DOES PENSION REFORM REALLY SPUR PRODUCTIVITY, SAVING, AND GROWTH?

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Resumen

El reemplazo de un sistema de pensiones de reparto por uno de capitalización provee potenciales ganancias de eficiencia en mercados de factores, puede contribuir a un mayor ahorro, y luego puede elevar el crecimiento económico. Sin embargo, los reformadores de sistemas de pensiones enfrentan dudas significativas acerca del cuánto y del cuándo de estos beneficios. Este trabajo arroja luces sobre estas preguntas en dos direcciones distintas. Primero se revisa la evidencia mundial reciente, reflejada en estudios empíricos y de simulaciones, acerca de los sistemas de pensiones y sus reformas. Ello permite acotar los posibles beneficios de las reformas sobre los mercados de factores y los potenciales efectos sobre el ahorro, derivando los consiguientes efectos sobre el crecimiento. Luego el trabajo provee nueva evidencia empírica para Chile, el país que ha realizado la reforma pensional más antigua y más radical hasta la fecha. Los resultados sugieren que la reforma chilena ha mejorado el desempeño del mercado del trabajo y elevado los niveles de ahorro, inversión y productividad de factores, contribuyendo a una cuarta parte del aumento de la tasa de crecimiento del país.

Abstract

Substituting a fully-funded system for a pay-as-you-go regime provides potential efficiency gains in factor markets, can contribute to higher saving, and hence could raise growth. But pension reformers face significant uncertainty about the size and timing of these benefits. This paper sheds light on this issue in two directions. First it reviews recent world-wide empirical and simulations evidence on pension systems and reforms to infer about the likely factor market benefits and potential saving effects of pension reform and their quantitative implications for growth. Then new evidence is provided for Chile, the country with the oldest and most radical pension reform to date. The results suggest that Chile's pension reform has improved labor-market performance and raised saving, investment, and factor productivity, contributing to a quarter of the country's growth increase.

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Introduction

In a world that is quickly adopting market-based and private sector-led economic systems, conventional state-managed pay-as-you-go (PAYG) pension regimes are not immune to reform efforts. In fact, disenchantment with existing PAYG systems is growing universally, as people and governments are increasingly aware of the ineffectiveness of most PAYG schemes in providing adequate old-age saving, insurance, and distribution. In addition standard PAYG arrangements impose significant efficiency, saving, and growth costs that grow with population ageing and PAYG coverage and maturity.

The 1990s are seeing a world trend of pension reforms aimed at correcting state-managed PAYG systems and replacing them -- at least in part -- by privately-run fully-funded (FF) regimes. The demonstration effects of Singapore's high saving under a FF system, Chile's successful 1981 reform and subsequent reforms in two OECD countries (Switzerland 1985, Australia 1992), as well as the influential three-pillar proposal made by the World Bank in its 1994 Old-Age Crisis report, have spurred pension reform in all regions. Since 1992 more than 110 countries have undertaken minor adjustments to their existing systems while some 20 countries have undertaken major pension reforms in the sense of adopting new systems or replacing their old regimes (Demirguç-Kunt and Schwarz 1996). Since the early 1980s some 14 countries have substituted or complemented their old PAYG systems by FF schemes.[1] Curiously, reverse reforms -- adoption of PAYG schemes -- have also been implemented in a few countries.[2]

Pension reform is certainly the most complex of all structural reforms because it upsets existing political-economy equilibria, affects public finances, intervenes severely in the functioning of labor and capital markets, distributes income both across and within generations, and changes an economy's saving, investment, and growth paths from the short to the very long term. The economics profession has seen significant progress in understanding the qualitative effects of pension regimes on public finances, factor markets, income distribution, and aggregate saving and growth. However strong discrepancies and uncertainties remain about the quantitative magnitude of pension reforms. Some of the disagreements are about the ills and costs of existing PAYG systems. For instance, there is very little consensus about the effects of PAYG on labor markets or their effects on capital-market under-development. Other disagreements arise from holding different views about the relevant macroeconomic paradigms. For instance, distributional and output gains of a pension reform based on a contractionary fiscal policy will be strikingly different in models with or without operating bequest motives. Another example is provided by different views on growth. Opposite answers will be provided by Solow and endogenous growth models to the question how on how temporary or permanent the growth gains from pension reform are.

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[1] They include Chile (1981), Switzerland (1985), Peru (1991), Australia (1991), Guatemala (1991), Mexico (1992, 1997), Argentina (1994), Colombia (1994), Uruguay (1996), Bolivia (1997), Italy 1996), Latvia (1996), Sweden (1996), and Seychelles.

[2] Indonesia (1992) and Nigeria (1993) substituted PAYG systems for provident funds while Angola (1990), Mozambique (1990), Oman (1991), and Zimbabwe (1991) adopted new PAYG schemes.

To these analytical difficulties one should add three empirical difficulties in estimating PAYG-FF reform effects in real-world economies. First, it is hard to adequately represent an economy in a general-equilibrium context, taking account of the relevant externalities and feedback effects of a reform that affects the most important economic decisions and the major markets. Second, even if we shared a common analytical framework to apply to assess pension reform, countries differ widely in incentives and behavior, and little is known about key preference, production, and institutional parameters in most of them. Third, PAYG-FF pension reforms are typically implemented in conjunction -- often simultaneously -- with other major structural reforms with similar effects on public finances, labor markets, capital markets, and saving incentives, making it hard to identify the marginal contribution of pension reform.

Against this background, there is a small recent literature that surveys previous work on the consequences of pension regimes and reforms.[3] Being part of this literature, this paper does two things differently. First, a selective survey of the quantitative effects of PAYG-FF reforms is provided, distinguishing between partial-equilibrium consequences for public finances and factor markets and general-equilibrium effects for intergenerational distribution, aggregate saving, and growth (section 1). This review draws selectively from the theoretical, empirical, and simulations literature of the last decade. Next new evidence is provided on the first and most radical PAYG-FF reform experience in the world -- Chile's -- and its likely effects on the country's saving, investment, and growth takeoff (section 2). Chile's case is of particular interest -- and difficulty -- because pension reform was only one component of a large set of structural and macroeconomic reforms that have been highly successful. A final section concludes.

1. REFORMING PENSIONS: WHICH EFFECTS? HOW LARGE ARE THEY?

In this paper I limit the analysis of pension reform to a shift from unfunded (or partially funded) to funded (or higher funded) systems. Minor reforms of PAYG systems -- typically undertaken to address operational deficits -- are not considered here. Other major aspects of pension reform that will not be addressed include pension system privatization, political-economy features, intra-cohort redistribution, the redistributive (first) pension pillar, the market structure of the new private pension fund industry, regulatory and supervisory aspects, risk-management and portfolio issues, or insurance and pension annuities.

What is pension reform in this limited sense? It means doing at the same time many things in public finances and factor markets (capital and labor markets), affecting factor accumulation, factor productivity, and hence growth. Therefore pension reform alters the tie paths of all major macro flows and stocks, short and long term. This implies that pension reform is best understood by unbundling its effects in five areas:

[3] This literature includes World Bank (1994), Arrau and Schmidt-Hebbel (1994), Feldstein (1996), Holzmann (1997a) and (1997b), Mitchell and Zeldes (1996), Mackenzie, Gerson,and Cuevas (1997).

public finances, capital markets, labor markets, saving, and growth. This is what I do next.

1.1 Public finance: Pension reform deficit financing

It is well known that a public PAYG pension system involves a commitment of paying pension benefits to current pensioners and workers. This contingent and implicit public liability -- called implicit PAYG debt -- is a useful summary indicator of the transfers received by the first cohorts that benefited from paying little or no contributions while receiving pensions from the PAYG regime and that are paid by all subsequent cohorts.

PAYG-FF reform implies that the reforming government will show reform transition deficits. They are caused by the shortfall of pre-reform PAYG pension contributions that are now invested in FF pension funds while the government continues honoring its PAYG commitments by paying current and future pension benefits to those contributors that remain affiliated with PAYG. Visible reform transition deficits make explicit the until-now hidden PAYG debt. [4] However the present value of reform transition deficits can differ quite substantially from the estimated value of the implicit PAYG debt accrued at the time of the reform. [5]

A selective survey of present values of reform transition deficits or implicit PAYG debt levels for a dozen developing and industrial economies is summarized in Table 1. The evidence suggests that is large on average but varies significantly with country and PAYG system features, as well as with the depyh of the PAYG-FF reform. Implicit debt levels tend to be larger in OECD and transition economies than in developing countries because the former feature wider pension system coverage and less evasion, higher PAYG system maturity, larger PAYG benefits, and larger old-age dependency (due to a more advanced demographic transition and higher life expectancy).

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[4] The implicit PAYG debt at the date of the reform reflects the present value of pensions to be paid in the future on the basis of accrued rights. Alternative measures include the accumulation of future liabilities (net of contributions) under current PAYG rules. For a review of alternative concepts see Franco (1995) and Holzmann (1997).

[5] The present value of transition deficits differs from the implicit PAYG debt when the government defaults on its PAYG benefits before starting the transition toward a FF system or, more generally, part of transition deficits are paid by transition cohorts. In both cases the corresponding inter-generational transfers also imply different paths for interest rates and growth rates that imply further differences between PAYG debt and the present value of transition deficits. Only when the transition deficit is financed by explicit government debt at interest costs financed in perpetuity by taxes on labor (in substitution for the abolished implicit PAYG tax) -- the case when a PAYG-FF reform has no fiscal, saving, and growth effects -- both valuations are identical.

Table 1
Size of Implicit Debts of Public PAYG Systems or PV of Reform Deficits in Selected Countries
(percentage of GDP)

Country	*Year*	*Debt/GDP*	*Debt Concept*
Chile	1981	126	Present value of reform deficits
Colombia	1994	86.5	Present value of reform deficits
Mexico	1994	73.2	Current net implicit PAYG liabilities
Philippines	1995	43	Current net implicit PAYG liabilities
Hungary	1997	143.5	Current net implicit PAYG liabilities
U.S.	1990	89	Current net implicit PAYG liabilities
Canada	1990	105	same
Germany	1990	157	same
France	1990	216	same
Italy	1990	259	same
United Kingdom	1990	139	same
Japan	1990	145	same

Sources: Arrau (1991) for Chile; Schmidt-Hebbel (1997b) for Colombia; Cerda and Grandolini (1997, Table 2) for Mexico; Cifuentes and Valdés-Prieto (1997) for Hungary and the Philippines; van der Noord and Herd (1993) and Holzmann (1997) for rhe U.S., Canada, Germany, France, Italy, the U.K., and Japan.

There are two fundamental ways how transition deficits can be financed -- and much of the fiscal and macroeconomic discussion and literature on pension reform revolves around these ways. First, the implicit PAYG debt can be swapped for another public-sector asset (i.e., by selling governments assets like public enterprises or international reserves) or liability (i.e., by issuing explicit government debt. Abstracting from Pareto-welfare gains, this case entails only second-order distributional and macroeconomic consequences of pension reform. They arise as a result of different ways to finance the decline in government asset returns or the increase in the cost of the higher explicit debt, imposing expenditure cuts or tax increases on certain generations. At least in theory these second-order effects could be entirely avoided by an appropriate fiscal policy (as discused in footnote 5).

The second way to finance transition deficits is by cutting expenditure or rasing taxes for a period that lasts as long as transition deficits last. In this case the PAYG-FF reform is combined with a contractionary fiscal policy that hurts transition generations and benefits future cohorts. Abstracting from additional Pareto efficiency gains, this first-order inter-generational transfer has first-order macroeconomic effects reflected in higher long-term saving and income levels (or growth rates) as long as inter-generational links are weak.

However under both ways of financing it is likely that pension reform brings about Pareto welfare gains from the elimination of distortions and deadweight losses in capital and labor markets, as discussed below. Appropriate inter-generational

distribution of these gains may avoid losses to any specific cohort and even ensure gains to all cohorts.[6] However such win-win reform designs are hard to implement.

