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(Partial) privatization social security: The Chilean model - a lesson to follow?

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No. 2000/13

**(Partial) Privatization Social Security:
The Chilean Model – A Lesson to Follow?**

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September 2000

Abstract: This paper examines thoroughly the Chilean Pension Reform, giving first an overview of the mandatory saving plan, the relevant institutions, and the rules for transition from the old to the new system. The main part of the paper contains a critical evaluation of the reform, in particular the macroeconomic performance with respect to capital formation and growth, and the effects on the savings rate as well as on the rates of return and labor market are discussed. Furthermore, the development of capital markets is reviewed. A short critique is presented with respect to intergenerational distribution and risk sharing as well as with respect to the social consequences.

Keywords: Privatization, Social Security reform, Chile

JEL classification: H 55

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Summary

There is an ongoing debate about economic problems, macroeconomic and social effects of different forms to finance pension insurance: pay-as-you-go vs. funded systems, state vs. private. The background of the paper is a report of the World Bank (1994) about "Averting the Old Age Crisis" where a three-pillar system is propagated. Furthermore, because of the "double aging" effects, the traditional pension systems face increasing financial problems.

Privatization combined with funded individual pensions may have several positive advantages: a more efficient labor market, higher savings and via extra investment faster growth, and faster development of financial markets, combined with financial self-determination of the citizens.

In Chapter II, the concept of privatization and different possibilities of privatization as well as the reasons for privatizing Social Security are summarized. In Chapter III the Social Insurance reform of Chile is reviewed shortly: Starting with an overview of the old Social Security system and its problems, the mandatory saving plan and the Administradoras de Fondos de Pensiones (AFPs) are presented. Then the role of the transition rules is described, in particular the bonos de reconocimiento and the indexed bonds. This chapter closes with a preliminary statement about the performance of the new system: the rates of return, the costs as well as the role of the state's guarantee of a minimum rate of return and a minimum pension.

The main part (Chapter IV) contains the critical evaluation of the reform (while recognizing that the model is still in its "infancy", and some of the early mistakes were amended in later stages). This is done in three steps: In the first step (Chapter IV.2), though no econometric model is available, the macroeconomic performance of the Chilean economy is reviewed and compared with her neighbours', the Western Hemisphere, and the World, with respect to growth rates and capital formation. Then the effects on the savings rate, on the rates of return as well as on the labor market are presented. In the second step (Chapter IV.3), a financial-theoretic perspective is taken and the development of capital markets is reviewed using different indicators. In the third step (Chapter V) a short critique is presented with respect to intergenerational redistribution and risk sharing as well as with respect to the social consequences of the Chilean reform, taking into account two alternative targets of social policy: to avoid poverty in old age and to maintain the standard of living. Chapter VI contains a short summary and some conclusions.

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I. Introduction

Pushed by the World Bank's report on "Averting the Old Age Crisis" (World Bank 1994) and the example of Chile, the discussion about the multi - or three-pillar-system of old age security is flourishing around the world recently.

While Chile went first, in 1981, with mandatory individual retirement accounts administered by competing fund-management companies, many other countries in the region followed with reforms of their own – Peru in 1993, Columbia in 1994, Argentina in 1994, Uruguay in 1996 and Mexico in 1997 (see Mitchell/Barreto, 1997, and Queisser, 1998 for overviews of other Latin American nations' pension reforms). Changes in Social Security are on the agendas of many countries, and since there are differences in financing social security, in the state of the economy, in the political details etc., topics of discussions vary across countries ¹.

Partial privatization combined with funded individual pensions may have several positive advantages: a more efficient labor market, because the distorting social-security tax levied only on labor income is replaced; higher savings and therefore extra investment and faster growth; as well as faster development of financial markets which in turn may foster economic growth.

As mentioned, several Latin American countries have shown that the reforms can be politically feasible and successful, in the following we shall discuss whether those reforms are also economically successful. As an example the Chilean reform will be taken because it started in 1981, so there are at least almost twenty years of history. Nevertheless the critical evaluation of the reform will recognize that the model is still in its "infancy", and that some early mistakes were amended in later stages.

On the other hand the consequences in relation to social policy or the social dimension of these reforms has to be considered. To assess these consequences one needs a measuring rod which can be either of the following goals of old age income security: To avoid or to alleviate poverty in old age or to secure the standard of living in retirement ². While in a public PAYG social security system different forms of income redistribution, are incorporated, in a (compulsory) private system these choices are much more restricted (and one must rely almost entirely on the redistributive power of the tax system).

¹ See for an overview Gern (1998).

² Cf. e.g. Hauser (1999).

However, all these questions will be discussed in the following not primarily within a theoretical model but with the help of an empirical example, namely the Chilean economic performance.

The discussion, therefore, will follow these lines: First of all, in section II the different steps to privatization as well as the reasons to privatize will be summarized. In the third section a "curmudgeon's guide" to the Chilean social security reform is presented. In the section four then follows a discussion of the macroeconomic performance of the Chilean economy in particular with respect to growth rates and capital formation, savings, rates of return, and the labor market. In the fifth section the performance of the capital markets is evaluated using different indicators relating to financial development. The social consequences, in particular with respect to income distribution and intergenerational risk sharing, are discussed. The last section contains a short summary and some conclusion whether the "Chilean model" is only a "historic stroke of good luck" or a model case to be followed not only by "transformation countries" but also by industrialized countries.

II. Possible Forms and Ways and Some Reasons for Privatization of Social Security

II.1 Privatization: Forms and Ways

"Privatization of retirement income means often the replacement of government -managed social security by plans with private sector management and private sector investment" (Turner and Rajnes, 1998, p. 283).

However, even a mandatory government -managed scheme can rely on capital accumulation, originally the German as well as the (old) Chilean social security system were fully-funded systems but changed to pay -as-you-go systems in the fifties! Furthermore, government -managed schemes may have individual capital accounts. Moreover, government intervention can take many forms: taxes, transfers, guarantees, regulation, tax incentives etc.

