from the tax system prior to 1984, when the tax system was not integrated and there was double taxation on profits. In fact, firms paid a corporate tax and later owners paid a second tax on profit at the personal level, which was paid even if no retirement was made, i.e., the personal tax was set on an accrued base and not on a retired base (see Cerda et al., 2014). As a result, taxes at the personal level were extremely high, as shown in Figure 4 below.

Figure 4 illustrates the evolution of the tax rate paid by the owners of the company when they receive dividends and the tax rate on retained earnings. Both rates were relatively high before 1984, and not very different in the period 1975-1985. After the 1984 tax reform, the tax rate on retained earnings drops to its lowest historical level, creating an important difference between the reinvestment rate and the dividend tax. This suggests that the tax system may have produced a change in the composition of private investment.

Another important variable to be considered in the analysis of corporate saving is its return. Since corporate saving are retained earnings for reinvestment at the same or at a related company, the marginal productivity of capital (MPK) might be a key determinant of private investment. Figure 5 plots the evolution of MPK, showing a boom after 1986, which coincides with the golden period of the Chilean economy. MPK rose on average from 15 percent to 18 percent after 1986. This is another plausible explanation for the increase in corporate savings.

Figure 4. The Evolution of Tax Rates, 1960-2012

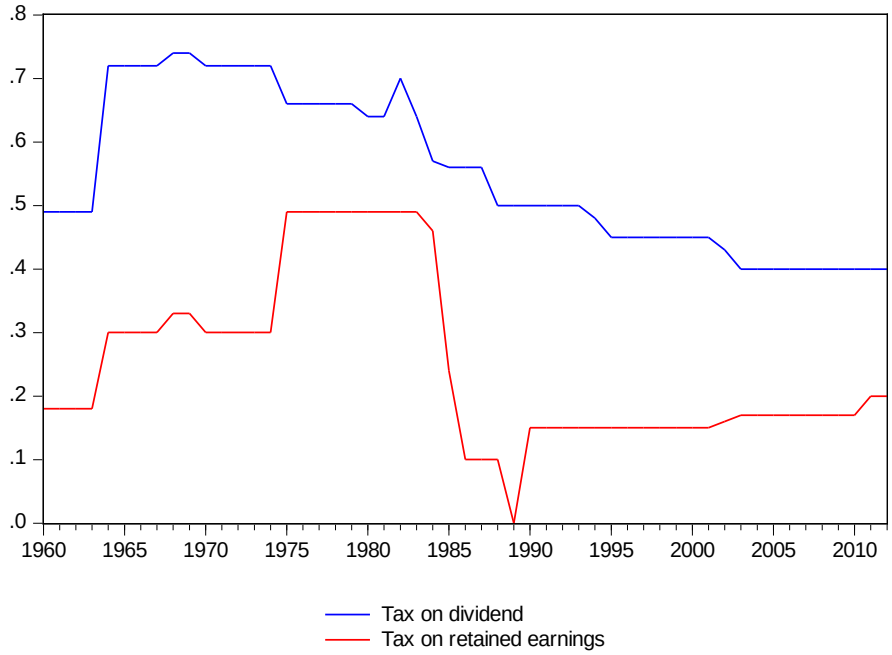
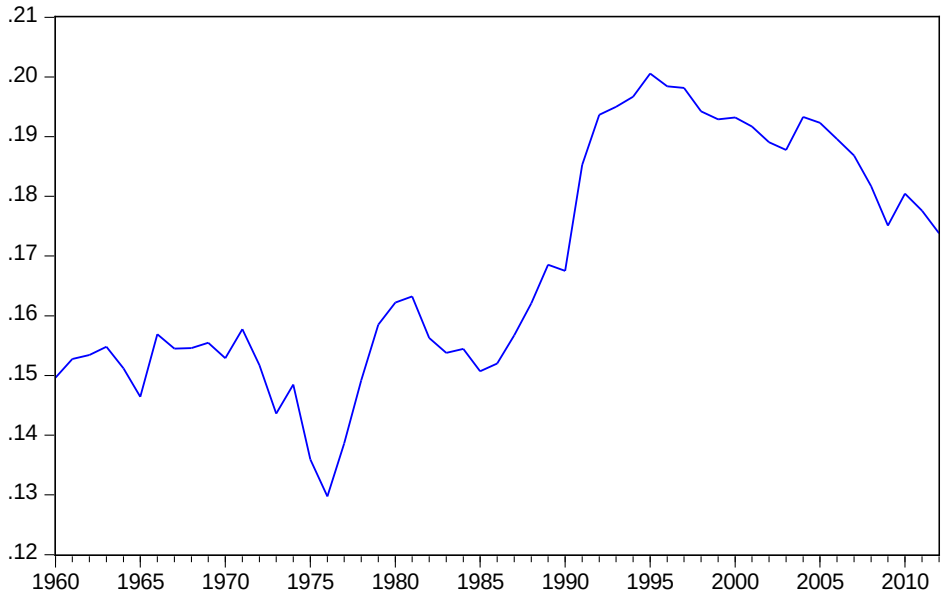
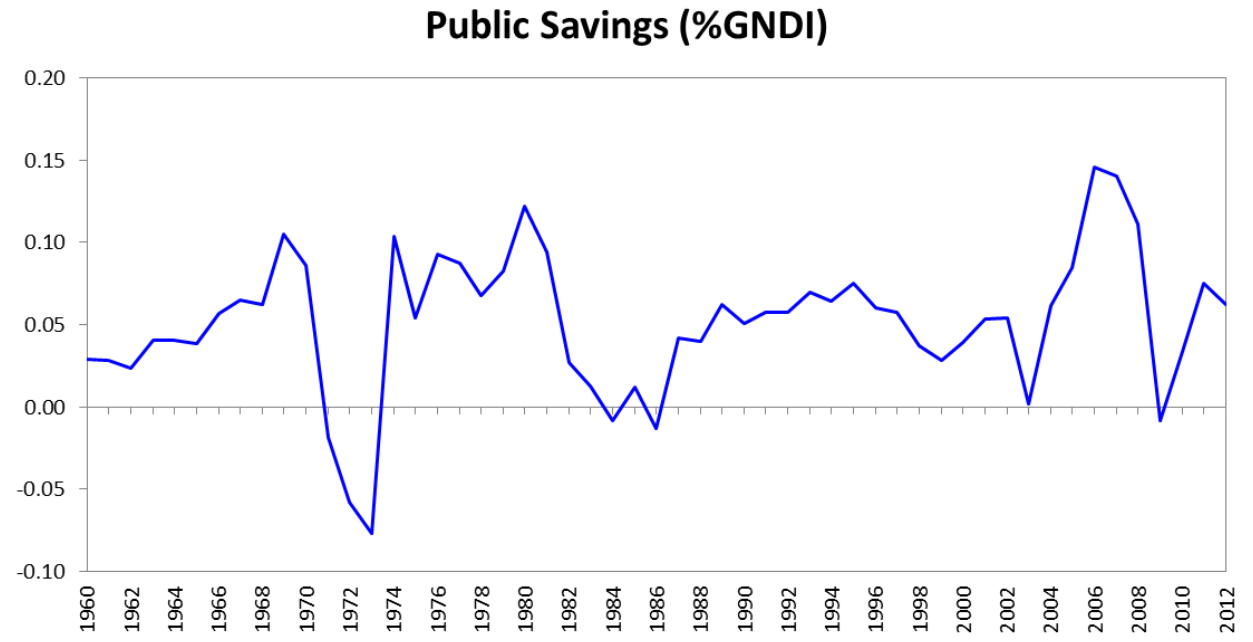