In principle implicit debt levels should say little about the time path of making them explicit and about the way they are financed. If people and markets consider implicit PAYG debt and explicit government debt equivalent it would be feasible to engineer an instantaneous debt swap at the moment of the pension reform with no consequences for financial markets and public debt interest rate premiums. But such an equivalence seems to be highly unlikely. First, few people understand the nature of an implicit PAYG debt that is not traded as opposed to explicit public debt that is instantly valued in financial markets. Second, PAYG debt is a contingent implicit liability of long maturity and very uncertain value -- actuarial estimates are based on highly questionable assumptions -- because of frequent changes in pension contributions and benefits in response to unforeseen shifts in demographics, economics, and politics.

Reflecting this perceived non-neutrality of PAYG and explicit government debt, reform transitions in actual reform experiences are designed to take place over long horizons. Chile's generation-long transition of 40 years, intended to keep annual transition deficits relatively low, has been followed by most other pension reforms. In fact, apprehension about large explicit transition deficits tends to bias -- at least on paper -- deficit financing away from debt issuance and toward fiscal contraction. More important, anxiety about large deficits, by governments and international institutions alike -- is the most important reason -- in conjunction with political-economy aspects -- why pension reform is not spreading more quickly around the globe.

How are transition deficits financed in actual pension reform programs? While this issue occupies center stage in most reform simulations and proposals, little can be said about actual financing sources. One reason is fungibility of money: it is impossible to relate specific above-the-line expenditure items in government budgets to their above-the-line or below-the-line financing sources. Second, government budgets reflect annual changes in fiscal policy of which pension reform is only one component.

1.2 Capital markets

Shifting to capital markets the intermediation of pension savings in substitution of the PAYG transfer program could in principle, contribute to the development of financial and capital markets. It is argued that the growth of privately-managed mandated pension funds encourages the development of new instruments (long-term bank and corporate liabilities, equity, mortgages, pension annuities) and new financial services (risk rating, individual investment and pension annuities advice), and contributes to financial deepening. (World Bank 1994, Holzmann 1997). In addition, in view of the mandated character of pension saving flowing into privately-managed pension funds, pension reform requires and encourages putting into place a strong regulation and effective supervisory institutions, not only for the pension industry but also for other capital market segments and instruments.

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[6] Examples of PAYG-FF pension reform designs -- financed by fiscal contraction -- that avoid any losses to transition generations and distribute Pareto welfare gains to future generations are the consumption tax-financed proposals for the U.S. by Kotlikoff (1996) and Kotlikoff et al. (1997).

However there is still very little we know about the actual contribution of a FF privately-managed competitive pension service industry to financial development and and growth. Starting with the latter part of the link, the profession is starting to understand the empirical contribution of financial development to growth and some of its theoretical underpinnings (as documented by Levine 1997). But it is much harder to anchor the contribution of private pension funds to financial and capital-market development in a strong analytical framework subject to empirical testing. Until such a framework is developed we are only be able to point to broad positive correlations between the pension fund asset growth and overall financial development (Holzmann 1996, Reisen and Bailliu 1997, Corsetti and Schmidt-Hebbel 1997, James 1997).

1.3 Labor markets

As is well known, a PAYG system weakens the links between contributions and pension benefits by imposing an implicit tax wedge between the cost of labor to firms and the sum of the take-home wage and the expected future pension benefits perceived by the worker. The size of the implicit PAYG tax on labor grows with the difference between the market interest rate (or the subjective discount rate in case of borrowing-constrained myopic individuals) and the expected rate of return of PAYG. For the system as a whole, the latter is equal to the economy's growth rate in steady state and when the PAYG system has reached maturity. However at the level of the individual worker -- which is where it matters -- the rate of return of PAYG differs significantly from GDP growth when PAYG provides intergenerational and intra-generational distribution. Further differences between the relevant rate of return in financial markets and the return on PAYG contributions arise when considering risk. Risk adjustment of market returns (reflecting market uncertainty) may be very different from risk adjustment of PAYG returns (reflecting changing rules over pension contributions and benefits). But one should note that here a tradeoff emerges between efficiency losses due to the PAYG distortion and the insurance gains from intra and inter-cohort income insurance (Diamond 1977, Kotlikoff 1995).

While PAYG causes labor market distortions, their quantitative dimension is hard to assess. Nonetheless, several empirical studies have estimated the implications of PAYG schemes for several important labor-market features: the supply of labor, labor force participation of aged people (or early retirement), the composition of formal and informal employment, and the level of structural unemployment.

Labor supply

As forcefully argued by Feldstein (1996), the PAYG tax distorts not only the number of hours that individuals spend on work in taxed activities but other dimensions of labor supply including occupational choice, effort, and location. It also encourages the shift of taxable income to untaxed fringe benefits. Using a static partial-equilibrium framework, Feldstein estimates the total deadweight loss of the latter labor-market distortions caused by U.S. Social Security at about 1% of U.S. GDP.

Labor force participation

A number of country and cross-country studies have identified significant negative effects of PAYG systems on labor force participation. Evidence -- mostly confined to OECD countries -- shows that PAYG system variables like the estimated stock of PAYG social security wealth (SSW) or observed flows of PAYG pensions reduce labor force participation by people aged 65 and over, i.e., induce early retirement (Table 2 [7]).

Table 2
Econometric Evidence on the Response of Labor Force Participation of the Elderly (or on Early Retirement) to PAYG

Country or Country Sample	*Effect on Labor Force Participation of Elderly*	*Study*
Japan	Negative	Yamada and Yamada (1988), Yamada, Yamada, and Liu (1992)
14 OECD countries	Negative	Kopits and Gotur (1980)
40 LDC countries	Negative	Kopits and Gotur (1980)
21 OECDs	Negative	Modigliani and Sterling (1983)

Formal and informal employment

Empirically more important than the costs of reduction in total labor supply and labor force participation by the elderly seem to be the effects on the structure of formal and informal employment and production. The reason is simple: people are more likely to shift employment -- either on a full-time or a part-time basis -- from formal taxed activities to informal untaxed work than to drop out of the labor force. Casual evidence suggests that the elasticity of the total labor supply is significantly smaller than the elasticity of formal-informal employment allocation.

The response of formal-informal labor shifts to formal-sector taxes obviously depends on an economy's structure and its PAYG system features. Labor mobility declines with PAYG system coverage, declines with government controls on tax compliance, increases with the size of the pre-PAYG informal sector, and increases with other taxes and restrictions imposed on formal employment and production. (Corsetti 1994, Loayza 1996, Schmidt-Hebbel 1997a). Given the high correlation of the preceding features with the level of development, the size of informal sectors is much larger in developing than in OECD countries.

One measure of the relative size of the informal sector, based on the structure of non-farm employment, is estimated by ILO for most Latin American countries since 1980 (Figure 1). This evidence shows that the informal-sector share of employment is growing steadily in each and every of 13 Latin American countries except Chile since 1980. This is likely to be no coincidence. Chile is the only country with a growing FF pension system since 1981 -- the other Latin American that have partially reformed

[7] Much of the summary information presented in tables 2, 3 and 5 draws from the excellent survey in Mackenzie, Gerson, and Cuevas (1997), Appendix II.

their PAYG pension have done so in recent years only. Hence pension reform may contribute significantly to employment formalization -- as reflected in expanding pension system coverage -- in countries where initial informality is large. An alternative estimate for production informality is provided by Loayza (1996) for 9 Latin American countries in 1990 (Figure 2). The figures range from 18% of official GDP in Chile to 66% in Bolivia, with a mean regional share of the informal-sector estimated at 39%. Even in industrial countries the size of the informal economy can be surprisingly large; in Italy the irregular sector is estimated to produce 16% of value added in 1990 (Rey 1993, as quoted by Corsetti 1994).

In concluding, informal sectors are relatively large in most countries but may shrink after introducing FF pension systems, in response to lower net labor taxes in the formal sector that encourage resource reallocation toward the formal sector.

Structural unemployment

The PAYG tax on labor is also likely to affect the level of structural unemployment. Edwards (1997) develops a partial-equilibrium two-sector (formal-informal) Harris-Todaro model with sector-specific capital and an exogenous labor force. The allocation of labor among the formal and informal sector and total unemployment are determined by a minimum wage and the pure PAYG tax on labor that are both binding in the formal sector but not in the informal sector. (Figure 3). Eliminating the pure PAYG tax T raises formal-sector labor demand (L^F), raises informal-sector wage W, reduces informal-sector labor demand (L^I), and therefore has an ambiguous effect on structural unemployment. However Edwards shows that for a large range of informal labor demand elasticities unemployment declines as the labor tax falls.

1.4 Private and National Saving

The effects of a PAYG-FF reforms on private saving (or consumption) depend critically on how the transition deficit is financed, on possible crowding out of voluntary saving by mandatory FF pension saving, and on the strength of intergenerational transfer motives. Further changes in private saving arise when the reform involves redistribution among income groups or age cohorts that differ in their marginal saving propensities or in their degrees of myopia and access to borrowing. As stressed above, a pension reform reduces overall uncertainty by decreasing political risk but raises it because of the reduction of insurance. Therefore the net effect on overall uncertainty is ambiguous and so is its effect on precautionary saving. Finally, indirect effects of pension reform on private saving are reaped when growth is accelerated by efficiency gains in factor markets, giving rise to a virtuous cycle of higher saving and growth.

The empirical evidence on some of these issues is examined next. I start by looking at how private voluntary saving has been affected by PAYG systems throughout the world. The next issue is how private saving reacts to lower public saving (as a result of reform transition deficits not entirely financed by a fiscal contraction). Finally the evidence on crowding in or out of voluntary private saving by mandatory saving going into a FF pension system is reviewed.

Voluntary private saving response to PAYG systems

A large empirical literature has analyzed the effects of PAYG systems on private saving.[8] Closely or loosely based on the life-cycle model, voluntary private saving (or non-pension private wealth stocks) is regressed on PAYG social security wealth (SSW), contributions, or benefits. Most of the studies are based on one-equation models that reflect the reduced-form influence of PAYG systems on saving flows (or stocks), including indirect effects through factor markets and income or growth rates, unless the latter variables are explicitly controlled for.

Table 3
Econometric Evidence on the Response of Voluntary Private Saving (or Voluntary Financial Wealth) to PAYG Social-Security Wealth, PAYG Contributions,or Benefits

Country or Country Sample	*Effects of PAYG SSW, Contributions or Benefits on Private Saving*	*Study*
U.S.	40-50% lower	Feldstein (1974)
U.S.	No robust effects	Leimer and Lesnoy (1982)
U.S.	Significant negative effects	Leimer and Richardson (1992)
U.S.	60% lower	Feldstein (1995)
Canada	Higher	Denny and Rea 1979)
Belgium	Lower	Perelman and Pestieau (1984)
France	No effect	Oudet (1979)
Germany United Kingdom	No robust effects	Blum and Gaudry (1987)
Japan	68% lower	Yamada and Yamada (1988)
Japan	34-38% lower	Yamada, Yamada, and Liu (1992)
India	Slightly higher	Shome and Saito (1980)
Sri Lanka	Slightly higher	Shome and Saito (1980)
Philippines	No effect	Shome and Saito (1980)
15 countries	1.5% lower saving rate	Feldstein (1977)
14 OECD countries	No significant effect	Kopits and Gotur (1980)
40 developing countries	No significant effect	Kopits and Gotur (1980)
21 OECD countries	No significant effect	Modigliani and Sterling (1983)
16 OECD countries	No significant effect	Koskela and Viren (1986)
11 OECDs and 25 LDCs	Lower	Edwards (1995)

Country or Country Sample	*Effect of SSW on VoluntaryPrivate Wealth*	*Study*
Netherlands	40% offset	Draper (1994)

A set of results from representative studies are reported in Table 3. [9] Feldstein (1974) initiated this research, finding a significant and large negative effect of SSW on

[8] For reviews of this literature see Magnussen (1994), Gale (1995), Munnell (1985), Mackenzie, Gerson, and Cuevas (1997), and OECD (1997).

[9] In addition to major differences in specification, the data vary substantially from study to study. Some studies for individual OECD countries are based on cross-section micro household data while most others

voluntary saving, a result that is generally confirmed by subsequent research for the U.S. However private saving offset is significantly less than full. Studies for other countries and cross-country samples offer a wide variety of results that range from large negative (but less than full) offset to zero effects and even, in some cases, a modest crowding in of voluntary saving in response to mandated PAYG saving.