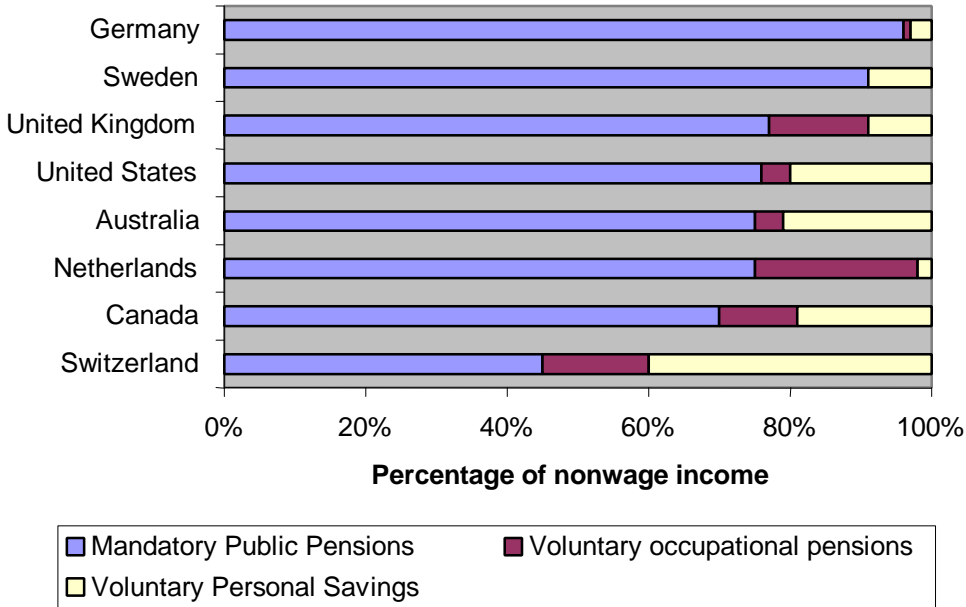
"Privatization" is a relatively ambiguous concept, nevertheless there seems to be consensus that the substitution of one function of the State (or the government) by the private sector is part of privatization. Most retirement income schemes maintain however some government involvement, sometimes even extensively. The Chilean scheme e.g. incorporates a number of State guarantees and tight regulations and therefore is not a purely private system.

Furthermore, the notion of privatization is sometimes extended to include supplementary occupational or private pension plans, mandatory plans that "replace benefits that would have been provided by government" (Turner and Rajnes, 1998, p. 283).

A measure of privatization of retirement income in this sense, more relying on outcomes than on the transformation of governmental functions and institutions, is the percentage of retirement income provided by social security (see Figure 1).

Formal arrangements for old age differ in ways that go beyond the type and degree of

Figure 1: Social Security as Percentage of Retirement Income (selected countries)



Source: World Bank (1994, Figure 7.1.).

government involvement. Pension systems include savings and insurance as well as redistribution as important objectives. They may specify either benefits or contributions in advance – defined benefit (DB) systems or defined contribution (DC) systems. And they may be financed on a pay-as-you-go (PAYG) basis or on a funded (fully or not) basis (FF). This leads to the following distinction between different forms and ways to privatization (see Table 1).

Table 1: Forms and Ways to Privatization

Form of Privatization	Country			
	Defined contribution	Defined benefit	Combined	Hybrid Form
Fully Privatized + Mandatory	Bolivia Chile Mexico			
Fully Privatized and Voluntary	Columbia Peru			
Partial Mandatory Privatization	Denmark Australia Finland	Netherlands Sweden	Switzerland	France
Voluntary Partial Privatization (or Opting Out)	Argentina	Japan	United Kingdom	

Source: Adapted from Turner and Rajnes (1998, Table 4.2.1).

The management of investments in a funded scheme may be the most important aspect of social security privatization, it is however only one of several functions that can be privatized. To see how different functions can be privatized, the Thrift Savings Plan for federal government employees in the United States is an illuminating example: The individual worker can choose within limits the amount he/she wants to contribute and the assets in which the contributions are invested. The government contracts with private investment management companies to handle the investment. The government organizes the administration and the book keeping, the choice of investment managers, and the menu of possible investments. The workers select the investments from this menu. A similar interesting example along these lines is the Central Provident Fund of Singapore.

II.2. Some Reasons for Privatization³

In the literature several reasons for privatization are put forward. As mentioned above, in economics mainly efficiency arguments are at the focal point of all considerations. Besides this, however, also very pragmatic reasons were considered. Nevertheless, considerable controversy exists over many of the reasons, therefore, some will be discussed later while evaluating the Chilean performance.

1. In many countries the contributions to the current social security systems are not sufficient to cover expenditures, therefore, large subsidies (or transfers) by the government are

³ Cf. also Turner and Rajnes (1998)

necessary. Privatization tends to reduce the need to subsidize the system, therefore reduces the government budget and the deficit.

2. Many countries face problems in managing defined benefit systems and think that defined contribution systems could be easier to manage – both financially and politically. Competition in privatized services will be more efficient and lead to better quality (than the monopolistic management by government).
3. Some of the PAYG systems distribute their benefits very inequitably. Since most Latin American countries rely or relied heavily on indirect taxation to subsidize social security benefits, the poor contribute disproportionately to services they probably will never receive. Another aspect of equity is equity across generations in contributions paid and benefits received (generational accounting, in particular see Figure 13).
4. Many economists conjecture that privatization of social security (a) will tend to raise domestic savings, (b) will reduce economic distortions in labor markets presumably caused by traditional financing methods, and (c) will tend to reduce contribution evasion.
5. Demographic changes will raise the dependency ratio (the ratio of beneficiaries N_B to covered or contributing workers N_C) making PAYG systems *cet.par.* more expensive. Given the balance $b \cdot N_C \cdot W = B \cdot N_B$, it follows easily that $b = \frac{N_B}{N_C} \cdot \frac{B}{W}$. This means: the contribution rate (b) is given by the dependency ratio (N_B/N_C) times the income-replacement ratio (B/W ; with B = benefits, W = Wage income). Furthermore, the decline of the population growth rate and the growth rate of real wages have reduced the implicit rate of return of social security contributions, making the market rates of return (on capital) more attractive (cf. Figure 9).
6. Some people favour privatization as a means to increase the choice set of the individual, and also to move to greater individual responsibility for his/her retirement income.
7. Privatization is favoured as a way to develop the private enterprise sector (financial services providers, insurance companies) as well as a way to develop capital markets in countries with poorly developed capital markets. However, the argument can be put differently: privatization is feasible in countries where capital markets have developed up to the point where they could provide adequate investment opportunities.
8. In some countries privatization is favoured because capital markets show a remarkable strength in recent years. On the one hand, the average real rate of return of stocks in the United States increased from an average of 6 to 7 percent per year to over 11 percent in

the past decade. On the other hand, negative rates of return became less probable and the volatility declined. Hence, privatization seems to provide higher benefits for the same level of contributions.