Figure 5. Marginal Productivity of Capital 1960-2013



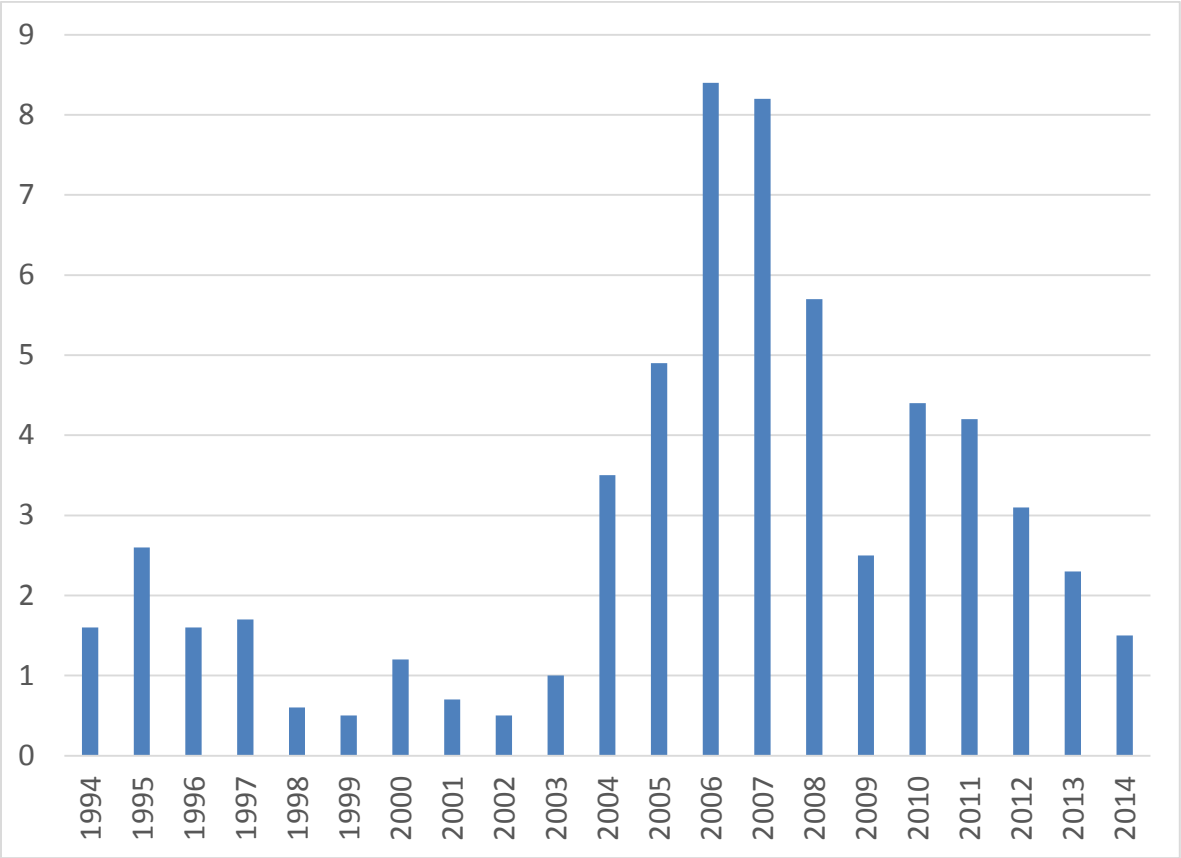
Regarding public savings, it is important to bear in mind that, since 2001, Chile has explicitly implemented a fiscal rule to stabilize the fiscal budget. This rule involves increasing public savings during boom years (high tax revenues) and reducing public saving during years of low tax revenues. Figure 6 plots public savings since 1960, and it highlights the increase in Chilean public savings since 1986, years before an explicit fiscal rule was imposed. During the mid-2000s, government revenues experienced a large increase[11] along with public savings as the copper industry boomed. Figure 7 plots total fiscal revenue from the mining industry. It includes corporate contributions, the royalty enacted in 2004 and modified in 2010 and the contributions from Codelco to the central government. As it can be seen in the figure, generally the government used to have mining's revenue fluctuating between 0.5 percent and 2 percent of GDP since 1994 to 2003. Between 2004 and 2012, fiscal revenue increased and reached a contribution larger than 8 percent of GDP in 2006 and 2007. In 2013 and 2014, fiscal revenue from mining returns to pre-2003 levels as a share of GDP.

Figure 6.



[11] Fuentes (2011) argues that fiscal savings are explained by the price of copper and the economic cycle position; moreover, the fiscal balance is affected by the price of copper with a one-year lag.

Figure 7. Fiscal Mining Revenue, Percent of GDP



The study of the impact of the structural fiscal rule in savings is still unexplored. In this paper we provide some estimates of that impact. In addition, and following Bennett, Loayza and Schmidt-Hebbel (2001), who studied the compensation coefficients among all the components of private savings in Chile (household voluntary saving, firm savings and household mandatory savings), we will revisit this analysis with a longer time series. We will also study the compensation coefficient between public and private savings in the empirical analysis.

6. Empirical Results

This section presents the result by type of agents: public and private savings, dividing the latter into corporate savings and voluntary savings.

6.1 Public Savings

Public savings represent general government savings and thus include savings from the central government, public firms and the Central Bank. They are the sum of government revenues minus government expenditures, excluding public investment.

To model public savings we include the following determinants: i) variables that allow us to distinguish between permanent and transitory fiscal revenues, ii) variables that might determine fiscal expenditures, iii) variables related to fiscal institutions and political regimes and iv) the real interest rate, in order to capture potential substitution and income effects.

Fiscal revenues depend on general economic activity and mining. As a matter of fact, fiscal revenues were 23.7 percent of GDP in 2013, and mining fiscal revenues accounted for almost 2 percent of GDP. The rest of fiscal revenues are related to economic activity. To distinguish between permanent and transitory shocks, we calculate Hodrick-Prescott (HP) filters on two series: i) the copper price and ii) the level of real GDP. To obtain a proxy for a transitory shock on the copper price and on the GDP, we calculate deviations from the Hodrick-Prescott filters. We define copper price as the product of the international value of copper and the nominal exchange rate (peso/dollar), and we then deflated by the CPI to obtain a measure of the real copper price measured in Chilean pesos. Column (1) of Table 7 reports the results when we estimate public savings as a function of i) copper price deviations from trend and ii) GDP deviations from trend, variables that measure transitory shocks to the copper price and the GDP level. In addition, in column (1) we include the HP filters on both the copper price and the real GDP to provide a measure of permanent shock. We also include the lag of the dependent variable to capture potential dynamics and a variable related to the structural balance rule implemented since 2001. In that variable, we have the effective structural stance as a share of GDP. As explained above, the use of the structural rule allows the fiscal sector to save during economic expansions and dissave during economic contractions. Transitory shocks to the price of copper have positive and significant coefficients, while the coefficient on permanent shocks is non-significant and similar to the real GDP transitory component. Those results indicate that the

fiscal sector increases its expenditure when there is a permanent revenue increase in a similar magnitude to the permanent shock. In contrast, when there is a positive (negative) transitory copper price shock, the fiscal sector tends to save (dissave) the rainfall. The coefficient on the structural balance stance is positive and significant, meaning that a fiscal rule skewed to a structural surplus requires larger savings. As the fiscal structural stance is measured in points of GDP, the estimates indicate that a 1-point increase in the structural balance is associated with 1.2 additional percentage points of fiscal savings in the short run and 2.2 percentage points in the long run.