There are various explanations for why mandatory PAYG saving is never fully and often not even partly offset by lower voluntary private saving. First, as PAYG induces earlier retirement the need for voluntary saving is increased. Second, mandatory social security systems (in this case, PAYG) induce a "recognition effect" as they make people more aware that they should save for old age. Finally, mandatory PAYG saving falls disproportionately on middle income or borrowing-constrained groups that are not saving much anyway, while most private saving is done by higher-income households less affected by PAYG obligations and by corporations. In concluding, and to say the least, voluntary private saving does not fully offset mandatory PAYG saving.

Public-private saving crowding out

When pension reform deficits are financed -- at least in part -- by issuing debt, the question arises about how consumers react to larger measured government deficits, given that they know that their old PAYG contributions are now channeled into a FF pension system. Most consumption and general-equilibrium models (like those reviewed below) that deal with pension systems are variations of life-cycle overlapping-generations (OLG) models that assume weak or absent intergenerational links and therefore reflect large intergenerational distribution and saving effects of fiscal contractions. At the opposite end of macroeconomic paradigms there is the Barro-Ricardo equivalence hypothesis (Barro 1974). Assuming strong intergenerational links and absence of capital-market imperfections, the latter model leads to perfect crowding out of (permanent) private saving by (permanent) public saving.

A large empirical literature has tested the Ricardian proposition by regressing private or household saving (or consumption) on public saving (or surplus), controlling for various saving determinants. These studies differ widely in data, specifications, and econometric techniques.[10] Leaving aside all country studies by focusing only on recent cross-country pooled or panel data studies, it is surprising to note how close the results are (Table 4). The Ricardian hypothesis of perfect crowding out is rejected by these studies but significant partial offset is found, with point estimates of offset coefficients that range between 0.36 and 0.66. Hence transition deficits are partly offset by higher private saving by approximately half their size.

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are based on aggregate time series, cross-section long-run aggregate country data. or pooled time-series cross-country aggregate data.

[10] See Bernheim (1987), Leiderman and Blejer (1988), Seater (1993), and Agénor and Montiel (1996) for reviews of the empirical literature on Ricardian equivalence. While three of the preceding authors conclude that the available evidence rejects full Ricardian offset of public saving by private saving, Seater reaches surprisingly the opposite conclusion.

Table 4
Econometric Evidence on Ricardian Equivalence: Public-Sector (or Government) Saving (or Surplus) Offset Coefficients in Private Saving Panel-Data Estimations

Country samples	*Private-public Offset Coefficients*			*Study*
	World sample	*OECD countries*	*Developing countries*	
13 LDCs			0.47 (0.06) to 0.50 (0.07)	Corbo and Schmidt-Hebbel (1991)
21 OECDs and 40 LDCs	0.64 (0.04)	0.53 (0.11)	0.66 (0.06)	Masson, Bayoumi, and Samiei (1995)
11 OECDs and 25 LDCs	0.36 (0.10) to 0.58 (0.12)			Edwards (1995)
7 OECDs and 4 LDCs	0.46 (0.14) to 0.54 (0.10)			Reisen and Bailliu (1997)

Voluntary private saving response to mandatory FF saving

Finally let's review the empirical evidence on voluntary saving crowding out or crowding in due to mandatory saving flowing into FF pension funds. A variety of fully-funded systems are considered here, including those with or without individual accounts, with public or private management, and with occupational or non-occupational funds (Table 5).

Surprisingly the results are split along the dividing line of data, choice of dependent variable and, partly degree of development. When the dependent variable is private saving and macroeconomic data are used, the results point either to no effects or significant crowding-in effects (for Chile and for a panel of OECD and developing countries). However empirical results for household non-pension wealth in OECD countries point to an array of results that range from no effects to large offsets, attaining offset coefficients of up to 66%.

These results suggest -- abstracting from methodological differences arising from specification and data differences -- that the combined extent of recognition effects and the combination of myopia and borrowing constraints that push many consumers into corner solutions seems to be larger in developing than in OECD countries. Therefore the establishment of FF mandatory pension funds will be most effective in developing countries in raising saving. This effectiveness is much weaker in the U.S. or Canada (or other industrial countries) where a large range of saving crowding out is observed although no evidence of full crowding is recorded.

Table 5
Econometric Evidence on the Response of Private Saving to Funded Pension Systems' Wealth or Assets

Country or Sample	*Type of Pension Fund*	*Effects of Funded Pension System's Wealth on Other Private Saving*	*Study*
Singapore	Public Central Provident Fund	Significant positive	Faruqee and Husain (1994)
		Non-significant	Husain (1995)
Malaysia	Occupational Pension Funds	Not significant	Faruqee and Husain (1994)
Chile	Private Pension Funds	Significant positive	Corsetti and Schmidt-Hebbel (1997)
		Significant positive	Morandé (1996)
Panel of 7 OECDs and 4 LDCs	Various Funded Pension Funds	Significant positive	Reisen and Bailliu (1997)

Country or Sample	*Type of Pension Fund*	*Effects of Funded Pension System's Wealth on Other Private Wealth*	*Study*
U.S.	Occupational Pension Funds	62% lower	Munnell (1976)
U.S. (same data as previous study)	Occupational Pension Funds	No effect	Kotlikoff (1979)
U.S.	Occupational Pension Funds	No effect	Diamond and Hausman (1984)
U.S.	Occupational Pension Funds	16% lower	Hubbard (1986)
U.S., older households	Occupational Pension Funds	66% lower	Avery, Elliehausen, and Gustafson (1986)
Canada, homeowners	Occupational Pension Funds	50% lower	Waters (1981)
Canada	Occupational Pension Funds	27%-51% lower	Dicks-Mireaux and King (1984)

1.5 Growth and general-equilibrium effects on income and welfare

Overall effects of PAYG-FF reform depend on specific features of PAYG, its distortions imposed on factor markets, saving decisions, and the growth process, and, certainly, on the way FF is implemented and financed by the reforming government. In addition, general equilibrium effects reflect the interaction of the latter features in ways that escape a partial-equilibrium analysis and often imply surprising outcomes, of which some examples are provided next. A wide range of simulation results for tax-financed PAYG-FF pension reforms in representative and actual economies are reviewed. Here the focus is on steady-state income and welfare level effects, derived from exogenous-growth OLG models. Subsequently a few steady-state growth results of pension reform

are reviewed, based on endogenous-growth models. Finally it is stressed that the short and medium-term effects of pension reform on saving, income, and welfare can be very different from their steady-state effects.

Steady-state income and welfare level effects of tax-financed pension reform

No attempt will be made here to provide a comprehensive review of the qualitative links between market and institutional features and pension reform income and welfare effects studied by OLG general-equilibrium models. Due to the large number of combinations that grow geometrically with the number of features such a task would go well beyond the scope of this paper. As a more fruitful alternative next I review selectively the results of various pension studies, providing a range of income level (or growth) effects obtained by a representative set of studies.

The seminal contributions by Samuelson (1958) and Diamond (1965) have introduced the two-cohort OLG model to analyze the main public finance, accumulation, and intergenerational welfare dimensions of public debt and old-age security arrangements. A major extension of Diamond's (1965) two-cohort OLG model is Auerbach and Kotlikoff's (1987) many-generations OLG dynamic model which provides a realistic number of interacting cohorts and is particularly useful in showing impact, transition, and steady-state effects of mandatory pension systems and reforms. In the 10 years since publication of Auerbach and Kotlikoff's book, a growing set of applications and extensions of the Diamond-Auerbach-Kotlikoff (DAK) framework has provided simulation results for pension reforms in representative and actual economies.

Four sets of results for steady-state output and welfare (wealth-equivalent) level effects of tax-financed PAYG-FF reforms are reported in Table 6. Studies were chosen to show a wide range of results, reflecting different behavioral assumptions and variations of the basic DAK framework. While the focus is here on the welfare of cohorts living in the very long run -- typically decades down the road, well beyond the period of transition deficits -- one should bear in mind that transition generations bear the income and welfare costs of this contractionary fiscal policy unless they share into the Pareto efficiency gains of pension reform.[11]

The studies suggest that, assuming reasonable parameter values for representative economies, most tax-financed pension reforms deliver long-term level effects that are positive and in the single-digit range. The long-run gains reaped by future generations from a fiscal contraction-based PAYG-FF reform grow with the size and the distortions of the initial PAYG system. Population growth reduces the long-term gains because it raises the rate of return of the initial PAYG system. A critical variable is the share of borrowing-constrained myopic consumers who are forced to save in excess of their voluntary saving. Their presence raises significantly long-term saving

[11] If taxes and pension contributions were lump sum , the economy's Pareto efficiency is not affected by pension reform in the sense that it only induces Pareto non-comparable changes of welfare of different cohorts. However in the empirically relevant case when both PAYG pension contributions and taxes are distortionary , a tax-financed pension reform causes Pareto-efficiency losses (gains) in the sense that the losses of the transition cohorts are higher (lower) than the benefits of future cohorts. This will be the case when taxation required to finance the transition deficit is more (less) distortionary than the initial PAYG contributions (see Breyer 1989, Homburg 1990, and Arrau and Schmidt-Hebbel 1993).

and income levels but their own welfare level could even decline because of forced FF saving. Even when the initial PAYG is distributive toward the poor it is possible that the poor living in the long run will gain from adopting a non-redistributive FF regime. Only when the initial PAYG is highly distributive and contribution rates are low the poor loose in the long term.

Table 6
Range of Steady-State Output and Welfare Effects of Tax-financed PAYG-FF Reforms in Representative Economies: Simulations from General-Equilibrium Exogenous-Growth OLG Models

Simulation Studies	*Output Change (%)*	*Welfare Change (%)*
1. Reproducers and non-reproducers (Arrau and Schmidt-Hebbel 1993)		
2% population growth	+ 3.0	+ 6.8
Zero population growth	+ 5.0	+12.5
2. Homos and heteros (Valdés-Prieto and Cifuentes 1993)		
Homogeneous consumers (No myopia and credit constraints)	+ 1.9	+ 5.9
Heterogeneous consumers (economy includes group of myopes facing credit constraints)	+27.1	+13.5
3. Rich and poor: substituting FF for a highly redistributive PAYG system (Valdés-Prieto 1994)		
Low income concentration, moderate contribution rates		7.2; 4.6
High income concentration, low contribution rates		1.4; -1.1
4. Law abiders and tax evaders (Schmidt-Hebbel 1997a)		
One-sector economy	11.9	6.9
Two-sector economy:		
Labor-intensive formal sector	9.3	5.9
Capital-intensive formal sector	-0.04	-1.2

However, in a two-sector economy where formal-sector labor contributes to the pension system but informal-sector labor does not, the long-term effects of a tax-financed reform could be negative for future cohorts. This case can arise when formal-sector production is more capital intensive than informal-sector production, so that factor reallocation toward the formal sector in response to the removal of the implicit PAYG tax leads to lower wages and higher interest rates. If the derived income loss suffered by the young more than offsets the reform benefits stemming from paying off the implicit PAYG debt and eliminating other PAYG-induced distortions, long-run income and welfare levels decline. The likelihood of this perverse outcome is not high but increases with the initial size of the implicit PAYG tax and the informal sector.[12] Figure 4 depicts the range of long-term income effects of pension reform in one and two-sector economies for different assumptions on capital intensities and implicit PAYG taxes.

[12] The simulation results summarized in line 4 of Table 6 assume a low PAYG contribution rate that is fully considered as a pure tax by pension contributors.

Let's consider now six simulation studies for pension reforms in five countries (Table 7). They share the basic DAK framework with the preceding studies but are parameterized for actual countries. The initial Auerbach and Kotlikoff (1987) study reports long-term income and welfare losses close to 5% as a result of introducing PAYG in the U.S. The next studies report long-term income and/or welfare effects of actual pension reforms in Chile and in Colombia, and of reform proposals for Hungary, the U.S., and Germany. Country features, actual and proposed reform contents, and model structures vary quite substantially among the five studies. Simulated long-term welfare gains differ substantially, ranging from 1.6% in the modest PSA reform proposal for Hungary to 9% in the more comprehensive reform proposal for Germany. Long-term income and welfare gains increase with the size and distortions of the initial PAYG system and with the degree of substitution -- partial or full -- of PAYG by a new FF system.