9. Privatizing social security may be used as a vehicle in privatization of government assets. The assets of state-owned enterprises can be sold to the privatized social security system!
10. In general, the public seems to mistrust the financial operations of the government – in particular as a financial or asset manager.

As mentioned in the World Bank report (World Bank, 1994, p. 255), privatization seems to be difficult and more costly, the higher are the "unfunded liabilities" (the implicit social security debt) of the existing systems. Furthermore, privatization should not be confounded with capital formation or fully-funded systems (see Table 1), because also privatized systems can rely on PAYG financing (see e.g. France)⁴. And last but not least, some (or most?) of the advantages expected from privatization may equally well be gained from reforms within the existing social security systems.

III. The Chilean Pension Reform

III.1 First Steps away from the Old System

The Chilean pension reform was part of a far reaching social program of modernization, re-orienting the social and economic order towards the neo-liberal model of Chicago. Besides an extreme de-regulation of labor relations in 1978/9 and a wide-reaching privatization of the health sector⁵, the state drew back widely and transferred also other functions to the private sector⁶.

The old Chilean social security system was founded in 1924 as one of the first comprehensive social insurance systems outside Europe. With the creation of the Private Employees Social Security Fund (EMPART, i.e., Caja de Prevision de Empleados Particulares) and the State Workers and Journalists National Social Security Fund (CANAEMPU, i.e. Caja Nacional de Empleados Publicos y Periodistas) in 1925, the system expanded rapidly, reaching about 75

⁴ Geanakoplos/Mitchell/Zeldes (1998, p. 140) present a tripartite decomposition, the third component is diversification which means "inverting funds (either from the personal accounts or from Social Security trust funds) into a broad range of assets" (139).

⁵ Cf. Sapelli (1999).

⁶ On the global Chilean reforms see Bosworth et al. (1994) and Edwards and Edwards (1991).

percent of the labor force in 1979. However, the system was widely differentiated according to industries and professions (32 institutions with over 100 different regimes) with many inefficient bureaucracies (see Mesa-Lago, 1989). Owing to political "gifts", over-generous benefit and eligibility provisions, and wide-spread evasion, contribution rates were very high and pensions very dispersed.

Table 2: Contributors to the Old Pension System in 1980

Institutions	Number of contributors	% Total
Servicio de Seguro Social	1,394,300	62.61
EMPART	430,000	19.31
CANAEMPU	264,200	11.86
Other	138,400	6.22
Total	2,226,900	100.00

Source: Superintendency of AFPs (1999, p. 19).

Table 3: Pension Contribution Rates (% over Imposable Salary)

Year	SSS			EMPART			CANAEMPU		
	Cont. (1)	Empl.(2)	Total	Cont. (1)	Empl.(2)	Total	Cont.(1)	Empl.(2)	Total
1968-1973	7.25	14.25	21.50	9.00	17.00	26.00	11.00	5.00	16.00
1974-1977	7.25	15.95	23.20	9.00	17.00	26.00	11.00	5.00	16.00
1978	7.25	15.95	23.20	10.16	15.00	25.16	11.00	5.00	16.00
1979-1980	7.25	15.70	22.95	10.16	14.75	24.91	11.00	4.75	15.75

(1) Contributors.

(2) Employers.

Source: Superintendency of AFPs (1999, p. 19).

The system experienced severe financial imbalances, and several attempts to unify the system followed. Furthermore, high inflation eroded most of the accumulated reserves. Therefore, when the Pinochet government took power in 1973, several gradual changes to the pension schemes were made: raising retirement age to 65 for men and to 60 years for women; introducing a uniform minimum pension as well as a uniform indexation mechanism; abolishing all pension regimes based on years of service.

Despite these reforms, contributions – ranging from 16 percent for public sector and 26 percent for white collar employees in the private sector (see Table 3) – covered less than 70 percent of expenditures. Between 1977 and 1980, direct fiscal contributions grew at a rate of

8.5 percent per year, reaching 2.7 percent of GDP in 1980. To prepare for the more fundamental reform in 1981, the Chilean government took steps during 1974 -1979 to build up a remarkable budget surplus (see World Bank, 1994, p. 268).

III. 2. The Mandatory Scheme

In 1981, a fully-funded defined-contribution scheme with individual pension accounts was introduced (see for a short description Queisser (1995) and Edwards (1996)).

The centerpieces of the reform are a privatized compulsory savings plan together with a market for indexed annuities to convert capital accounts into retirement income. The system is administered by private pension funds, the Administradoras de Fondos de Pensiones (AFP), which compete for members. The new system allows the workers to choose the AFP they want to affiliate with, and to transfer their accumulated funds among them (twice a year). Membership is mandatory for new entrants into the labor force and optional for self-employed. The new system emphasizes uniformity of contributions and its structure of benefits, therefore, every private or public-sector employee contributes 10 percent of his monthly income (subject to a ceiling of about US -\$ 1,500 monthly) and on average 3 percent for invalidity and survivors' insurance. This insurance is bought on a group basis by the AFP with private insurance companies. Contributions and benefits are exempt from the income tax; workers can make additional voluntary contributions (in particular to a so-called Voluntary Saving Account (VSA)) which are subject to taxation only when they are withdrawn. Furthermore, these funds are not taken into consideration when determining the State minimum pension guarantee.

Every AFP manages only one fund, and the returns are credited to the personal accounts minus the fees charged by the AFP for its services.

The employers pay no contribution. The contribution of employers within the old system was redeemed by a once-and-for-all increase in gross wages. The contribution rate of employers within the old system were on average 16 percent (see Table 3), and the increase in income was 17 percent, i.e. 10 percent for old age security and 7 percent for health insurance ⁷.