Column 2 includes variables that could influence fiscal expenditure such as demographics (rural population, old age dependency rates), economic conditions (lagged unemployment rate that might incentivize larger fiscal expenditure programs), the real interest rate (to capture substitution effects or income effects in case the government is net creditor or net debtor) and dummy variables for the different presidential periods. As we include additional controls, both the transitory shock to real GDP and to the price of copper price are positive and significant, indicating that a fraction of the positive (negative) income shock is saved (dissaved). While the coefficient on GDP trend is non-significant, the coefficient on price of copper trend is positive and significant, indicating that a share of long-lasting (positive) copper price shocks is also saved. While we should have expected this last coefficient to be non-significant, the result might be due to our imperfect measure of the long-run copper price trend. As a matter of fact, since 2001 the government has convened an independent committee of economists and copper market experts who annually provide an estimate of the long-run copper price that is used to estimate fiscal revenues and determine fiscal expenditure.

Figure 8 plots long-run cooper price estimates from the copper committee and from a Hodrick-Prescott filter. Price estimates from the copper committee are always lower than the estimate from the Hodrick-Prescott filter, indicating that decisions on the budget were based on a more conservative estimate of the long-run copper price than the one used in our regressions. Thus our estimate on the long-run copper price might be capturing at least part of a transitory shock. The interest rate has a positive impact on fiscal savings in line with the usual substitution effect, but it is non-significant since the structural balance rule still has a positive effect on savings. The coefficient on rural population is significant and positive, as generally more fiscal expenditure is needed in urban centers. Unemployment also has a non-significant coefficient.

This is not really surprising since, beginning in 2002, Chile has implemented an unemployment insurance scheme, and the scope of government programs related to unemployment is generally limited (in the case of the 1983 crisis, temporary job programs were created and later discontinued). Finally, the dependency ratio shows a negative and significant coefficient, as a country experiencing a demographic transition, with an increasing share of the elderly, has lower tax revenues but higher expenditure on the elderly. The coefficient on the lagged dependent variable becomes small and statistically non-significant.

In column 3 we do not include non-significant variables and obtain our final model on public savings. The interest rate is significant and positive, and the remaining determinants that increase public savings are transitory shocks on both the real GDP and copper price, as well as the long-run price of copper, the structural balance and the rural population. The only determinant with a negative impact on public savings is the dependency rate.

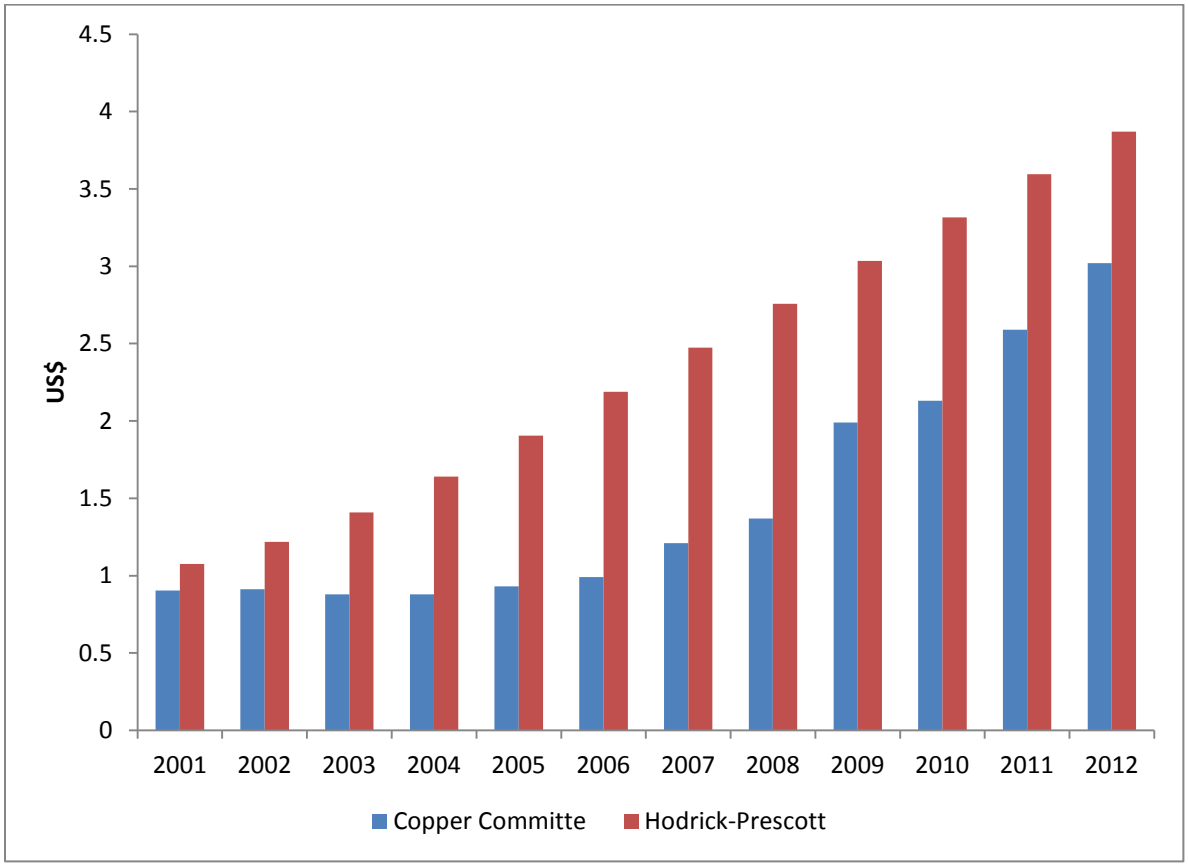
Table 7. Public Savings

Dependent Variable: Public Savings

1961 – 2012	(1) OLS	(2) OLS	(3) OLS
Constant	0.049	-5.090	-1.529**
	(0.18)	(-2.69)	(-2.74)
Public Savings (t-1)	0.476**	0.052	
	(4.57)	(0.40)	
(Copper price - HP Copper price)/HP Copper price	0.102**	0.035*	0.053**
	(4.91)	(1.85)	(3.21)
Ln(HP Copper price)	-0.014	0.137**	0.094**
	(-0.63)	(3.46)	(3.18)
(GDP - HP GDP)/HP GDP	0.126	0.415**	0.346**
	(1.47)	(5.96)	(6.53)
ln(HP GDP)	0.013	0.148	
	(1.21)	(1.69)	
Structural Balance Target	0.013*	0.022**	0.022**
	(1.86)	(4.55)	(4.53)
Interest rate (90 to 360 days)		0.0004	0.0007**
		(1.120)	(3.41)
Rural Population		0.020**	0.004**
		(2.74)	(2.02)
Unemployment (t-1)		0.129	
		(0.77)	
Dependency rate		-0.065**	-0,039**
		(-2.36)	(-2.24)
R squared	0,578	903	0,876
Breusch-Godfrey Serial Correlation LM Test	0,44	0,61	0,68
Heteroskedasticity Test: ARCH	0,04	0,64	0,56
Normality test	0,00	0,49	0,9
Observations	51	51	51

Note: Significance at levels of 5 %(**) and 10%(*). T-statistic in parenthesis. a, b and c: p-values are reported. We also include dummy variables for presidential periods.

Figure 8. Long-Run Copper Price Estimates, USD$



6.2. Private savings

Private savings comprise corporate savings and household savings; the latter includes both mandatory and voluntary savings. In this section, we use as reference the conceptual framework presented in Section 3. We will proceed with the analysis of savings by each private agent: corporate savings and household savings. Later, we study total private savings behavior.