Table 7
Steady-State Output and Welfare Effects of Tax-financed Pension Reforms in Selective Countries: Simulations from General-Equilibrium Exogenous-Growth OLG Models

Simulation Studies	*Output Change (%)*	*Welfare Change (%)*
1. United States: introduction of PAYG (Auerbach and Kotlikoff 1987)		
Under income taxation	-5.3	-6.0
Under wage taxation	-4.9	-6.3
Under consumption taxation	-4.5	-4.8
2. Chile: 1981 PAYG-FF pension reform (Arrau 1991)	3.1	
3. Colombia: 1994 PAYG-FF pension reform (Schmidt-Hebbel 1997b)		
Homogeneous consumers	2.4	4.2
Heterogeneous consumers (includes group of myopes facing borrowing constraints)	3.9	5.5-6.5
4. Hungary: 1997 partial PAYG-FF pension reform (Cifuentes and Valdés-Prieto 1996; heterogeneous consumers)		
Evaluation of Ministry of Finance proposal		8.3
Evaluation of Pension Fund Administration proposal		1.6
5. The U.S.: hypothetical PAYG-FF pension reform (Kotlikoff, Smetters, and Walliser 1996)	11.1	8.0
6. Germany: hypothetical PAYG-FF pension reform (Raffelhueschen 1993)		9.0

Long-run growth effects

Up to now we have reviewed pension reform results for long-term level effects. Let's refer next to some studies that have focused on long-term growth gains (Table 8).

Simulations for a representative "AK" economy in general equilibrium for a two-sector formal-informal economy report a permanent growth gain of 0.3% per annum. This increase reflects the conventional inter-generational transfer caused by tax financing that benefits future cohorts. However, instead of raising only temporary growth and permanent income levels, a tax-financed pension reform now raises permanent growth because the marginal product of capital (of saving) is bounded from below at a constant "A". Further growth gains -- by 0.4% of GDP -- are reaped when pension reform eliminates the initial PAYG distortion that biases employment toward the less-productive informal sector.

None of the studies reviewed so far focuses on potential income level or output gains of pension reform derived from the development of capital markets. The exception is Holzmann (1997) who estimates ex-post growth effects of Chile's 1981 pension reform. Holzmann identifies two channels of growth gains from capital-market development: higher TFP growth and higher investment rates. Based on econometric estimations for the two latter variables, the (permanent) growth gains due to capital market development range fromn 0.9% (low estimate) to 1.7% (high estimate). Additional (temporary) growth gains are attributed in this study to higher employment growth in response to pension reform, yielding a further high-estimate effect of 1.1%.

Table 8
Steady-State Growth Effects of Tax-financed PAYG-FF Reforms in a Representative Economy and in Chile: Simulations from Endogenous-Growth Models

Simulation Studies	*Growth Change (%)*	
1. Simulations for a representative AK economy in general equilibrium (Corsetti and Schmidt-Hebbel 1997)		
Initial PAYG does not distort formal-informal labor allocation	+ 0.3	
Initial PAYG distorts formal-informal sector labor allocation	+ 0.7	
2. Estimations/simulations for Chile's 1981 PAYG-FF reform (Holzmann 1997b)		
Total growth effect: Low estimate	+1.0	
TFP growth gain from financial market development		+0.4
higher investment rate due to financial market development		+0.5
growth gain from higher employment growth		0
Total growth effect: High estimate	+2.9	
TFP growth gain from financial market development		+1.1
higher investment rate due to financial market development		+0.6
growth gain from higher employment growth		+1.1

Short-term welfare, saving, and income changes

Up to now the focus has been on very long-term effects of pension reform. However the dynamic response of macroeconomic variables to pension reform -- even debt-financed ones -- is very different in the short and medium-term, even decades after the reform start. This is illustrated by the welfare gains and losses that accrue to different cohorts in response to tax and debt-financed reform in a representative economy (Fig. 5). When a pension reform is implemented without smoothing out welfare changes across cohorts -- i.e, when tax rates, government spending and transfer policies are maintained constant after the start of pension reform -- different cohorts are affected very differently by the reform. Therefore cohort behavior will derive in (and also affected by) complex dynamics of all relevant macro variables, including the saving rate and GDP growth for decades after the pension reform was started (Fig. 1.62). Note that the short and medium-term dynamcis of saving and growth -- reflecting optimizing behavior by representative agents along the transition path -- imply significant deviations from the steady-state levels attained by these variables.

Certainly these intergenerational transfers and complex dynamics of accumulation nand growth can be avoided. One way to do it, as in Kotlikoff (1996) or in some country simulations in Cifuentes and Valdés-Prieto (1997), is by imposing a temporary tax on labor equivalent to the implicit initial PAYG tax. However such a policy is unlikely to be adopted in real-world pension reforms and actually has not been observed in any to date. Minimizing intergenerational transfers does not seem to be high on the agenda of fiscal policy makers.

2. HAS PENSION REFORM PLAYED A ROLE IN CHILE'S GROWTH TAKEOFF?

There are three reasons for choosing Chile as the country case for assessing if PAYG-FF pension reform has contributed to saving and growth. First, Chile has pursued the most radical reform to date, leading to a complete abolition of PAYG in the long-term and with a first-pillar social pension insurance financed by general taxation, not labor taxes. Second, Chile's early reform in 1981 provide 16 years of relevant post-reform experience and data that can be subject to empirical testing. Finally -- and this is more of a challenge than a reason -- the country has pursued a wide range of structural reforms other than pension reform which should be controlled for when assessing the implications of the latter reform.

Following a similar structure to that of the preceding section, here I analyze the consequences of Chile's pension reform for the country's public finances, labor markets, capital markets, and saving-investment-growth takeoff. Descriptive statistics for relevant subperiods are summarized in Table 9. The measurement of the contribution of pension reform to Chile's takeoff is based on regression results for private saving, private investment, and productivity growth in Chile, reported in the appendix.

Table 9
Chile: Various Indicators, 1961-97 (percentages unless noted otherwise)

	1961-74	1975-81	1982-89	1990-97
Pension Systems and Public Finance				
Pension system contribution rate	n.a.	26.0	10.0	10.0
Pension system contributors / labor force	n.a.	44.8 (1)	51.1	60.7
Pension transition deficit / GDP	0	0	6.5	4.4
Non-pension public deficit / GDP	6.3	-2.8	-5.6	-6.3
Macroeconomic Stabilization and Structural Reform Indicators				
Total non-financial public deficit / GDP	6.3	-2.8	0.9	-1.9
Normalized inflation ($\pi/(1+\pi)$)	29.3	43.0	16.3	11.6
Index of overall quality of structural policies (1995=62.8)	8.4	40.5	54.5	62.0
Capital markets				
M3 / GDP	15.9	18.4	28.4	36.8
Stock market capitalization / GDP	n.a.	27.7 (2)	24.8	91.7
Private Pension Fund (AFP) Assets / GDP	0	0	9.9	34.9
Labor Markets				
Unemployment rate	6.3	13.1	13.2	7.2
Real wage growth	2.1	10.5	-0.7	4.1
Labor market informality	n.a.	43.3 (1)	43.8 (3)	40.3 (4)
Male labor force participation rate	n.a.	70.2	72.2	75.9
Saving, Investment, and Growth				
National Saving / GDP	12.5	11.4	12.1	24.8
Foreign Saving / GDP	2.6	5.6	6.2	2.4
Gross Domestic Investment / GDP	19.2	17.8	19.2	29.2
Gr. FK Investment / GDP (const. prices)	19.2	16.0	17.9	25.5
Average Productivity of Capital	33.7	34.7	35.7	41.8
TFP growth	1.2	2.0	-0.1	2.7
GDP growth	3.3	4.4	2.6	6.7

Notes: n.a.: not available. (1) 1981. (2) 1980-81. (3) 1985. (4) 1990-94. The data for 1990-97 includes projected figures for 1997.
Source: Central Bank of Chile and author's calculations.

2.1 Pension System Reform and Public Deficit

Chile's 1981 pension reform brought about a significant decline in contribution rates, from an average 26% under the state-managed PAYG system to an average 13.5% under the new privately (AFP)-managed FF system, of which 10% is deposited in individual pension accounts. The drop in contributions was reflected in higher take-home wages, providing a substantial incentive to quick reaffiliation from the PAYG to the AFPs. However -- beyond the change in composition from PAYG to AFP affiliation -- a large increase in pension system coverage has taken place since reform

start. Total (PAYG plus AFP) active pension system contributors have increased from 44.8% of the labor force in 1980 to 60.7% of the labor force in the 1990s.

The pension reform transition deficit -- the sum of an operational pension deficit due to the shortfall of contributions by active workers and the payment of recognition bonds at retirement of active workers in lieu of their past PAYG contributions -- has been substantial: 6.5% of GDP in the 1980s and 4.4% of GDP in the 1990s. It is gradually declining and will converge toward zero in two to three decades. The remaining non-pension surplus of the non-financial public sector has increased sharply during the last two decades, from 2.8% of GDP in 1975-81 to 6.3% of GDP in the 1990s.

As noted above, the fungibility of financial resources does not allow to infer any causal relation from the changes in pension transition deficits and the non-pension transition fiscal position. Such an attempt is particularly useless in this case because Chile's public finances have reflected major structural changes during the last decades that were totally unrelated to pension reform. Among the latter changes are major fiscal adjustments, terms-of-trade shocks, deep recessions, and the banking crisis in the early 1980s. For instance, asserting that the pension reform was financed by non-pension surpluses before and after 1981 is equivalent to saying that changes in all other non-pension revenue and expenditure categories -- for instance the costs of the 1982-85 banking crisis estimated at a cumulative 41.1% of GDP (Marshall and Schmidt-Hebbel 1994) -- were accomodated residually by the available mix of tax resources, debt issuance, and inflation taxation. This example illustrates that it does not make sense to attempt identifying a particular source of financing Chile's reform transition deficit.

2.2 Macro stabilization, structural reform and pension reform

More than two decades of systematic stabilization and structural reform efforts are reflected by country's improved fiscal and monetary stance. Non-financial public-sector surpluses were attained early on (in the late 1970s), reversed in sign during the early 1980s due to the financial crisis and deep recession, and were again corrected in the mid-1980s. For the past 10 years the non-financial public sector has consistently recorded surpluses close to 2% of GDP. Since 1975 Chile has pursued a very gradualist anti-inflation program, bringing inflation down from some 1000% in 1973 to an projected 6% in 1997.

Chile has adopted a broad and deep program of structural reform since the mid-1970s. Recently an index of structural reform progress has been made available by the IDB for a number of Latin American countries, including Chile (Lora 1997).
This measure combines reform progress in five areas (attaching equal weights to them): trade policy, tax policy, financial policy, privatization, and labor legislation.[13] Extending Lora's figures for Chile for the years before and after his 1985-95 period, yields the time-series data reported in Tables 9 and 10. Reform progress in all areas was particulary intense during the military government's first reform period (1975-81). After partial reversals and halts in the early 1980s, further but slower progress was

[13] Partial indicators are used in each area. Policy reform progress is ranked from zero to 100 by each partial indicator and by the overall index.

reached during the military's second reform period and is continued by the democratic governments through the present.

How much did pension reform contribute to the 54-point improvement in the overall structural policy stance? If pension reform acts by improving financial and labor market policies, one should focus on the improvement observed in the two latter indexes since the start of the pension reform. The increase recorded by the financial and labor policy indexes between 1979 and 1990-97 was 33 points and 36 points, respectively (Table 10). Under a very optimistic assumption, 80% of the latter is attributed to the positive contribution made by pension reform in terms of removing labor-market distortions and developing capital markets. Less extreme assumptions are reflected by contributions of 50% and 20%. The corresponding pension reform-induced average effects on labor and financial markets are 27.6, 17.3, and 6.9 points. If weighted by the combined 40% share of labor and financial policy indexes in the overall policy indicator, the latter translates into contributions of pension reform to strucpol that range from 11 points (large effect) to 7 points (moderate effect) and to 3 points (small effect). Therefore the relative contribution of pension reform to the improvement in the overall quality of Chilean policies is estimated at a minimum of 5% and a maximum of 20%.