Upon retirement (fixed by law at 65 for men and 60 years for women), members can choose either to purchase an annuity with a life insurance company or to negotiate a phased with -

⁷ The total contribution rate of employers (for pensions, health benefits and labor accident) however ranged from 14 percent (CANAEMPU) over 25,95 percent (SSS) to 28,71 percent (EMPART) (see Superintendency, 1999, Table I.1, p. 18)!

drawal of their balance with the AFP. Early retirement is possible if the balance of the individual pension account is sufficient to provide for an annuity at least 50 percent of the previous wage income (subject to the above-mentioned ceiling). A minimum pension is guaranteed by the state to all members who have contributed for at least 20 years to the new scheme but whose balances are not sufficient to reach the minimum pension throughout the retirement period. Therefore, the government also guarantees the minimum pension to those individuals who, having opted for a phased withdrawal, outlive the program and exhaust their accumulated funds. Furthermore, the state guarantees the contractual obligations of the AFPs and insurance companies up to the minimum pension and thereafter 75 percent up to a maximum level.

The AFPs are licensed and regulated by the AFP Superintendency. An AFP can be established by any groups of shareholders; but they are allowed to operate or manage only one pension fund for all its affiliates. The AFP has a minimum capital requirement (US-\$ 160,000) which rises, however, with the number of affiliates. There is strict regulation of the capital stock, however, the regulation has been gradually relaxed in recent years. The Chilean system imposes a maximum and a minimum rate of return, set in relation to the average performance of the whole system over the last twelve months⁸. The AFPs charge fixed fees and commissions related to the covered wages for the services, in 1996 on average 3 percent of the base salary or 10 percent of contributions! The importance of the fixed fees (on average 1.5 percent) is declining. 70 percent of total fees are for management, 30 percent for sales and marketing. Compared to other systems, e.g. in the U.S.A., the scheme is criticized as being relatively expensive⁹. Despite high competition between the AFPs, so their number declined from more than 20 in the mid-eighties to 8 in 1998, the operating costs remained high: Instead of reducing commissions, the AFPs have spent more on advertising and sales agents¹⁰.

III.3. Transition Arrangements

Most of the discussion about privatizing pensions is turning around the transition arrangements: "The costs of a transition from one system of old age security to another are large" (World Bank, 1994, p. 255). Even in many theoretical analyzes there remains a "double burden" at least for one generation (cf. Breyer, 1989). This burden falls on the working population, who has to pay the pensions of the old system and the contributions for their own

⁸ The minimum rate, e.g. is equal to the average of all AFPs minus 2 percent or 50 percent of the average real rate of return of all AFPs, depending on what is lower.

⁹ See Diamond (1998, pp. 54-55) for some cost calculation.

¹⁰ The number of sales agents, e.g. increased from 1.882 in 1982 to 17.448 in 1997 (see Superintendencia, 1999, p. 226).

capital accounts. But, first and most important, efficiency gains can and should be used to pay off the implicit debt behind the value of expected benefit rights of the elderly (see e.g. Homburg and Richter, 1990, and Belan, Michel and Pestieau, 1998).

Additional debt reduction comes from the reform of the social security itself, e.g. by raising the retirement age and by eliminating the early and special retirement regimes. "What remains of the debt can be financed by issuing government bonds, cutting other government expenditures, selling public assets, or raising tax rates. The methods chosen will determine savings, growth, and the generational distribution of the benefits and costs of the transition" (World Bank, 1994, pp. 266-267).

The Chilean government privatized more than 500 firms in two rounds - the first from 1974 to 1982, the second from 1985 through 1992, while between 1982 and 1984 there "was a partial reversal in the process" when the government had to take over more than 50 banks and firms that failed in the recession of 1981-1982 (see Edwards, 1996, p. 3).

In Chile, upon establishment of the new AFP-system in 1981, the members of the old pension system (who had not already retired when the new system was introduced) were given the choice of remaining in the public system or to switch to one of the private AFP.

Current and future pensions for those members who had already retired or have chosen to stay with the old system are financed from current contributions to the public scheme and from the general treasury.

For those who moved to the new scheme, the accumulated entitlements were paid off by an immediate issue of "recognition bonds" ('bonos de reconocimiento'). These recognition bonds were supposed to equal the expected present value of the benefits these workers had thus far earned. However, calculating the social security entitlement is difficult in developing countries where employment records are incomplete. Therefore, the recognition bonds are rated so as to equal the present value of a pension replacing, for a full contribution period, 80 percent of the member's average income in the 12 months prior to June 1979 (see Queisser, 1995, p. 27; Edwards, 1996, p. 26).

The recognition bonds were nontransferable, are adjusted to inflation and earn 4 percent real interest, and are redeemable for lump sum payments into the workers' mandatory savings account upon retirement (or invalidity or death).

III.4 A Preliminary Statement about Performance¹¹

The annual deficit resulting from subsidies to current pension payments and recognition bonds started at 0.6 percent of GDP in 1981, raised gradually to 4.8 percent in 1991 (see World Bank 1994, Box Table 8.5, p. 268), and is now expected to decline thereafter, "as older retirees die". The pension debt will gradually diminish until the last covered retiree dies and the last worker with a recognition bond retires, around 2025.

The subsidy to the Pension Normalization Institute (INP), the central administration of the still existing different old regimes (with different contribution rates and benefit levels), has been fluctuating around 3 percent of GDP (see Superintendency 1999, Table II. 3). These costs will, however, decline rapidly because of life expectancy in Chile. In September 1998, the old pension system still had around 300,000 contributors (or 4 percent of the labor force) and paid benefits to about 1 million pensioners.

The new AFP scheme consisted in the first year of 13 AFPs with 1.4 million persons – 38 percent of the labor force – enrolled. 1993 the system expanded to 25 AFPs with a total of 5 million members, corresponding to a coverage of almost 95 percent of the Chilean labor force. In Sept. 1998 the number of affiliates is above 5.8 millions, and after a process of mergers and acquisitions, the number of AFPs was 10. (For a short summary of the AFP industry's development see Appendix A.) However, the share of contributors has been declining steadily, from 65 percent in 1982 to less than 55 percent in 1998. These figures are shown in Table 4 for some selected years.