6.2.1 Corporate Savings

As discussed in Section 4, corporate saving is mainly defined as retained earnings plus depreciation. This is basically the part of cash flows used to re-invest in the company. In other words, company owners have the alternative of i) receiving dividends and withdrawing them on their own or ii) saving through the company. In our conceptual framework, firms maximize the present value of cash flows, obtaining the condition that marginal productivity of capital after tax is equal to the cost of use of capital corrected by the corresponding tax rates. It is almost

impossible to construct a long time series of cost of capital for an economy like Chile, since there are no good statistics on the components of the cost of capital. Therefore, we will take the advantage of the first order condition of the maximization process and we will use the marginal productivity of capital net of corporate taxes.

Table 8 shows the results of the regression for corporate savings. The first column presents a modified version of equation (9), where the after-tax marginal product of capital is divided into two components: i) the marginal product of capital and ii) the reinvestment tax rate. None of these variables appear to be statistically significant. In the following columns the corporate savings in t depend on the after corporate-tax marginal productivity of capital (ATMPK) in t and t+1, which is consistent with the conceptual framework. As expected, the contemporaneous ATMPK is not statistically significant in any of the specification, while the one period ahead is not statistically significant in the simplest specification. When we drop the contemporaneous ATMPK then the ATMPK in t+1 becomes positive and statistically significant.

Columns 2 through 4 show the strength of the result when controlling other variables. The financial intermediation ratio is positive and statistically significant. This variable captures the financial market deepening, ensuring that firms can have the option of separating investment decision from financing and dividends decisions. Other variables such as the personal income tax and the growth rate of the economy are not statistically significant. Furthermore, the inclusion of these variables does not change the effect of ATMPK on corporate savings.

These results are very important in order to explain the large increase in the investment rate in Chile financed with corporate savings. The Chilean economy experiences a process of rapid growth since the mid-1980s, which is shown in the large increase in the ATMPK. In addition, in 1986, there is a structural change in the tax scheme that includes a reduction in the corporate tax rate plus the fact that reinvested profits do not pay the personal tax of the stockholders as was previously the case. That change in the tax system also affects considerably the ATMPK evolution. Finally, starting in the late 1970s there is a continuous development of the financial market, as reflected in access to loans and in a more active stock market due to a massive privatization of state-owned companies, the implementation of the private pension system and the development of the insurance market, among many other structural changes that took place at the time.

Table 8. Corporate Savings

Dependent Variable: Corporate Savings

1961 – 2012	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
Constant		-0.006	0.021	0.013	0.020
		(-0.40)	(1.09)	(0.21)	(1.09)
Marginal productivity of capital	-0.038				
	(-0.05)				
Reinvestment tax rate	-0.014				
	(-0.16)				
Marginal productivity of capital (t+1)	0.470				
	(0.62)				
Reinvestment tax rate (t+1)	-0.070				
	(-0.82)				
Marginal productivity of capital net of tax		0.021	-0.074		
		(0.04)	(-0.16)		
Marginal productivity of capital net of tax (t+1)		0.538	0.428	0.382**	0.366**
		(1.24)	(1.02)	(1.78)	(2.01)
Financial intermediate ratio			0.017**	0.018**	0.017**
			(2.34)	(2.81)	(2.36)
Personal Income Tax				0.008	
				(0.12)	
Income per capita growth rate				-0.010	
				(-0.12)	
Corporate savings (t-1)		0.513**	0.374**	0.369**	0.367**
		(4.14)	(2.75)	(2.78)	(2.86)
R squared		0.684	0.710	0.710	0.710
Breusch-Godfrey Serial Correlation LM Test[a]		0.325	0.241	0.364	0.338
Heteroskedasticity Test: ARCH[b]		0.907	0.584	0.572	0.545
Normality Test: Jarque-Bera		0.506	0.789	0.787	0.782

Note: Significance at levels of 5%(**) and 10%(*). T-statistic in parenthesis. a, b and c: p-values are reported.

6.2.2 Household and Voluntary Savings

Estimating an equation for household savings is a challenge because, while this variable is measured as the sum of voluntary plus mandatory savings, we do not have a direct measurement of the former. Voluntary saving is only a residual calculated as total private savings minus corporate savings minus mandatory savings, which may be considered noisy. We estimate an equation for total household savings using our conceptual framework; later we also estimate an equation for voluntary savings and show the validity of estimating an equation for the household as a whole.

In our framework, household savings are a function of corporate savings, fiscal savings, transitory and permanent income and taxes. Besides the other two types of savings, we include more traditional determinants such as the growth rate of per capita income (to control transitory savings), real interest rates, dependence rate, inflation (measure of uncertainty) and unemployment (transitory shocks).

Given that a household may decide whether to save in their own company or in another instrument, a problem of endogeneity is expected when estimating this equation. We used two-stage least squares to estimate the equation of household saving, applying to corporate savings those variables used in the previous section as instruments.

Table 9 presents the results for household savings. The first column shows the general equation estimated using IV. Corporate savings has a coefficient equal to -0.3, although it is not statistically significant at the classical level. On the other hand, government savings has a coefficient equal to -0.74 and it is statistically different than zero. The personal income tax has a negative coefficient but not statistically significant, while per capita growth rate (GDP12) is positive as expected. The coefficient on the real interest rate is negative, similar to what Loayza, Schmidt-Hebbel and Servén (2000) obtained. This is confusing since voluntary savings are negative, which means that households are net debtors and therefore the substitution and the wealth effect of an interest rate increase will reduce everyday consumption or, similarly, will increase savings. It is important to consider that the interest rate coefficient is statistically significant but very small.

[12] We tried to estimate transitory income using the cyclical component of the HP filter, but the variable did not show a statistically significant effect.

In column 2 we provide OLS estimates, which should be consistent as we exclude corporate savings (which was not significant and was the source of potential endogeneity in column 1). The results are similar to the 2SLS, with some minor changes. The compensation coefficient of public saving is smaller than in the previous regression. Personal income tax has a negative coefficient but is now statistically different from zero. The interest rate enters with a negative sign with an even lower t-value, remaining non-significant.

The interest rate was regulated during the 1960s and part of the 1970s. Thus, it is difficult to interpret financial transactions as a result of funds demand and supply in what was a competitive market at the time. In the mid-1970s there were concrete serious attempts to liberalize it, which could explain the negative coefficient on the interest rate in the regression. Therefore the third and the fourth columns of Table 9 show the same regressions as in the previous two columns, but using a shorter sample of 1977-2012. The results change in some important aspects. The conclusions regarding corporate and government savings are not different than the previous analysis, nor are they for the growth rate of per capita GDP. However, the magnitude and level of statistical significance of the personal income tax and the sign for the interest rate do change. We now obtain a positive sign for the interest rate, although it is not statistically significant.

One could argue that household savings is hidden under the effect of voluntary savings since it is the sum of voluntary and mandatory savings. The last two columns of Table 9 show the same regressions, this time using voluntary savings as a dependent variable and mandatory savings as control, for the period 1977-2012. The results are almost exactly the same as in the previous two columns. The only important difference is the positive coefficient for the interest rate, which becomes statistically significant in the OLS estimation. The hypothesis that the coefficient of mandatory savings is equal to -1 cannot be rejected; this means that it is valid to estimate an equation for household savings.

In summary, as expected, government saving and personal income tax negatively affects household savings, and transitory income positively affects household savings. Corporate savings negatively affects household savings, but the coefficient is not statistically significant when properly estimated by using IV. The interest rate enters with a positive coefficient in the equation, when we use a period that excludes interest rate rigidities.