Table 10
Contribution of Pension Reform to the Improvement in Overall Quality of Structural Policies

	Structural Policy Indexes			*Rise in Policy Indexes due to Pension Reform*		
	Overall Strucpol index	Financ. policy index	Labor policy index	Large effects (80%)	Moder. effects (50%)	Small effects (20%)
1961-74	8.4					
1979		40	30			
1990-97	62.0	73	66			
1. Policy improvements from 1961-74 (or1979) to 1990-97	53.6	33	36			
2. Average financial and labor policy improvements due to pension reform from 1979 to 1990-97				27.6	17.3	6.9
3. Overall policy improvements due to pension reform from 1961-74 to 1990-97:						
in points				11.0	6.9	2.8
in % of total improvement				20.8%	12.9%	5.2%

Source: Lora (1997) and Schmidt-Hebbel (1998).

2.3 Capital markets

Banking and capital markets have developed rapidly and diversified broadly in Chile since the start of domestic financial liberalization and capital-market reforms in 1974-75. Capital-market deepening is reflected by the substantial increase in broad financial liabilities measured by M3 (from 16% of GDP in 1961-74 to 37% in the 1990s) and in stock market capitalization (from 28% in 1980-81 to 92% in the 1990s). Capital-market liberalization helped developing new financial instruments and industries, including insurance services, bond markets, mutual funds, and risk-rating agencies. Banking and capital-market development takes place under conditions of sound regulation and effective supervision by specialized agencies.

Private pension fund assets have increased to 35% of GDP in the 1990s and pension funds hold significant shares of Chile's equity, bank deposits, and public debt. There is little doubt that the AFP industry has helped in developing and deepening Chilean capital markets. But going beyond this general assessment is very hard. As discussed in section 1, pointing out the precise contribution of the privatized and FF Chilean pension industry to the current structure and quality of financial and capital markets would require to agree on an appropriate counterfactual which is unavailable to date.

2.4 Labor markets

After almost two decades of high unemployment, Chile has reached levels close to full employment since the early 1990s, allowing for high annual real wage growth during the 1990s. As noted in section 1, Chile has been the only Latin American country where employment informality has declined since 1980. Total male labor force participation has increased substantially, from 70.2% in the late 1970s to 75.9% during the 1990s.[14] Due to the significant decline in the pure tax component of pension contributions, its is likely that pension reform has contributed to employment (and production) formalization, a larger labor supply, and lower structural unemployment in Chile.

Edwards (1997) simulates labor-market effects of Chile's pension reform using the partial-equilibrium two-sector (formal-informal) Harris-Todaro model with sector-specific capital and an exogenous labor force that was summarized above (Table 11). He considers the extreme case when the full 26% PAYG contribution is a pure tax on labor. As stated by the author, the simulated reduction in structural unemployment (by 2.0 to 3.2%) and real wage gains in the informal sector (by 4.6 to 7.7%) should be taken as upper-bound values of pension-reform benefits. When considering a pure-tax component of PAYG contributions lower than 100%, or allowing for capital reallocation among sectors that differ in capital-intensities and allowing for static and dynamic general-equilibrium feedback effects (as in Schmidt-Hebbel 1997a) the values are likely to be much lower than those obtained by Edwards.

[14] Male labor force participation is a better indicator of labor supply than total male plus female labor force participation because of the long-run trend increase that is observed in female participation.

Table 11
Labor-Market Effects of Chile's Pension Reform (percentage)

	Low labor demand elasticities	*High labor demand elasticities*
Change in the rate of structural unemployment	-2.0	-3.2
Change in the real wage of the informal sector	+4.6	+7.7

Source: Simulation results from Edwards (1997), tables 3 and 4.

2.5 The saving-investment-growth takeoff

After decades of economic under-achievement, a major shift of performance took place in the late 1980s. Chile's decade-long takeoff is reflected by significant trend breaks of saving, investment, and growth rates from historical levels. (Figures 7 and 8). National saving attains 24.7% of GDP in the 1990s, twice its average level observed during the preceding three decades. Current-price gross domestic investment reaches 29.2% of GDP during 1990-97, exceeding substantially its historical level. Gross fixed-capital investment (GFKI) rises by less, to 25.5% of GDP during 1990-97, as inventory accumulation jumps to 3.6% in the 1990s. TFP growth attains 2.7% per annum in the 1990s, a figure that exceeds substantially the meager 1.2% recorded in 1961-74 or the 0.9% observed in 1975-89. As a result of higher investment and TFP growth, GDP growth doubles, increasing from a modest historical level of 3.3% to attain 6.7% in the 1990s.

Next I focus in more detail on the behavior of saving, investment, and growth in order to estimate the contribution of structural reforms in general -- and pension reform in particular -- to the country's takeoff.

2.6 Saving

A major shift in the structure of national saving has taken place in Chile (see Figure 9). The changes in the central government saving ratio to GDP reflect policy shifts and business cycles that have characterized the last three decades, stabilizing in the 1990s at an average 4.5% of GDP. Public enterprise rationalization adopted since 1974 raised public enterprise saving to positive levels but subsequent privatization led to a trend decline of SOE saving levels. Chile's radical pension reform of 1981 led to a gradual increase in mandatory private pension saving that stands today at 3.8% of GDP. However the most radical change is observed in voluntary private saving. After a dozen years of sub-standard saving from 1985 through 1986, the private sector has been able to raise its voluntary saving rate in a few years, from 4.5% in 1986 to an average 14.4% through 1990-97. There is preliminary evidence that most of this increase has taken place in the corporate sector while households are saving little more than before 1987 (Agosin, Crespi and Letelier 1997).

Based on the empirical literature for Chile and other work on worldwide saving [15], regression results for voluntary private saving are provided in the Appendix, including relevant economic, demographic, and policy variables.[16] The first regression result (eq. 1a) is used to decompose the rise in voluntary private saving observed between the 1961-1974 pre-reform period and the 1990-97 period when a significant part of the reforms -- including pension reform -- had already taken place and saving had taken off.

Figure 10 shows that the doubling in the national saving rate is due to a rise in non-financial public sector saving (from 4.9% to 6.6% of GDP), the emergence of mandatory private pension saving at an average 3.7% of GDP, and a large increase in voluntary private saving (from 7.7% to 14.4% of GDP). The latter increase is decomposed using the regression coefficients and the corresponding changes in regressor values.

Fiscal adjustment as reflected by the aforementioned increase in total public saving was only partially offset by lower private saving and by a low amount (0.5% of GDP). The combined effect of overall tax reforms and saving incentives is reflected in a 3.5%-of-GDP rise in voluntary private saving. The small increase in foreign saving contributes to a tiny 0.1%-of-GDP in private saving. More important is the effect of Chile's demographic transition, explaining 2.1% of the private sector's saving increase. Finally, the increase in trend GDP growth from the 1960s to the 1990s explains another 2.1% of Chile's private saving rise. The latter variable confirms the existence of a virtuous saving-growth cycle, widely documented in other takeoff experiences.

What about the direct effect of mandatory pension saving on voluntary private saving? To test for crowding in or out of voluntary by mandatory saving (MSAV), a second saving regression that includes MSAV as a regressor is reported in the Appendix (eq. 1b). Surprisingly a large offset coefficient (exceeding 100%) was obtained, a result that diverges sharply from crowding-in effects reported for Chile by previous studies (Corsetti and Schmidt-Hebbel 1997, Morandé 1996). Hence one should exercise care in interpreting this result. One way to do this is by considering that pension reform crowding in is partly captured by the positive effect of overall tax reform on voluntary saving, offset by the negative influence of MSAV.

Now let's look at the overall contribution of pension reform to saving. This is not an easy task. First, as discussed above, there is no way to pin down how pension transitions were financed and therefore how public saving was affected by the reform. Second, it is difficult to establish the direct contribution of pension reform through overall tax reforms net of crowding out of MSAV. Table 12 summarizes three

[15] Recent studies for Chile include Agosin, Crespi and Letelier (1997), Morandé (1996), Hachette (1997), Corsetti and Schmidt-Hebbel (1997). Recent cross-country and panel-data studies for saving in the world include Edwards (1995), Masson, Bayoumi and Samiei (1995), and Schmidt-Hebbel and Servén (1997), (1998).

[16] An alternative regression is reported, including mandatory pension fund saving as an additional regressor.

alternative estimates of the effects of pension reform on the rise of national saving from 1961-74 to 1990-97.[17]

Table 12
Contribution of Pension Reform to the 1961-74 to 1990-97 Rise in the National Saving Ratio to GDP (percentage)

	Large effects (1)	*Moderate effects (1)*	*Small effects (2)*
Rise in total public deficit due to pension deficit, at hypothetical proportions of 0, 25%, and 50% of pension deficit	0	-0.25*4.4 = -1.1	-0.5*4.4 = -2.2
Rise in mandatory private pension saving	+3.7	+3.7	+3.7
Increase in voluntary private saving due to:	+1.8	+1.2	-0.3
(i) Crowding in by lower total public deficit at regression coefficients	0	0.26*1.1 =0.3	0.34*2.2 = 0.7
(ii) Crowding in by overall 1980s tax reforms at regression coefficients and hypothetical participation of pension reform in overall 1980s tax reforms	0.5*3.5 = 1.8	0.25*3.5 = 0.9	0.5*5.3= 2.7
(iii) 100% crowding out by mandatory pension saving	0	0	-1.0 * 3.7 = -3.7
Rise in national saving explained by pension reform	+5.5	+3.8	+1.2
Total rise in national saving rate	+12.2	+12.2	+12.2

Note: (1) Based on equation (1a), Appendix. (2) Based on equation (1b), Appendix.

Hence the two crucial features determining the effects of pension reform on national saving are how transition deficits are financed and how the private sector reacts to mandatory pension saving. For the first dimension we assume fiscal-contraction financing of pension reform at 100%, 75%, and 50% in columns 1, 2, and 3, respectively. For the second we assume moderate net crowding in at 50% and 25%, and moderate net crowding out at -27% (= -(2.7 - 3.7)/3.7) of mandatory pension saving, in columns 1-3, respectively.

The results of this simple calculation suggest that national saving has increased in response to pension reform by a range of 1.2% to 5.5% of GDP. The mid-point contribution of 3.8% is equivalent to 31% of Chile's national saving rise. The remaining 69% is due to other measures of fiscal adjustment, tax reform, and various structural changes.

[17] The calculations make use of the saving and deficit data reported in Table 9 and Figure 10 and the regression coefficients of equations 1a and 1b in the Appendix.

2.7 Structural reform and pension reform: effects on investment and productivity

As in the case of saving, a major shift in the structure of gross domestic investment at constant prices has taken place in Chile (see Figure 11). The ratio of gross fixed capital investment (GFKI) by the central government to GDP fell significantly after 1974, with little further variations or structural breaks. Public enterprise GFKI shows a trend decline reflecting the decreasing share of public SOEs in GDP, as a result of large-sacle privatization. Inventory accumulation is highly erratic and close to zero up to 1983 and stabilizes at a couple of percentage points of GDP afterwards. As in the case of saving, private GFKI shows a massive structural break.

Based on empirical work on worldwide investment,[18] a regression for private GFKI is provided in the Appendix, that includes a number of relevant economic and policy variables. This regression is used to decompose the rise in investment from 1961-1974 to 1990-97 (Fig. 12). The increase in the gross domestic investment ratio is due to a rise in inventory accumulation (from 0.1% of GDP to 3.4% of GDP), a large decline in overall public sector GFKI (from 11.2% to 4.7% of GDP), and an impressive rise in private GFKF, from 7.8% to 20.8% of GDP.

The massive cut in overall public investment has crowded in private investment, by an amount of 1.6% of GDP. Separately, the large reduction in the corporate tax rate on retained earnings that took place between the 1960s and 1990s has contributed to a 3.2% rise in private investment -- a magnitude that is similar to the one contributed by overall tax reforms to the rise in private saving. Macro stabilization, as measured by the decline in the volatility of inflation, contributed a meager 1.7% to higher private investment. Additional benefits (0.4% of GDP) from macroeconomic improvement were reaped as a result of lower real interest rates. However this gain was more than offset by the negative effect of a slightly higher external debt ratio to GDP in the 1990s -- as compared to 1961-74 -- that reflects a strong negative effect from debt overhang. Finally GDP growth has a modest independent effect on private investment (1.4% of GDP), due to the likely effect of growth on the private sector's expectations about future rates of return on their investment projects.