Table 4: Evolution of Affiliates and Contributors (selected years)

Year	New Pension System ¹⁾		Pension Normalization Institute (former SS Funds) ²⁾
	No. of Affiliates	No. of Contributors	
1979	-	-	2,291,184
1981	1,400,000	-	731,939
1982	1,440,000	1,060,000	488,856
1985	2,283,830	1,558,194	454,409
1989	3,470,845	2,267,622	
1994	5,014,444	2,879,637	
1997	5,780,400	3,296,361	

¹⁾ Up to Dec. each year

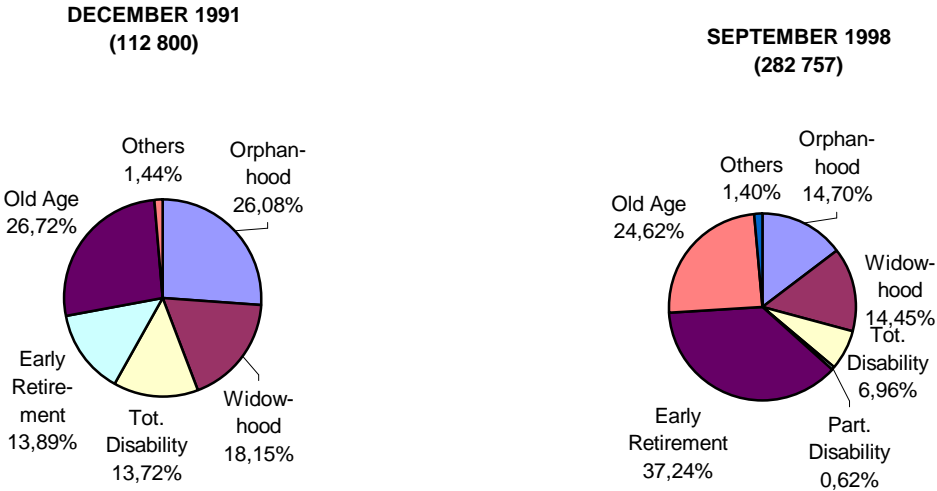
²⁾ Annual Average

Source: Superintendency (1999, Table II.1 and Table V.1).

¹¹ See Superintendency of AFPs (1999).

Several reasons are responsible for this decline: on the one hand pensioners, who chose the phased withdrawal of their balance, count still as members but don't pay contributions, on the other hand loss of a job or withdrawal from the labor force, and non-payment of contributions by self-employed affiliates, who contribute on a voluntary basis.

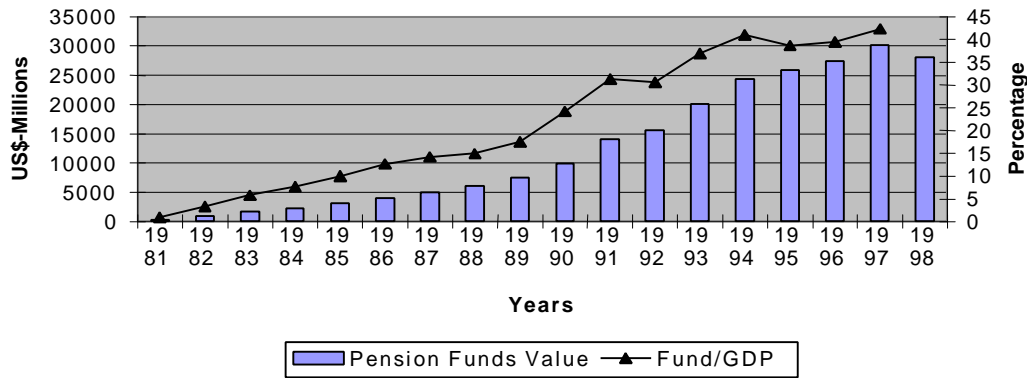
The number of pensioners in the AFP system is still very low; in Sept. 1998 only 282 757 pensions have been processed (see Figure 2).



Source: Superintendency of AFPs (1999, p.134).

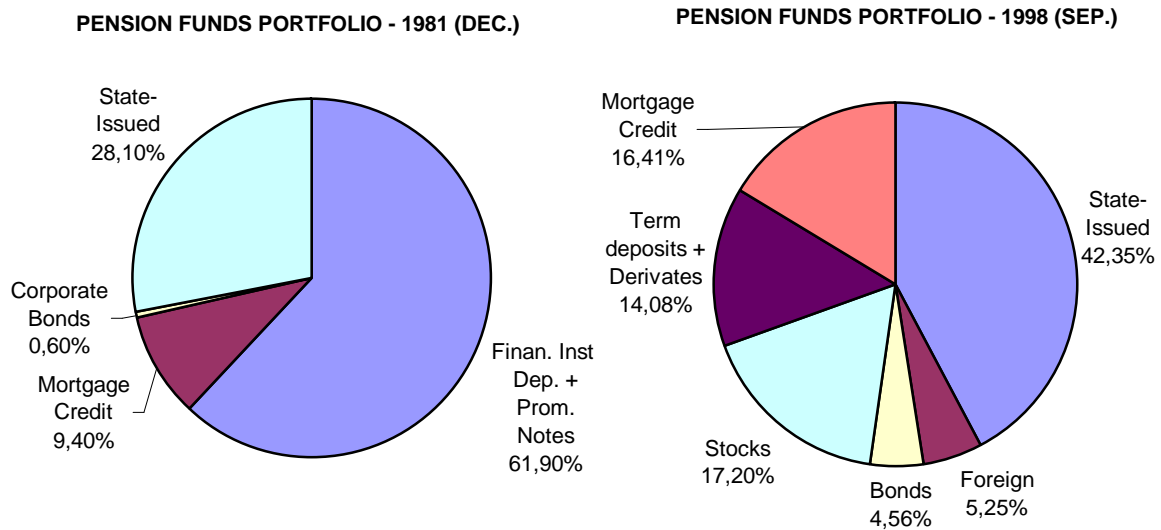
In 1998 the AFPs managed assets of more than US -\$ 28 Billion, corresponding to 40 percent of GDP (see for the evolution Figure 3). The investment portfolio (end of 1997) was composed of 40 percent government bonds, 23 percent equities, 17 percent mortgages, 5 percent corporate bonds, and 15 percent other instruments (see for a comparison between 1981 and 1998, Figure 4).

Figure 3: Pension Funds Evolution



Pensions Funds Value in Sept. 98 -US \$.
 Data up to September
 Source: Superintendency (1999, p. 21 7).

Figure 4: Changes in AFPs Portfolios



Source: Superintendency of AFPs (1999, p. 220).