Table 9. Household and Voluntary Savings

Dependent Variable:	Households Savings (1) - (4)				Voluntary Savings (5) - (6)	
1961 - 2012: (1) - (2) 1977-2012: (3) - (6)	(1) 2SLS	(2) OLS	(3) 2SLS	(4) OLS	(5) 2SLS	(6) OLS
Constant	-0.008	0.059**	0.219**	0.153**	0.203*	0.196**
	(-0.11)	(2.45)	(2.49)	(4.34)	(1.93)	(3.36)
Corporate savings	0.301		-0.192		0.007	
	(1.13)		(-0.74)		(0.02)	
Public savings	-0.738**	-0.660**	-0.730**	-0.754**	-0.788**	-0.785**
	(-5.40)	(-5.70)	(-5.28)	(-4.94)	(-4.36)	(-5.02)
Personal Income Tax (t+1)	-0.023	-0.078*	-0.362**	-0.282**	-0.358**	-0.346**
	(-0.26)	(-1.85)	(-3.09)	(-3.70)	(-2.65)	(-3.37)
Income per capita growth rate	0.278**	0.278**	0.356**	0.317**	0.353**	0.357**
	(2.19)	(2.6)	(2.63)	(2.25)	(2.27)	(2.40)
Real interest rate	-0.046	-0.034	0.108	0.112	0.154	0.156
	(-1.39)	(-1.14)	(1.40)	(1.29)	(1.39)	(1.57)
Household savings (t-1)		0.173				
		(1.40)				
Mandatory Savings					-1.349**	-1.321**
					(-2.67)	(-3.82)
R squared	0.329	0.517	0.689	0.574	0.562	0.546
Breusch-Godfrey Serial Correlation LM Test[a]	0.474	0.421	0.216	0.181	0.181	0.186
Heteroskedasticity Test: ARCH[b]	0.481	0.945	0.704	0.729	0.675	0.615
Normality Test: Jarque-Bera	0.866	0.648	0.816	0.765	0.869	0.773

Note: Significance at levels of 5 %(**) and 10%(*). T-statistic in parenthesis. a, b and c: p-values are reported.

6.2.3 Total Private Savings

Starting from what we have learned in the previous sections, we can model private savings. This variable will be a function of i) public savings which capture the eventual crowding out between public and private saving, ii) the marginal productivity of capital net of corporate taxes to measure the real return relevant to corporate savings and iii) personal income tax. In addition, other important variables will be iv) the growth rate, which is a proxy for transitory income that may affect household saving, v) the dependence rate (ratio of the number of people younger than 15 and older than 64 to the working age population), and vi) unemployment and the inflation rate, which attempt to capture uncertainty and a possible precautionary saving effect.

Table 10 presents the results. As expected, the estimates are consistent with the previous sections. The table contains four columns, where the first includes all the regressors mentioned above. As expected, public savings have a negative effect on private savings, with a short-run coefficient equal to -0.46 and a coefficient of up to -0.68 in the long run. An increase in public savings is partially compensated by a reduction in private savings.

The Coefficient on future after corporate tax marginal productivity of capital (ATMPK) is positive; an increase in the future ATMPK raises the desired capital stock and therefore increases investment today. An important part of investment in Chile is funded with retained earnings, the result of tax incentives since 1984. It is important to note that an increase in corporate taxes will reduce investment through its effect on corporate savings. Coherent with the previous section, the growth rate of per capita income positively affects the private savings through increasing voluntary savings. The financial intermediation ratio as a proxy of financial market development has a positive effect on the large increase in the saving rates, starting in 1987, since it coincides with the rapid development of the financial market.

Personal income tax, dependence, unemployment and inflation rates are not statistically significant. The second column eliminates unemployment and the third eliminates dependence rate. The last column eliminates inflation and personal income tax. Through all these columns the marginal effect of the statistically significant variables does not change.

Table 10. Private Savings

Dependent Variable: Private Savings

1961 – 2012	(1) OLS	(2) OLS	(3) OLS	(4) OLS
Constant	-0.169	-0.125*	-0.010*	0.003
	(-1.36)	(-1.86)	(-1.77)	(0.18)
Public savings	-0.463**	-0.462**	-0.456**	-0.448**
	(-5.28)	(-5.32)	(-5.31)	(-5.08)
Marginal productivity of capital net of tax (t+1)	0.910**	0.915**	0.900**	0.537**
	(3.65)	(3.71)	(3.69)	(2.93)
Personal income tax	0.072	0.078	0.088	
	(1.14)	(1.26)	(1.46)	
Income per capita growth rate	0.167*	0.185**	0.183**	0.144*
	(1.86)	(2.35)	(2.34)	(1.84)
Dependence rate	0.088	0.040		
	(0.69)	(0.69)		
Unemployment	-0.124			
	(-0.43)			
Inflation/(1+inflation)	0.050*	0.051*	0.047	
	(1.71)	(1.76)	(1.66)	
Financial intermediate ratio	0.037**	0.032**	0.027**	0.014**
	(2.21)	(2.74)	(3.04)	(2.15)
Private savings (t-1)	0.324**	0.307**	0.332**	0.451**
	(2.67)	(2.71)	(3.13)	(5.08)
R squared	0.889	0.888	0.887	0.875
Breusch-Godfrey Serial Correlation LM Test[a]	0.916	0.902	0.869	0.814
Heteroskedasticity Test: ARCH[b]	0.523	0.537	0.452	0.345
Normality Test: Jarque-Bera[c]	0.537	0.518	0.449	0.100

Note: Significance at levels of 5 %(**) and 10%(*). T-statistic in parenthesis. a, b and c: p-values are reported.

6.2.4 Micro Evidence on Corporate Savings

Corporate savings deserve further attention, as it increased permanently from 9 percent of national income to 17 percent in the mid-1980s. While we have already found some evidence on its determinants using macro data, however we next plan to validate those results using micro data. To do so, we obtain data from publicly traded private firms from the Economatica database. As explained in Section 4.2, we have part of the data since 1990, and dividends—which are

important for constructing construct savings—are available from 1997. Hence, we construct our micro dataset from 1997 to 2013. As with the definition of corporate savings in Section 4.2, we construct corporate savings by adding up after-tax corporate profits and depreciation and subtracting paid dividends. We then scale corporate savings per firm's net income—which is calculated by taking revenues and adjusting the cost of doing business, depreciation, interest expenses, taxes and other expenses. Hence our measure of corporate savings rate, which varies across firm and year, is:

$$\frac{S_{it}}{Y_{it}} = \frac{after\ tax\ corporate\ profits_{it} - paid\ dividends_{it} + depreciation_{it}}{Net\ Income_{it}}$$

where sub-indexes i and t denote firm and year. Corporate tax rate, τ_{it} , is measured by dividing effective corporate tax payments by pre-tax profits. We exclude cases in which firms had negative corporate tax rates. We measure the effective interest rate faced by firms, i_{it}, by dividing total financial expenses by non-short term debt. In addition, we construct four different measures of marginal product of capital, MPK_{it}. The first measure is similar to a Tobin's q, as it represents the stock value of the firm divided by its book value. The second measure is the firm's EBITDA divided by the book value of assets. The third measure is the EBITDA divided by non-short term debt, while the fourth is the EBITDA divided by the book value of machinery, equipment and buildings. We drop the 5 percent of outliers concerning the effective interest rate and the effective corporate tax rate. We end up with 215 firms and 18 years in our dataset.