Applying a procedure similar to the one used in explaining the contribution of pension reform to saving allows to estimate a range for its contribution to higher private GFKI (Table 13). Overall improvements in structural policies explain 7.2% of the 13.0% rise in the latter, of which we estimate a contribution of pension reform in the range from 0.4% to 1.5%. For the mid-point case of 0.9% of GDP, this is equivalent to a small contribution (9%) of pension reform to the overall rise in the private GFKI rate.

Finally I make use of the regressions for average productivity of capital (APK) and growth in total factor productivity (TFP, measured residually by a standard Solow growth equation) to identify the contribution of overall structural policy improvements and pension reform to the obsreved increase in both measures of productivity.

[18] See for instance Servén (1997).

For the mid-point estimates of the contribution of pension reform, the latter explains 0.7 point of the total 5.7-point increase in APK and 0.2% of the 1.5% rise in the TFP growth rate.

Table 13
Contribution of Pension Reform to 1961-74 to 1990-97 Increase in Private GFK Investment Rate, Average Productivity of Capital (APK), and TFP Growth Rates

Variable	*Total Rise*	*Rise attributed to Pension Reform*		
		Large effects	Mod. Effects	Small effects
Structural Policy Index	53.6	11.0	6.9	2.8
Private Investment Rate	13.0			
due to rise in strucpol	7.2			
due to pension reform		1.5	0.9	0.4
APK	8.1			
due to rise in strucpol	5.7			
due to pension reform		1.2	0.7	0.3
TFP Growth Rate	1.5			
due to rise in strucpol	1.8			
due to pension reform		0.4	0.2	0.1

Source: Author's calculations.

2.8 Growth

Now let's put together the preceding estimates in order to infer about the possible contribution of pension reform to Chile's 3.4% increase in GDP growth observed between the sixties and the nineties. Using a standard Solow growth model based on a Cobb-Douglas function with a 40% capital share, it is straightforward to decompose the growth increase by the contribution of the higher investment (or saving) rate, the higher average product of capital, and the increase in TFP growth. I make use of the saving function instead of the investment function, assuming that an increase in national saving is reflected by an equivalent rise in capital formation. This Feldstein-Horioka type of behavior seems to be validated by the Chilean takeoff experience as national saving and gross domestic investment rise approximately in tandem between 1961-74 and 1990-97.

The contribution of pension reform to growth through the three mentioned variables is estimated to range from 0.4% to 1.4% (Table 14). This range of estimated values is less than half the 1.0% to 2.9% range estimated by Holzmann (1997b) for Chile (summarized in Table 8).

The increase in growth attributed to pension reform in Table 14 means that pension reform may have contributed from 12% to 41% to Chile's 3.4% increase in

GDP growth, with a mid-point estimate of 26%. Contributing to the country's growth takeoff by a quarter implies a large payoff reaped from Chile's radical pension reform.

Table 14
Contribution of Pension Reform to 1961-74 to 1990-97 Increase in GDP Growth

Variable	*Total Rise*	*Rise attributed to Pension Reform*		
		Large effects	Mod. Effects	Small effects
National Saving Rate	13.0			
due to pension reform		5.5	3.7	1.2
Average Product of Capital	8.1			
due to pension reform		1.2	0.7	0.3
TFP Growth Rate	1.5			
due to pension reform		0.4	0.2	0.1
GDP growth	3.4			
due to pension reform (share of total GDP growth gain)		1.4 (41%)	0.9 (26%)	0.4 (12%)
through higher saving		0.8	0.5	0.2
through higher APK		0.1	0.1	0
through higher TFP growth		0.4	0.2	0.1
growth-saving feedback		0.1	0.1	0.1
due to other reforms and structural changes (share of total GDP growth gain)		2.0 (59%)	2.5 (74%)	3.0 (88%)

3. DOES PENSION REFORM REALLY SPUR SAVING AND GROWTH?

Substituting a fully-funded system for a pay-as-you-go regime provides potential efficiency gains in factor markets and can contribute to higher saving and growth. But pension reformers face significant uncertainty about the size and timing of these benefits.

The recent world-wide empirical and simulations evidence on pension systems and reforms reviewed in this paper points toward substantial labor market benefits and potential saving effects of pension reform and their implications for growth. PAYG regimes impose significant labor-market deadweight costs and derived income (and growth) losses. These are reverted by pension reform which affects positively total labor supply, labor force participation of aged people, reallocation of labor (and capital) from informal to formal sectors, and structural employment levels. However very little

is known yet about the quantitative links between pension system funding and economic growth that takes place through capital market development.

Private (and national) saving increases with the share of tax (or expenditure) financing of pension reform transition deficits. Less than perfect offsetting of lower public saving and higher mandatory pension saving by private voluntary savers implies that a tax- (or expenditure-) financed pension reform has substantial effects on national saving. Simulated long-term income and welfare level effects of pension reform vary somewhat with model assumptions but they are generally positive and of moderate size. Much more uncertain are potential permanent growth effects of pension reform -- not least because there is litttle agreement about the relevant endogenous-growth paradigm for analyzing pension reform.

New evidence for Chile presented here shows that its radical 1981 pension has improved labor-market performance and contributed to higher saving, investment, and factor productivity. A quarter of the country's growth increase could be attributed to pension reform. The remaining 75% is the payoff to other structural reform efforts. Chile's experience suggests that the benefits of pension reform are compounded by successful reform efforts in other areas and sectors. Pension reform should be seen as a necessary key component of an overall effort aimed at implementing a market-based and private-sector led development strategy that allows the public sector to concentrate on correcting externalities and fighting poverty.

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Appendix: Estimation Results

Subsequent regressions are based on annual data for 1960 (1961) - 1997, available on request. Data definitions and sources are noted at the bottom of each regression table

Voluntary Private Saving Ratio to GDP (VPRSAV)

	Equation 1a		Equation 1b	
	Coefficient	t-statistic	Coefficient	t-statistic
C	10.358	1.95	24.089	2.83
SGROWTH	1.477	6.69	2.043	5.81
PUBSAV	-0.259	-2.64	-0.344	-3.19
FORSAV	-0.886	-6.07	-1.131	-5.98
DEPEND	-0.095	-1.50	-0.292	-2.56
D84	3.508	2.98	5.337	3.60
D74	7.292	3.94	6.604	3.45
MSAV	-	-	-1.888	-2.09
R^2 adjusted	0.879		0.876	
F	40.19		33.97	
DW	2.12		2.51	

Estimated by Two-Stage Least Squares. SGROWTH: Exponential Smoothed Growth (author's estimation based on Central Bank data), PUBSAV: Public Saving Ratio to GDP (source: Balances Consolidados del Sector Público (1969-74), Larraín (1991) and Ministry of Finance (1997)), FORSAV: Foreign Saving Ratio to GDP (source: Central Bank of Chile), DEPEND: Dependency Ratio (source: National Institute of Statistics (INE)), D84: Tax Reform Dummy, D74: Dummmy 1974, and MSAV: Mandatory Saving Ratio to GDP (source: Superintendency of AFPs).

Average Productivity of Capital (y/k)

	Coefficient	t-statistic
C	-45.572	-7.72
STRUCT	0.106	4.07
E	0.743	9.72
LQI	0.089	2.31
D7182	3.449	5.76
R^2 adjusted	0.913	
F	94.42	
DW	1.50	

STRUCPOL: Structural Reform Indicator (source: Lora (1997)), E: Employment Rate (source: National Institute of Statistics), LQI: Labor Quality Index (source: Rojas et., al. (1997)), D7182: Dummy years 1971 and 1982.

Private Investment Ratio to GDP (PRINV)

	Coefficient	t-statistic
C	14.107	3.81
SGROWTH	0.943	4.02
PUBINV	-0.243	-1.10
CORPTAX	-0.076	-3.03
STRUCPOL	0.118	3.20
UCK	-0.218	-2.43
EXTDEBT	-0.088	-5.54
INFVOL	-0.283	-3.18
R^2 adjusted	0.951	
F	101.58	
DW	1.59	

Estimated by OLS. SGROWTH: Exponential Smoothed Growth (author estimation on Central Bank Data), PUBINV: Public Investment Ratio to the GDP (source: Balances Consolidados del Sector Público (1969-74), Larraín (1991) and Ministry of Finance (1997)), CORPTAX: Tax Policy Indicator (author estimation), STRUCPOL: Structural Policy Indicator (source: Lora (1997)), UCK: Use Cost of Capital (source: Central Bank), EXTDEBT: External Debt (source: Central Bank), INFVOL: Inflation Volatility (Standard Deviation) (source: Central Bank).

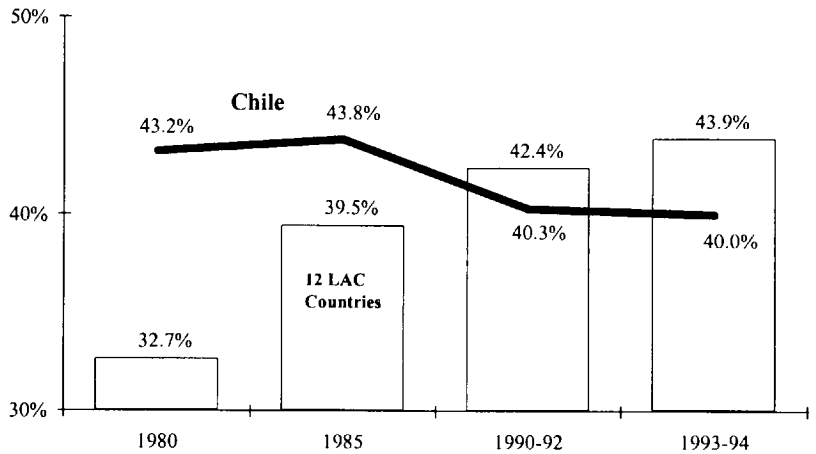
TFP Growth (gTFP)

	Coefficient	t-statistic
C	0.101	0.05
STRUCPOL	0.029	1.36
INF	-0.074	5.91
TOT	0.016	1.75
D7779	5.011	5.97
D82	-6.177	-4.31
R^2 adjusted	0.713	
F	18.85	
DW	1.95	

STRUCPOL: Structural Reform Indicator (source: Lora (1997)), INF: Standarized Inflation Rate (author estimation on Central Bank data), TOT: Term of Trade (source: Rojas et., al. (1997)), D7779 Dummy years 1977, 1978 and 1979. D82: Dummy 1982.

Figure 1

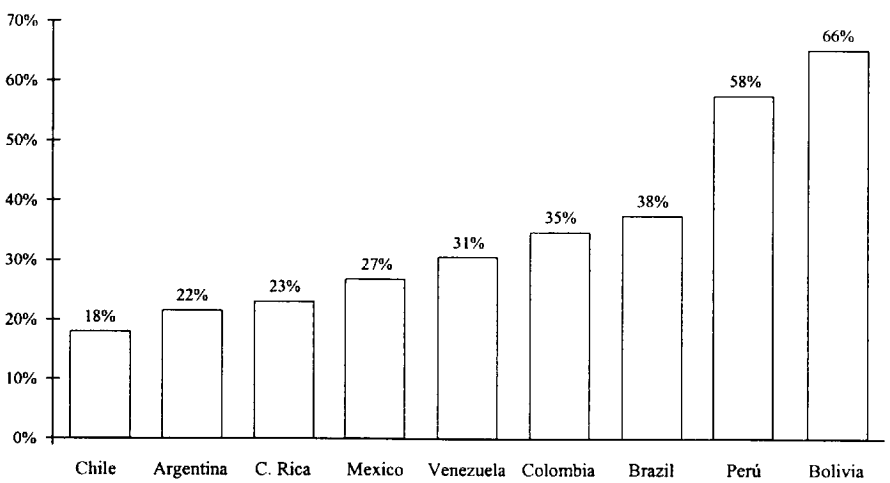
INFORMAL - SECTOR NON-FARM EMPLOYMENT SHARES IN LATIN AMERICA AND CHILE, 1980-1994



Source: ILO (1996).