From the beginning of the AFP system the composition of the AFPs' investment was highly regulated. In early 1985 Pension Funds were allowed to invest up to 30 percent of their resources in corporate stock of formerly State-owned companies in the process of privatization. The greater depth of the capital market following the privatization let to an increase in investments in private corporations' stock. Another change took place in 1990, when Pension Funds were allowed to engage in stock investments in corporations with a concentrated ownership and in foreign instruments. "A significant change in regulations governing Pension Funds investments is included in the so-called Capital Market Act, which amended investment limits and increased the number of eligible instruments" (Superintendency, 1999, p. 140). An overview is given in Table 5.

Table 5: Limits per Instrument before and after the Capital Market Amendment Act¹⁾

Instrument	Before Amendment				After Amendment			
	Range				Range			
	Lower Limit		Upper Limit		Lower Limit		Upper Limit	
1. State-Issued	0 %		45 %		35 %		50 %	
2. Financial Inst. Deposits and Bonds	40 % if at least 1/4 has expiry date beyond one year. 30 % if expiry term is ≤ one year				30 %		50 %	
3. Titles Guaranteed by Financial Institutions								
4. Credit Bills issued by Financial Institutions	40 %		100 %		35 %		50 %	
5. Bonds from Public and Private Companies	30 %		100 %		-	30 %	-	50 %
6. Convertible Bonds from Public and Private Companies					10 %		15 %	
7a. Stocks from Open Corporations Subject to Chapter XII of DL 3.500	10 %	20 %	30 %	40 %	30 %		40 %	
7b. Stocks from Open Corporations not subject to Chapter XII of DL 3.500	10 %		30 %					
8. Real Estate Corporate Stock	10 %	20 %	30 %	40 %	-	10 %	-	20 %
9. Real Estate Closed Mutual	10 %	10 %	20 %	20 %	-		-	
10. Shares of Corporate Development Closed Mutual Funds + the Amount of inputs committed via promissory contracts of subscription and payment of C.D.C.M.F. accounts	0 %	10 %	5 %	20 %	2 %		5 %	
11. Shares in Personalty Closed Mutual Funds	10 %		20 %					
12. Shares in Securitized-Credit Closed Mutual Funds	Non-eligible instruments				5 %		10 %	
13. Negotiable Instruments representing Bills of Exchange or Promissory Notes with Expiry term ≤ one year.	10 %		100 %		10 %		20 %	
14. Credit titles, securities and negotiable Instruments issued or guaranteed by Foreign States, Foreign Banks and Central Banks, and Shares, Stocks and Bonds issued by foreign companies, open and closed mutual funds; and hedging operations of the instruments noted in this number.	0 %		10 % Fixed-Income	10 %	6 % Fixed-Income	6 %	12 % Fixed-Income	12 %
			Variable Income Non-eligible		3 % Variable Income		6 % Variable Income	
15. Hedging Instruments -Domestic	Non-eligible instruments				5 %		15 %	
16. Pension Funds Shares	20 %		100 %		Non-eligible instruments			
17. Others authorized by the Central Bank, whose issuers are surveilled by the Superintendency of Securities and Insurances or by the Superintendency of Banks and Financial Institutions.	Non-eligible instruments				1 %		5 %	

¹⁾ Limits mentioned in the 'After Amendment' column may be found in the so -called Capital Market Act of 1994.

Source: Superintendency (1999, Table V. 6 (resp. Table III.2)).

At the end of 1994, the maximum limit for investment abroad was 10 percent of total assets (it is now 20 percent), but AFPs invested less than 1 percent in these assets. Only recently, AFPs raised their share of foreign assets to 5 percent.

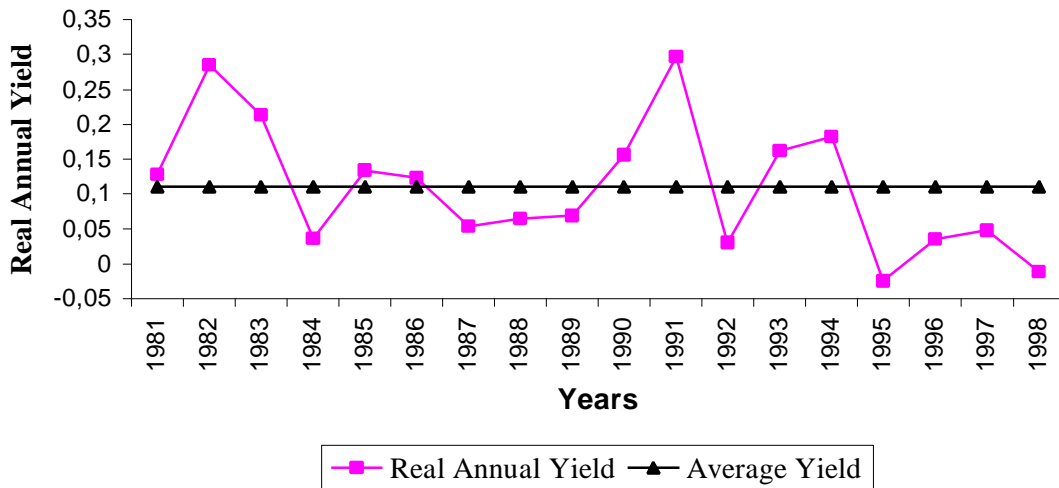
Private capital markets have flourished since 1981: When the new contributions to the AFPs substituted for the former "wage tax", then a new market for financial assets (inclusive government bonds) was created. Even when private savings decline in proportion to the new compulsory savings, the composition of portfolios is different: Shares and bonds substitute for bank credits and deposits. Even 1994 the AFPs kept 55 percent of governments bonds, 62 percent of outstanding mortgage credits, 59 percent of industry bonds, and 11 percent of all shares.

Since the introduction of the system, the AFPs have achieved an annual real rate of return of 15.9 percent (from 1982 through 1994) or of 11 percent (up to 1998), fluctuating between 44.5 percent in 1983 and - 2.7 percent in 1995 with a standard deviation of 11.63 (resp. 12.06). This has been partly due to the fact that government subsidies to the financial system shielded the pension funds during the 1983 -1984 financial crash, the pension funds, however, reaped all the benefits of the recovery starting in the late eighties. The real annual rate of return of 1998 is expected to be negative. For a more detailed review of the rates of return of different AFPs see Appendix B.