In our empirical approach, we estimate the following equation:

$$\frac{S_{it}}{Y_{it}} = \beta_0 + \beta_1 \tau_{it} + \beta_2 i_{it} + \beta_3 MPK_{it} + \mu_{it} + \gamma_t$$

where μ_{it} is a fixed effect and γ_t is a time effect. Tables 11 and 12 show the results. Table 11 presents estimates using the fixed effect method, while Table 12 allows for dynamics by including a lag of the dependent variable. To do so, we present results using the Arellano-Bond (1991) methodology to take care of the endogeneity problem in dynamic panel data estimation. In both tables, column (1) includes the effective tax rate while columns (2) to (5) in addition include the effective interest rate and the marginal product of capital. Columns (2) to (5) differ in the measure of the marginal product of capital used. In all the columns, we include time dummies for each year in the sample.

The results are consistent with our previous results using macro data. The coefficient on the tax rate is significant and its coefficient rages between -0.09 and -0.21. In the case of the effective interest rate, the coefficient is usually negative but in some cases it is non-significant. However in the table that uses the Arellano-Bond method, it is always negative and significant, ranging between -0.02 and -0.08. Finally, the coefficient on the marginal product of capital is positive and statistically significant most of the time.

Table 11. Corporate Savings, Fixed-Effect Method

	(1)	(2)	(3)	(4)	(5)
τ_{it}	-0.135***	-0.093**	-0.123***	-0.136***	-0.140***
	(-3.42)	(-2.03)	(-3.21)	(-3.46)	(-3.74)
i_{it}		-0.110	-0.134*	-0.037	-0.009
		(-1.02)	(-1.66)	(-0.46)	(-0.11)
MPK_{it}, Measure (1)		-0.001			
		(-0.43)			
MPK_{it}, Measure (2)			0.328***		
			(10.97)		
MPK_{it}, Measure (3)				0.000**	
				(2.29)	
MPK_{it}, Measure (4)					0.000***
					(3.08)
Observations	2,446	1,622	2,446	2,444	2,413
R-squared	0.025	0.028	0.075	0.027	0.028
Number of Firms	215	169	215	215	212

Note: Significance at levels of 5 %(**) and 10%(*). T-statistic in parenthesis. a, b and c: p-values are reported.

Table 12. Corporate Savings, Arellano-Bond Method

	(1)	(2)	(3)	(4)	(5)
Lagged $\frac{S_{it}}{Y_{it}}$	0.019***	-0.034***	-0.009***	0.045***	0.047***
	(23.86)	(-25.28)	(-8.58)	(53.26)	(44.94)
τ_{it}	-0.185***	-0.136***	-0.185***	-0.182***	-0.210***
	(-94.63)	(-45.82)	(-71.45)	(-80.34)	(-75.55)
i_{it}		-0.055***	-0.083***	-0.023***	0.045***
		(-10.42)	(-14.1)	(-4.24)	(9.40)
MPK_{it}, Measure (1)		0.013***			
		(20.16)			
MPK_{it}, Measure (2)			0.645***		
			(222.46)		
MPK_{it}, Measure (3)				0.000***	
				(712.66)	
MPK_{it}, Measure (4)					-0.000***
					(-43.11)
Observations	1,696	1,059	1,696	1,695	1,678
Number of ncode	190	140	190	190	188
Sargan Test	151.1	116.8	159.6	150.5	150.2
Autocorrelation (2)	0.891	-0.218	1.418	0.995	1.558

Note: Significance at levels of 5 %(**) and 10%(*). T-statistic in parenthesis. a, b and c: p-values are reported.

7. Policy Implications

In the last 30 years, Chile's growth rate increased considerably. From 1961 to 1984, the economy's average growth rate was 2.9 percent per year, increasing to a yearly average of 5.3 percent from 1985 to 2013. An important part of the increase in growth rate is explained by a higher investment rate, which increases from 15.6 percent of GDP to 22.3 percent of GDP in similar periods.[13] How could Chile sustain such a large increase in investment rate? Chile raised substantially its savings rate—by almost 12 percentage points—mainly through corporate savings (8 percentage points), while the public sector increased its savings by almost 1 percent of disposable income. Next, we quantify the contribution of each savings determinant to explain the extensive change in private savings after 1985 and the change in the composition of savings. We divide the sample in two, 1985 being a breakpoint. We begin by focusing on corporate savings. Using the long-run coefficients of the third column of Table 9 and the mean values of the

[13] We used nominal GDP and nominal investment. If we use real GDP and real investment, those figures are 12.5 percent and 17.9 percent, respectively.

explanatory variables in each period we calculate the contribution of each determinant to the increase in corporate savings. Table 13 shows these calculations. The Financial Intermediate Ratio as a percentage of GDP rose from 20 percent to 169 percent, increasing corporate savings by 4 percentage points. On the other hand, the increase of 6 percentage points in marginal productivity of capital net of tax (t+1) meant an expansion of 3.4 percentage points in corporate savings. This upsurge of the marginal productivity net of tax is explained by an increase of the MPK from 15 percent to 18 percent and a drop in corporate tax from 35.8 percent to 15.2 percent. In sum, the model predicts an increase of 7.41 percentage points of corporate savings post 1985, slightly lower than the actual change of 7.88 percentage points.

Table 13. Contribution to Corporate Saving, Average Change between 1960-1984 and 1985-2012

Contribution to Corporate Savings of each determinant	Mean value for each period		Long Run Coefficient*	Contribution to Corporate Savings (% GNDI)
	1960-1984	1985-2012		
Financial intermediate ratio (% GDP)	19.67%	169.32%	0.027	4.02%
MPK net of tax (t+1)	9.76%	15.62%	0.578	3.39%
Corporate savings predicted change				7.41%
Corporate savings actual change	9.04%	16.92%		7.88%

* Calculated as the current coefficient divided by one minus the coefficient estimated for the lag of corporate saving.

Table 14 shows a similar exercise for household savings. Public savings shows a long-run coefficient of -0.80, which reflects the existence of the Richard equivalence effect, though without a complete compensation effect. This means that the increase in public savings from 4.64 percent to 5.56 percent of GNDI was offset by a decrease in household savings of almost 0.74 percentage points. The average increase in the growth rate of per capita income from 0.98 percent to 4.05 percent meant an increase in household savings of 1.03 percent of GNDI, where the long-run coefficient is 0.336, much lower than 1. Following the theory of Permanent Income, only a small fraction of increase in the average income was considered as permanent by the households. The largest contribution to the increase in household savings comes from the reduction of Personal Income Tax from 65.9 percent to 45.5 percent, which induced an increase in household savings of 1.92 percent of GNDI. Finally, the real interest rate contributed -0.46 percent to the increase of household saving between both periods, where its negative value for

the first period was due to a long period of financial repression plus the hyperinflation of the 1970s.

Table 14. Contribution to Household Saving, Average Change between 1960-1984 and 1985-2012

Contribution to Household Savings of each determinant	Mean value for each period		Long Run Coefficient*	Contribution to Households Savings (% GNDI)
	1960-1984	1985-2012		
Public savings (% of GNDI)	4.64%	5.56%	-0.798	-0.74%
Income per capita growth rate	0.98%	4.05%	0.336	1.03%
Personal Income Tax (t+1)	65.90%	45.50%	-0.094	1.92%
Real interest rate	-8.92%	2.39%	-0.041	-0.46%
Households savings predicted change				1.76%
Households savings actual change	-2.23%	-0.22%		2.01%

* Calculated as one minus the coefficient estimated for the lag of corporate saving.

Table 15 summarizes the results for private savings. Adding up, the models predict that private savings should have increased in 9.2 percentage points while it has actually increased 9.9 percentage points. The main drivers are the Financial Intermediate Ratio, the ATMPK, the income per capita growth rate and the Personal Income Tax. The improvement in the fiscal budget had a negative, but small effect on private savings.