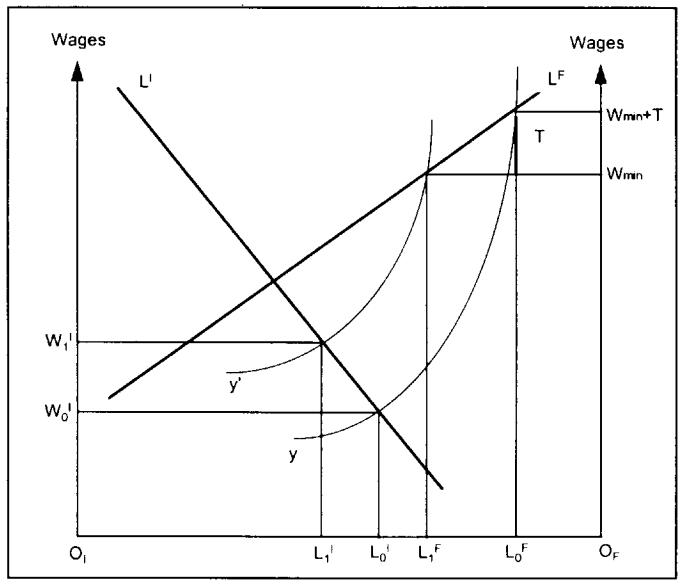
Figure 2

INFORMAL SECTOR SHARE IN GDP, LATIN AMERICA 1990



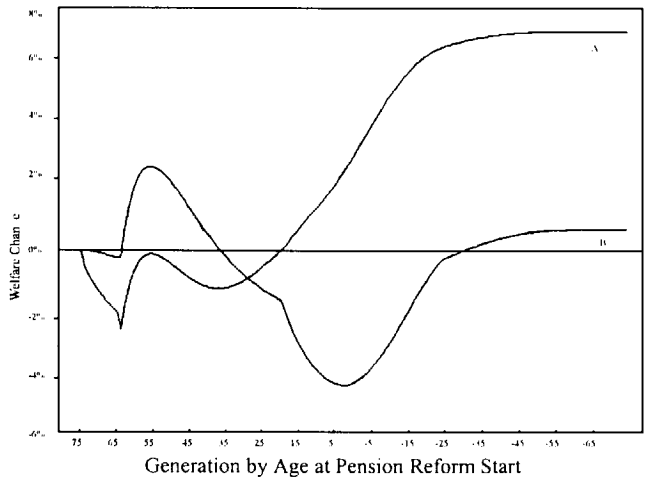
Source : Loayza (1996)

Figure 3
Formal-Informal Employment, Structural Unemployment, and PAYG Tax



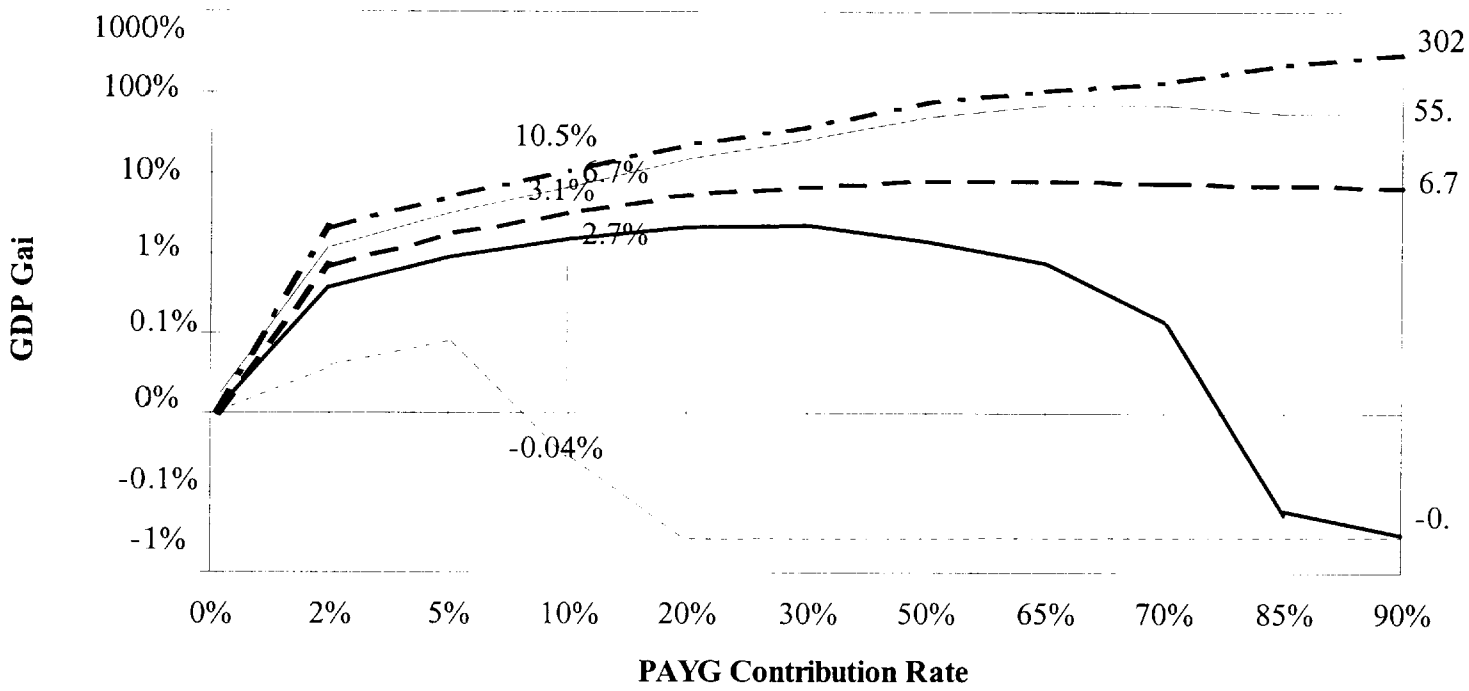
Note: this figure is based on Edwards (1997).

Figure 5
INTERGENERATIONAL WELFARE EFFECTS OF A PAYG-FF REFORM IN A REPRESENTATIVE ECONOMY UNDER TWO FINANCING OPTIONS
(Deviation from PAYG Welfare Levels, in percentage)



Note: Schedule A: Full income-tax financing. Schedule B: Full debt financing
Source: Arrau and Schmidt-Hebbel (1993).

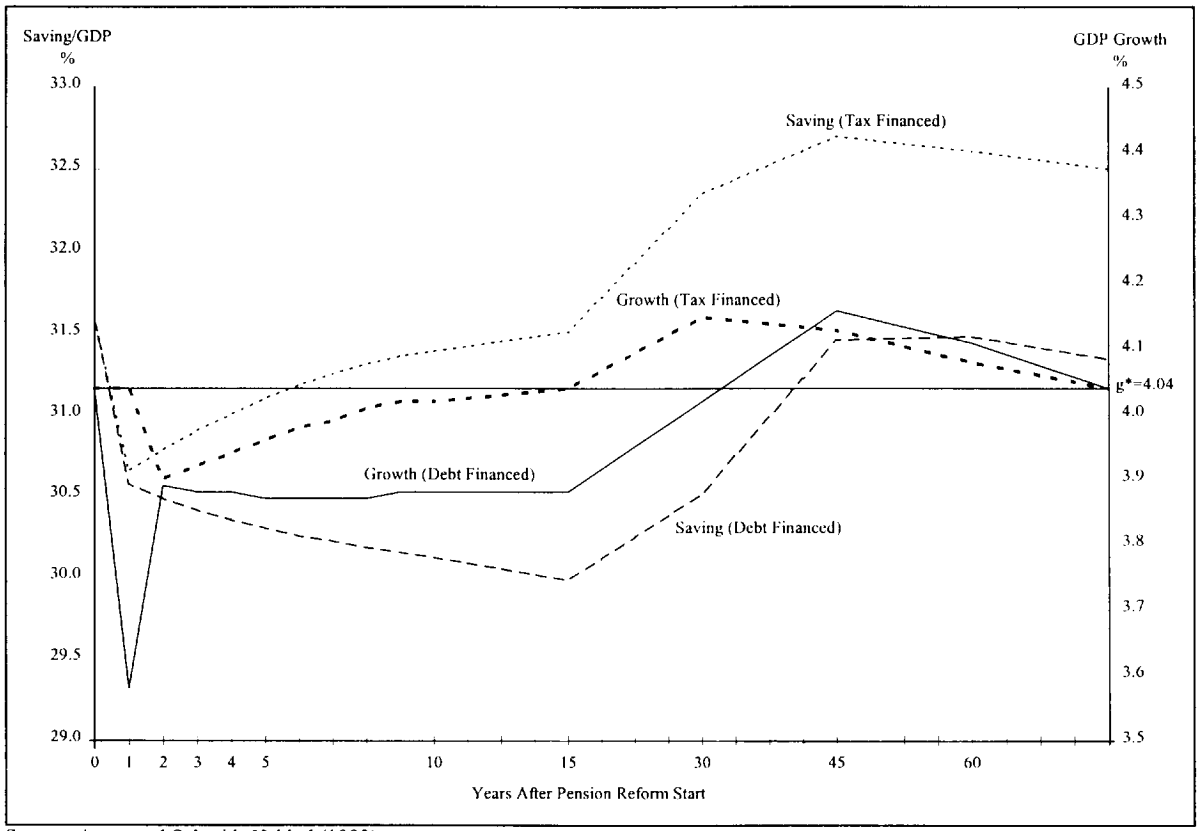
Figure 4
Steady State GDP Gains of PAYG - FF Reforms under Dynamic General Equilibrium for Various Economies
(Zero Intragenerational Distribution unless noted otherwise)



One-Sector Economy, Capital-intensive Formal Sector (Table 3.2, upper panel)
Two-Sector Economy Capital-intensive Formal Sector (Table 3.4, upper panel)
Two-Sector Economy, Capital-intensive Formal Sector, PAYG wtih 100% Intragenerational Distribution (Table 3.4, lower panel)
Two-Sector Economy, Labor-intensive Formal Sector (Table 3.5, upper panel)
Two-Sector Economy, Capital-intensive and more productive Formal Sector (Table 3.6)

Source: Schmidt-Hebbel (1997a).

Figure 6
Saving and Growth Transition Paths after a PAYG-FF Pension Reform under Two Financing Options



Source: Arrau and Schmidt-Hebbel (1993)

Figure 7
Real GDP Growth, TFP Growth, and Unemployment Rate (Chile, 1961-97)

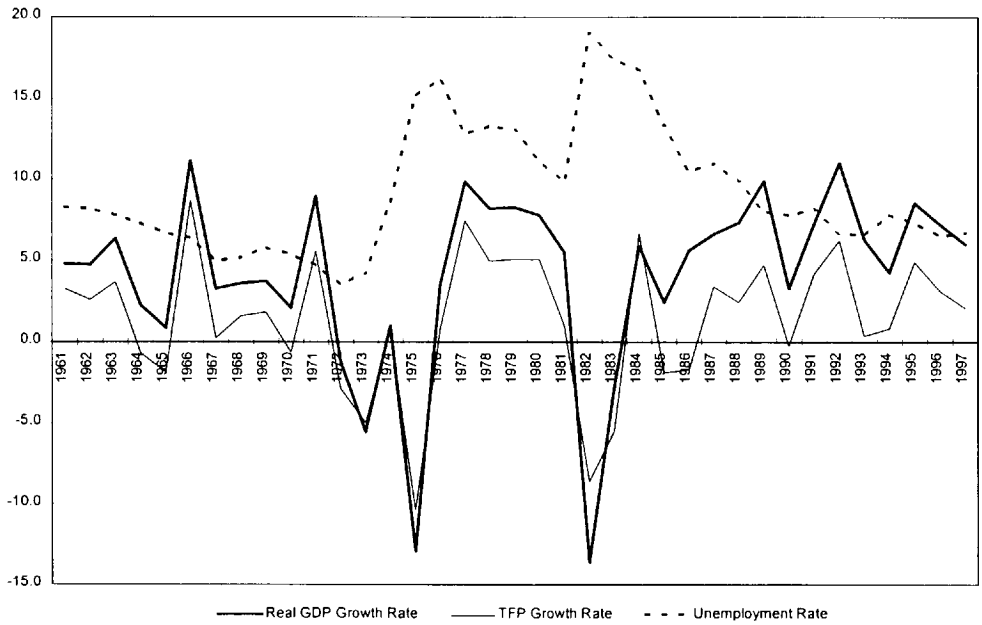


Figure 8
Gross Domestic Investment, National Saving, and Foreign Saving Rates (Chile, 1960-97)