The Superintendency (see Superintendency, 1999, pp. 151 -152) calculates an annual real (UF-deflated)¹² share yield, reflecting the profitability of the investments by the AFPs. It is identical to all affiliates of an AFP and independent of the accrued balance and the commissions collected. "This yield, measured in annual terms, is the percentage variation in the average value of the share [the value of which increases or decreases depending on the economic, or market, value of investments] in any given month, as compared with the average monthly value of that share in the same month of the previous year" (ibid, 151 and note 61). This yield peaked in 1991, reaching 29.7 percent, with a trough of merely - 2.5 percent in 1995. For 1998 the value end Sept. is - 9.6 (see Figure 5). However, there is an almost 5 - percentage-points difference in the after-tax rate of return between low wage earner and the top earner, as reported by Diamond (1997, p. 288).

¹² UF (= unidad de fomento), Chile's indexed unit of account.

Figure 5: Real Annual UF-Deflated Share Yield



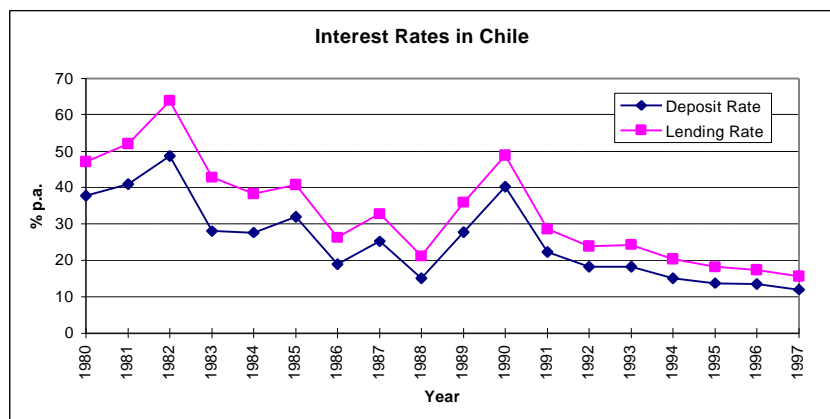
Source: Superintendency (1999, p.152) for 1998: <http://www.safp.cl/>

The "money stream" into the AFPs and the relatively favourable rates of return in the 1980s are certainly determined endogenously. The short time period since the implementation in 1981 reflects the "immature character" of the system whose growth rates are high. Furthermore, real rates of interest were decreasing, leading to sudden increases in some share prices and, therefore, high capital gains. Thus, the question remains, how such a system will perform when it is "mature"! Also the demographic changes so far were advantageous.

However, the "normal" development of interest rates shows high rates (see Tables 6 and Figure 6). Considering only the interest rate of deposits in 1997 (12 percent), subtracting the inflation rate (6 percent in 1997), yields a real interest rate of 6 percent. Comparing this figure with the rate of return of the AFPs of 4 percent in the same year, then the "gloriole" disappears. Furthermore, the high real returns of the new Chilean AFP system in 1981 through 1990 is not exceptional: It reflects only similar developments in other securities markets around the world.

Table/Figure 6: Interest Rates in Chile -- Deposit Rate/Lending Rate in % p.a.

	Deposit Rate	Lending Rate
1980	37,72	47,14
1981	40,9	52,02
1982	48,68	63,86
1983	28,01	42,82
1984	27,63	38,33
1985	31,97	40,81
1986	18,99	26,27
1987	25,22	32,8
1988	15,11	21,17
1989	27,72	35,92
1990	40,27	48,83
1991	22,32	28,55
1992	18,26	23,92
1993	18,24	24,3
1994	15,08	20,34
1995	13,73	18,16
1996	13,46	17,37
1997	12,02	15,67



Source: International Financial Statistics Yearbook (IMF) (1998, p. 109).

IV. Critical Evaluation of the Chilean Pension Reform

IV. 1 Preliminary Notes

In the following, my critical remarks will be related to two sets of key macroeconomic questions¹³. First, the welfare effects: How does privatization affect the relation between market interest rates, capital formation and economic growth? In answering this question the demographic changes have to be taken into account, because there are different effects caused alone by a reduction in population growth.

In simple models the "Aaron proposal" (cf. Aaron, 1966) holds: A PAYG system is "cheaper" (i.e. in a stationary equilibrium the contribution rate necessary for a given benefit level is lower) than a fully-funded scheme, if the interest rate is lower than the natural growth rate (defined as growth rate of the population plus productivity growth) or the growth rate of wages. This point has sometimes been discussed with reference to "dynamic inefficiency", where individuals are so eager to save that market rates of return fall below the population plus wage growth rate. Therefore, except under practically irrelevant conditions (cf. Abel et al., 1989), the implicit "return" of social security contribution is below comparable market rates of return.

In an ongoing social security system, the burden borne by the current generation depends upon the distance between the market rate of return and the population plus productivity growth rates. And it is not surprising that social security has been cast more and more under attack as population growth and wage or productivity growth have declined. But, is this not a historic "windfall gain"? Dynamic economies with relatively high government indebtedness (as a demand on the capital market) lead to relatively high average rates of return. However, the widespread attempts in reforming public budgets (i.e. the reduction of new indebtedness below the "3 percent line" of GDP) in combination with a declining population may well lead to declining real interest rates. However, the conversion of the "implicit social security debt" can compensate for this shortfall and contribute to the flourishing of (world-wide) capital markets.

The second set of questions raised here, relates to the distributional and risk-sharing question: How does a certain policy proposal affect the expected cash flows between different generations and the government, how are the macroeconomic risks allocated across

¹³ That does not mean, that microeconomic questions are not important for Social Security reforms (see e.g. Mitchell and Zeldes (1996)), they are only beyond the scope of this paper.

generations, and how does the government affect the sharing of such risks (cf. Bohn, 1997)? These questions are only briefly commented on in the following chapter V, mostly because there is no empirical evidence at hand.