Table 15. Contribution to Private Saving, Average Change between 1960-1984 and 1985-2012

Contribution to Private saving (% of GNDI)	Predicted	Actual
Corporate savings	7.41%	7.88%
Households savings	1.76%	2.01%
Total change	9.17%	9.89%

Table 16 shows the contribution of each determinant to the average change of public savings between similar periods used for private savings. The change on public savings was approximately 1 percentage point between 1960-1984 and 1985-2012, increasing from 4.63 percent to 5.58 percent. Public savings has two determinants that may predict an important decrease in public savings in the second period: i) old age dependency and ii) the decrease in rural population. Both effects induce larger fiscal expenditure, implying an expected reduction of public savings by around 11 percentage points. These effects are offset mainly by i) copper rainfall (the long run/permanent component) during the 2000s and ii) the government's change in attitude towards savings in the midst of our sample, captured by the dummy variables for presidential periods. The fiscal rule is also an important explanatory variable, but because the rule has been in place since 2001, it has little impact on average fiscal savings of 1985-2012. We might hypothesize that the shift in approach to fiscal savings since the mid-1980s resulted in the implementation of the fiscal rule at the beginning of the 2000s. In summary, the model predicts an increase in 0.62 percentage points, which is compared with the actual increase of 0.95 percentage points.

Table 16. Contribution to Public Savings, Average Change between 1960-1984 and 1985-2012

	Mean value for each period			
Contribution to Public Savings of each determinant	1960-1984	1985-2012	Long Run Coefficient	Contribution to the Change in Public Savings (% GNDI)
Real GDP deviation over HP trend (%)	0,55%	-0,63%	0,346	-0,41%
Real Copper price deviation over HP trend (%)	-3,19%	-0,03%	0,053	0,17%
Log(HP trend of real copper price)	18,02	18,38	0,094	3,32%
TIR 90-180 days (Percent points)	-0,01	7,26	0,001	0,51%
Older adults / population (Percentage point)	5,24	7,29	-0,039	-7,94%
Rural Population/population (Percentage point)	23,60	14,31	0,004	-4,15%
Presidential Period 1971-1973	0,12	0,00	-0,102	1,22%
Presidential Period 1990-1993	0,00	0,14	0,037	0,53%
Presidential Period 1994-1999	0,00	0,21	0,074	1,59%
Presidential Period 2000-2005	0,00	0,21	0,095	2,05%
Presidential Period 2006-2009	0,00	0,14	0,137	1,95%
Presidential Period 2010-2012	0,00	0,11	0,154	1,65%
Balance Budget Fiscal Rule	0,00	0,06	0,022	0,13%
Public Savings Predicted				**0,62%**
Public Savings Actual	4,63%	5,58%		**0,95%**

8. Concluding Remarks

This paper aims to explain two important facts about the Chilean economy. The first is how Chile substantially raised its savings rate—by almost 11 percentage points—in the period 1987-2012 compared to 1960-1986. The public sector increased its savings by almost 1 percent of disposable income, while the private sector raised savings by10 percent of disposable income. Second, the large increase in private savings is mainly explained by corporate savings, which seem to substitute household savings.

The most important message that results from studying the Chilean experience is that significant changes in savings rates can be achieved through the implementation of public policies. First of all, and by far, the most important variable was the development of the financial market, accounting for nearly 4 percentage points of the increase in savings as a fraction of GNDI. Fuentes (2013) argued that an important public policy that promoted the development of the financial system was the pension fund reform undertaken in 1981. Second, other public policies designed to improve the economy's productivity jointly with the 1984 tax reform also impacted total savings, as the increase in the after-tax marginal productivity of capital boosted corporate savings by 3.4 percentage points of GNDI. The tax reform implemented in 1984 lowered the corporate tax rate but also included other changes in the tax code such as i) implementing a full imputation system, ii) eliminating double taxation and iii) allowing taxation at the personal level and not on an accrual basis when withdrawal of profits occurred. In this line, and as a third element, the reduction in personal income taxes seemed to increase household savings by 1.92 percentage points of GNDI.

Besides public policy, another determinant is that only a fraction of the increase in the average per capita income growth rate was ween by households as permanent, so only a small part of the higher income was assigned to consumption (one third) and the remaining income (two thirds) would have increased household savings by 1.03 percentage points of GNDI. Finally, better public sector institutions are yet another source of savings. In Chile's case, the implementation of the structural balance rule was a source of 0.7 percentage points of GNDI.[14]

We could try to use our results to disentangle the impacts of the 2014 tax reform on Chilean savings. We might obtain some ideas by using our estimates to determine the impact of reinvestment tax on corporate savings. With the recent tax reform, corporate tax increased from

[14] Net of the negative impact on corporate savings.

20 percent to 27 percent, a value that will be reached in 2018. That increase in corporate tax should affect the taxation of reinvested profits. Although our model was not built to estimate the effect of the changes in the tax code system approved in 2014, our model predicts a long-run impact of -1.82 percent on aggregate corporate saving.

We should however be cautious. As described in Box 1, the 2014 tax reform included many other changes other than just that of the corporate tax. Therefore our estimates may be just the lower bound of the true impact.

Box 1. The 2014 Tax Reform

The Chilean tax system was a full imputation system in which firms paid a 20 percent corporate tax based on accrued base, while firm owners paid personal tax based on cash flows and they could use corporate taxes as credit for personal taxation. That tax system mimicked a system based on dividend taxation. The corporate tax was set at 20 percent, while the maximum personal tax rate was 40 percent.

The tax reform approved in September 2014 eliminated the full imputation system and introduced two different tax systems. The first is based on the concept of attributed income, in which firm owners are attributed with firm profits and therefore must pay personal taxes even if they do not pay dividends from the firm. The second tax system is a partial imputations system in which firm owners can only partially use corporate taxation as credit for their personal taxes. The tax payer can choose between both systems. In the attributed system the corporate taxation will increase to 25 percent, while in the partial imputation system, corporate taxation will rise to 27 percent, and just 65 percent of corporate tax will be allowed to be used as credit for personal taxes. Those changes will be gradually implemented in a four-year period.

The tax reform increased the limit on sales for firms to be classified as small and medium size enterprises (SME). Those firms pay taxes based on cash flows rather than on accrued profits. Starting in 2017, SMEs owned exclusively by natural persons (not by other firms) are exempt from paying taxes, but their owners are required to pay the personal tax on an attributed base. Those firms might also decrease from their tax base part of their investment cost. Finally, those firms could also delay in 90 days the payment of sales tax.

The tax reform also lowered the top rate in the progressive scale of the personal income tax from 40 percent to 35 percent starting in 2017.

The tax reform incorporated other changes as well. In the housing market, individuals, who were usually exempted from taxes on capital gains, will pay taxes if capital gains over their lifecycle are larger than US$ 300,000. In addition, subsidies for new housing valued between approximately US$ 80,000 and US$ 170,000 were eliminated. Subsidies remain for new houses valued at less than US$ 80,000.

Taxes on tobacco and alcoholic beverages increased, while a tax was applied to the first sale of new vehicles. The tax rate depends on emissions.

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Annex 1.

A.1. Corporate Savings

Corporate savings is basically calculated as non-distributed after-tax profits plus depreciation minus foreign firm's profits:

Corporate Savings = After tax corporate profits – Distributed dividends

+ Private firms depreciation – Foreign firms profits.