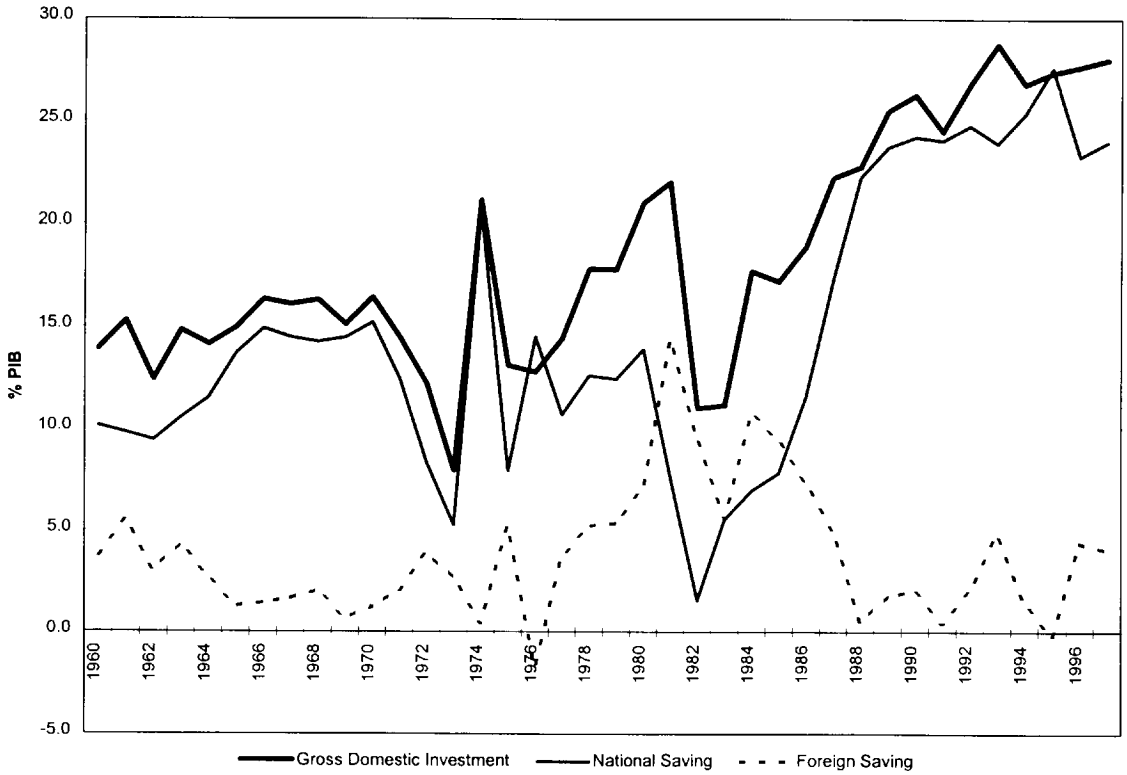


Figure 9
Sector Saving Rates (Chile, 1960-97)
(percentage of GDP)

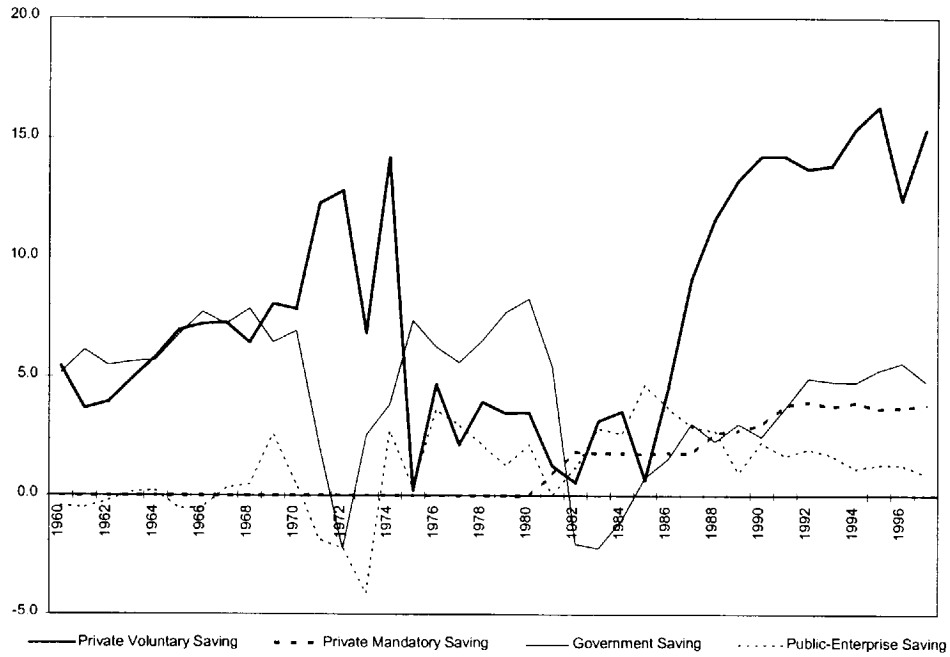


Figure 10
Explaining Chile's Higher National Saving
(percentage of GDP)

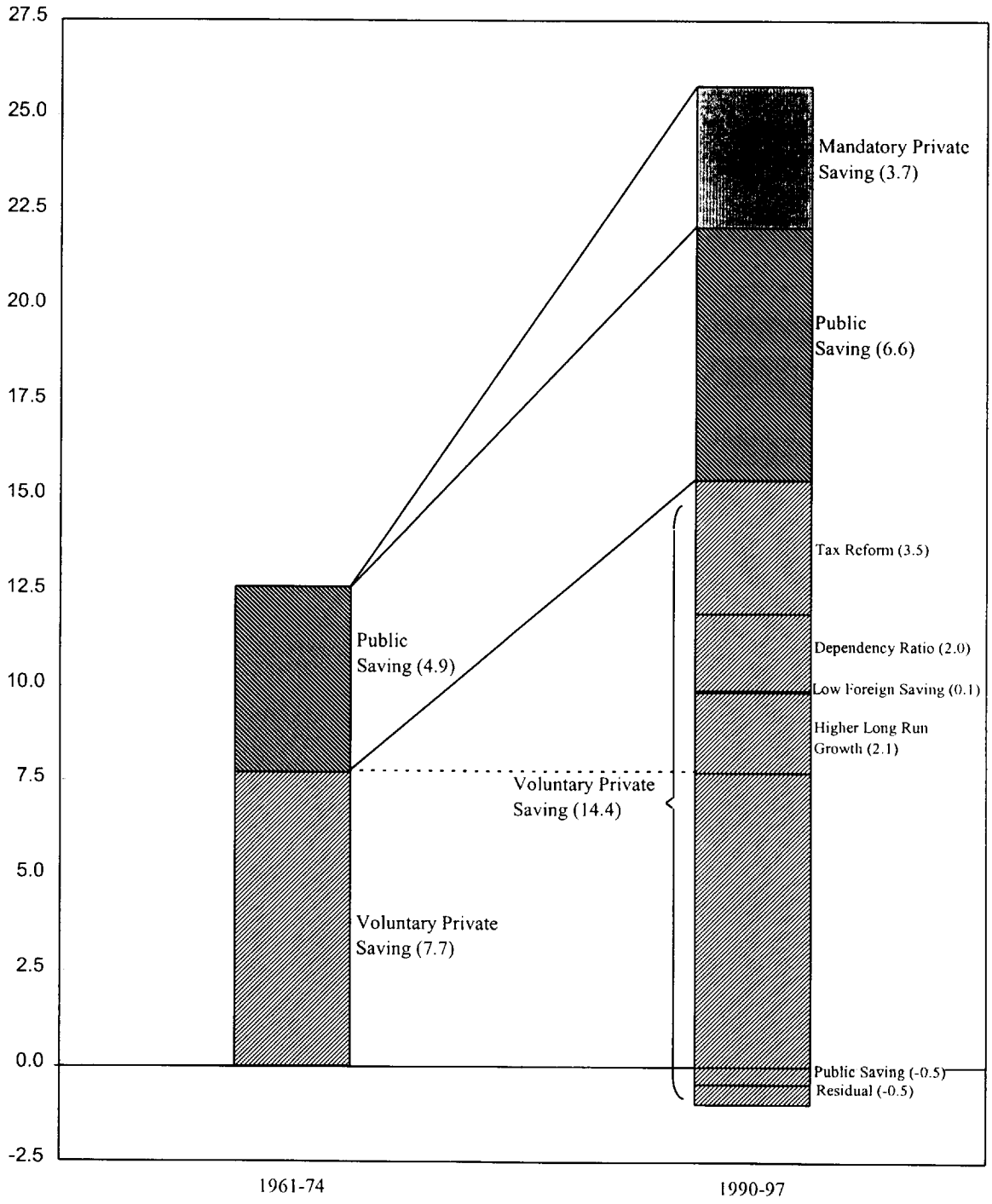


Figure 11
Sector Gross Investment Rates (Chile,1960-97)
(at constant prices, percentage of GDP)

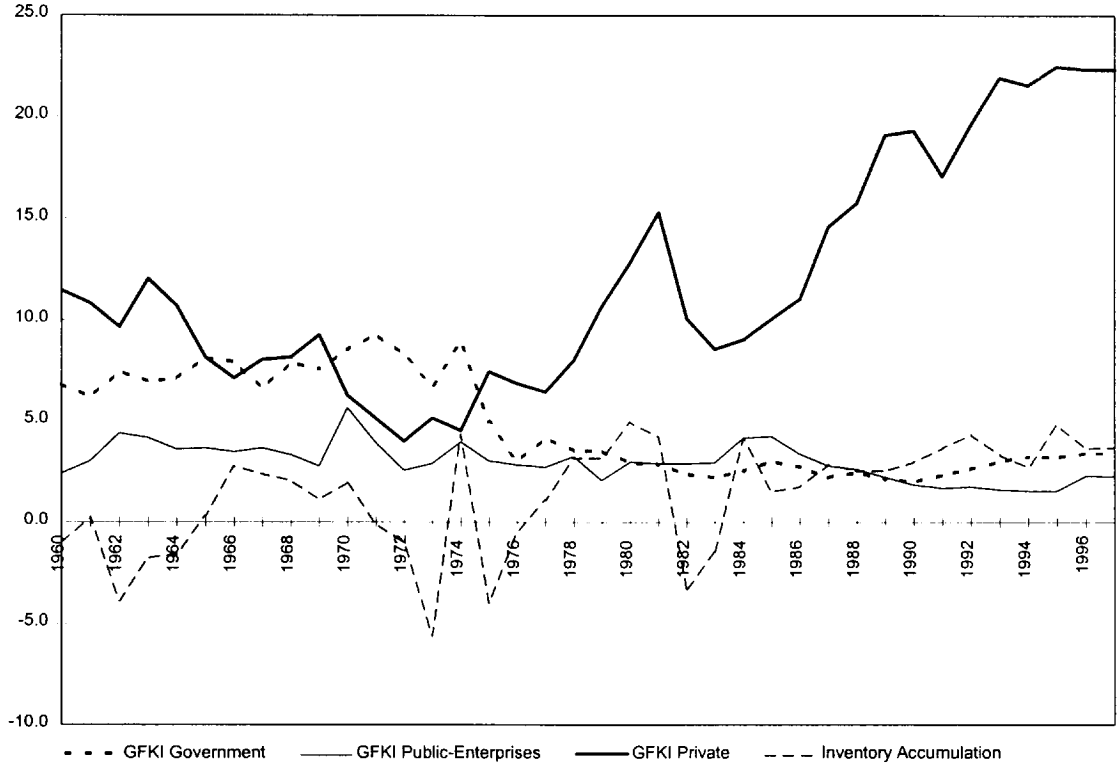


Figure 12
Explaining Chile's Higher Gross Domestic Investment
(percentage of GDP)