A.1.1 Total After-Tax Corporate Profits

To calculate total corporate savings, we require data on the rest of non-SAA firms. To do so, we obtain data on total corporate tax revenues from the national budget office (Spanish acronym: Dirección de Presupuestos, DIPRES). Then we subtract the corporate tax paid by the fiscal owned or public firms TAX_t^{PF} from the total corporate tax revenues TAX_t^{Total}, as in:

$TAX_t^{TP} = TAX_t^{Total} - TAX_t^{PF} = \pi_t^{BT} * \tau_t$

Where TAX_t^{TP} is the tax revenue from private firms and π_t^{TB} are profits before taxes. Using the yearly corporate tax rate, τ_t, which in Chile does not differ across economic sector, we estimate the total after tax corporate profits, π_t^{AT} , of private firms as:

$$\pi_t^{AT} = \frac{TAX_t^{TP}}{\tau_t} - TAX_t^{TP} = \frac{(1-\tau_t)}{\tau_t}\left(TAX_t^{Total} - TAX_t^{PF}\right)$$

The Chilean tax law allows firms to use previous losses to pay lower taxes in future periods. In fact, firms may use accumulated losses to decrease their current tax base. This problem could bias the estimate of a firm's profits. To fix this problem we need to calculate the amount of accumulated losses that firms are using each year in their tax returns. Unfortunately we do not have this information, so instead we estimate the amount of accumulated losses that a publicly held firm (SAA) could use to reduce taxation each year using FECUs and Economatica Data. We add this estimation to the estimated profits to get the real after tax profit of the firm:

$$\pi_t^{TP} = \frac{(1-\tau_t)}{\tau_t}\left(TAX_t^{Total} - TAX_t^{PF}\right) + AL_t$$

where π_t^{TP} the privates firm's profits and the parameter are AL_t corresponds to accumulated losses.

To estimate the accumulated losses that the firm could use to reduce it tax base, we estimate the total accumulated profits and losses for each publicly held firm (SAA) since 1984. Then we calculate the aggregate amount of positive profits that could be deducted by losses

every year until the accumulated losses were completely absorbed by positive profits. In this estimation we are assuming that the firms use the accumulated losses, as fast as they can, and all the years when they have positive profits.

A.1.2 Dividends

To calculate corporate firm savings, we require data on total dividends from companies to households. From the SII, we have data since 2006 that allow us to calculate cash withdrawals and dividends distributed from firms. Similarly, we add expenditures rejected by the tax authority to the cash withdrawals and distributed dividends series because they represent expenditures which are not allowed by the SII to be discounted from the firm tax base, as they resemble a capital retirement. We calculate dividends and cash withdraws as:

$$div_t^{\text{Total}} = R_t + D_t - C_t + RE_t \qquad \text{(A.1)}$$

where R_t stands for cash withdraws, D_t for dividends, C_t for tax credits related to corporate tax payments and RE_t are rejected expenditures. We subtract C_t because SII data on withdrawals and dividends include the corporate tax credit, which can be used as a credit in the personal tax statement, but it does not come from the firm balance. Similarly, we add RE_t as it corresponds to expenditures which are not allowed by the SII to be discounted from the firm tax base as they resemble a capital withdraw. The data on R_t, D_t, C_t and RE_t are for all firms.

Although we have publicly held firms' data from 1984, we do not have data on non-SAA firms. To complete the series before 2006, we calculate the average ratio between the dividends of non-SAA and SAA from 2006 and 2013, and then we calculate div_t^{NSAA} as follows:

$$div_t^{\text{NSAA}} = \theta * div_t^{\text{SAA}} \qquad \text{(A.2)}$$

where,

$$\theta = \frac{1}{8}\sum_{i=2006}^{i=2013}\left(\frac{div_i^{\text{NSAA}}}{div_i^{\text{SAA}}}\right)$$

Our series of div_t^{Total} corresponds to the SII and SAA data after 2005 and our estimates using the ratio θ for the non-SAA before that year.

A.1.3 Depreciation

To obtain corporate savings we need to include corporate depreciation Dep_t^C. We obtain aggregate capital depreciationDep_t and housing depreciation Dep_t^H from Henríquez (2008). We calculate the private corporate sector depreciation using the series without housing activities (which correspond primarily to households) and deducting the depreciation of government owned firms Dep_t^{PF}obtained from DIPRES reports. Then we calculate private firm depreciation as:

$$Dep_t^C = Dep_t - Dep_t^H - Dep_t^{PF}$$

A.1.4. Foreign Firms

Finally, we need to subtract foreign-owned companies' profits π_t^F , as they represent external savings. To do so, we obtain data on reinvested profits from the capital account (on the liabilities flows), published by the Central Bank.

It follows that non-public firm's corporate savings, S_t^C, are finally calculated as:

$$S_t^C = \pi_t^{\mathrm{TP}} - div_t^{\mathrm{SAA}} - div_t^{\mathrm{NSAA}} + Dep_t^C - \pi_t^F$$

A.2. Mandatory Savings

The data used to construct the series of Mandatory Savings for the period 1981-2013, with the exception of return on assets, come from the monthly statistical bulletins published by the Pension Superintendent.

The Assets Return for the portfolio of pension funds is estimated as the sum of four components: dividends from national stocks, dividends from foreign stocks, interests from national fixed income instruments and interests from foreign fixed income instruments. The Superintendency of Pension periodically publishes the portfolio composition of pension funds, providing disaggregated information for each investment instrument. Using this information, jointly with some assumptions, it is possible to estimate each one of the previous four components. The dividends from national stocks are estimated using the annual dividend yield rate reported by the Securities and Insurance Superintendent. Similarly, the dividends from foreign stock are estimated using the dividend yield of S&P 500. The estimation for the interest gains from fixed income instruments is slightly more cumbersome. The market interest rate for national instrument is estimated by the deposit indexed interest rate plus the inflation for the

period, while for foreign instruments the market interest rate is approximated by the interest rate of the 10-year U.S. Treasury bond. The deposit indexed interest rate of the Chilean market is approximated by the 90/360 days' deposit real interest rate of the banking system. Then the interests of fixed income instruments, both domestic and foreign, are estimated using the following formula:

$$Interest_t = X_{t-1} r_t + I_t(\sqrt{1 + r_t} - 1)$$

$$I_t = \frac{X_t - X_{t-1}(1 + r_t)}{\sqrt{1 + r_t}}$$

where

X_t represents the stock of fixed income instruments in year t, and

I_t represents the investment in fixed income instruments during year t, and

r_t corresponds the interest rate calculated for the fixed income instrument in year t.

It is assumed that investment in fixed income instruments takes place exactly in the middle of the period. Therefore, the interest gained for this investment during period t is approximated by $I_t(\sqrt{1 + r_t} - 1)$.

Finally, the Total Benefit Paid represents payments made by Programmed Withdrawals agreed with the Pension Fund Manager or by Life Annuity contracted with an insurance company. The Pension Superintendent regularly publishes information on payments due to Programmed Withdrawals. In the case of Life Annuity, however, the Superintendent only publishes disaggregated data for several different types of Life Annuity pensions; this information is expressed in real terms using the "Unidad de Fomento (UF)" index.[15] Therefore, the total benefit paid for Life Annuity for each year is constructed by multiplying the number of payments done for each type of pension by the average payment value (UF) for each type of pension. The result is adjusted by UF index in order to express the results in current prices.

It should be noted that Chile's Central Bank also estimated pension savings for the period 1996-2013; however its methodology does not take into account the outflows from pension funds due to payments received by retirees. Also, the methodology used by the Central Bank is based on information on household´s financial assets and liabilities, which is not available prior to 1996. Therefore, this methodology cannot be replicated for the period before 1996.

[15] Unidad de Fomento (UF) is an index constructed to reflect monthly inflation.

The results are shown in Figure A.1.

Figure A.1. Composition of Mandatory Savings