To answer the first set of questions, a first-rate solution here would be to develop a macroeconomic model of an open economy in which it is possible to explicitly incorporate the transition from a social security-defined benefit (PAYG-DB) system to a fully-funded, defined-contribution (FF-DC) scheme. On this basis the main effects of the reform could be formulated: First, the reform affects positively national savings and capital accumulation, and hence contributes to economic growth. Second, the reform enhances and accelerates financial market developments and thus the efficiency allocation. Third, the reform reduces labor market distortions, because a closer link between contributions and benefits is introduced, and thus may result in higher labor market participation. In the next step, this model should then be tested econometrically using data of Chile before and after the social security reform. This task, however, seems impossible, at least for me (but see Appendix C for a simple overlapping-generations model). In the following the most important variables will be identified, and then a non-structural approach is chosen: Instead of testing a particular theory (or model) to explain the macroeconomic relationship, a comprehensive statistical picture will be given. This "method of inspection" is less rigorous than desirable and mostly relies on "proof by assurance". Nevertheless, there are important results.

Furthermore, there exists a more basic problem. As mentioned above, the social security reform was part of a "landmark reform" starting in the mid-1970s. These structural reforms and the stabilization program – coupled with a severe shock in the terms of trade (e.g. higher oil prices and a collapse of copper prices) – "led to a harsh recession ... followed by several years of strong economic recovery... The euphoria came to an abrupt end in 1981, when the economy again collapsed ... The resulting recession was among the most severe in all Latin America: unemployment, including workers in special government-subsidized employment programs, rose to 30 percent of the labor force in 1983 ..." (Bosworth, Dornbusch, Labau, 1994, pp. 1-2). However, since 1983 Chile has achieved a sustained strong economic expansion: unemployment has declined; inflation, while still high, is below the rates that existed in the 70s and below the rates in other Latin America countries. "To a great extent, the growth of the Chilean economy during the 1980s should be viewed as a recovery from an extreme depression, fueled by high levels of surplus labor" (as Marfan/Bosworth, 1994, p. 165 remark). Therefore, it seems impossible to attribute or to credit the social security reforms with this development (see Table 7 for an overview of some macroeconomic indicators).

Table 7: Chile: Macroeconomic Indicators 1970-1997

Macroeconomic Indicators	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
GDP Growth (real)	2,1	9	-1,2	-5,6	1	-13,3	3,2	8,3	7,8	7,1	7,8	5,5	-14,1	-0,7	6,4
Inflation - CPI (Dec. To Dec.)	34,9	22,1	163,3	508,4	375,9	340,7	174,3	63,5	30,3	38,9	31,2	9,5	20,7	23,1	23
Unemployment rate	5,7	3,9	3,3	5	9,5	14,9	12,7	11,8	14,2	13,6	10,4	11,3	19,6	14,6	13,9
Gross capital formation to GDP	16,4	14,5	12,2	7,9	21,2	13,1	12,8	14,4	17,8	17,8	21	22,7	11,3	9,8	13,6
Gross savings rate	17,1	13,5	8,7	6,1	21,8	11,1	17,1	12,6	14,5	15	16,8	12,4	9,4	12,5	12,6
Macroeconomic Indicators	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997		
GDP Growth (real)	2,5	5,6	6,6	7,3	10,6	3,7	8	12,3	7	5,7	10,6	7,4	7,1		
Inflation - CPI (Dec. To Dec.)	26,4	17,4	21,5	12,7	21,4	27,3	18,7	12,7	12,2	8,9	8	7	6		
Unemployment rate	12	8,8	7,9	6,3	5,3	5,7	5,3	4,4	4,5	7,9	7,3	6,4	6,1		
Gross capital formation to GDP	17,2	18,9	22,2	22,8	25,1	25,1	22,6	23,8	26,5	24,1	25,8	26,6	26,9		
Gross savings rate	19,6	21,9	25,1	29,7	29,8	28,4	27	25,2	24,1	25,4	27,6	24,7	25		

Data in percent.

Source: Central Bank of Chile, Monthly Bulletin; International Financial Statistics Yearbook.

IV. 2 Macroeconomic Evaluation

IV. 2. 1 Effects on Economic Growth and Capital Formation

Kotlikoff (1996) examines the impact of social-security privatization. The pre-privatization economy shows the following characteristics: a progressive income tax, government consumption of 20 percent of output, a 12 percent social -security payroll tax, no linkage between social-security benefits and taxes, zero initial official government debt, a 1 percent population growth rate, zero technical change, a Cobb -Douglas production function, a CES -utility function in consumption and leisure with inter- and intratemporal elasticities of substitution of 0.25 and 0.8, respectively, and a time preference rate of 1.5 percent. And current generations are made no worse off by the reform.

The simulation phases out social-security benefits in a linear manner over a 45-year period, while this phase-out period starts 11 years after eliminating the payroll tax. This permits all beneficiaries at the time of the reform to collect all their benefits. Social -security benefits during transition are financed by a proportional consumption tax ! The government uses lump-sum taxes and transfers to redistribute across generations during the transition.

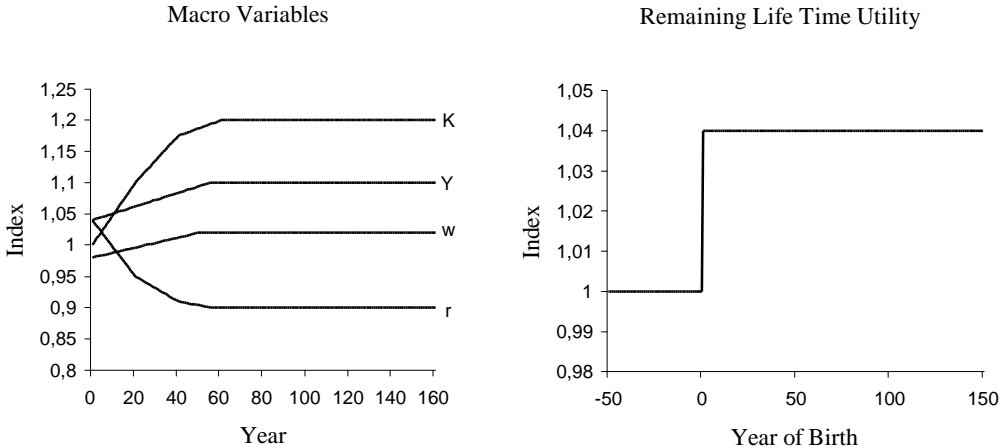
The effects of privatization in this simulation model depend largely upon (a) the nature of the pre-existing income tax, (b) the perceived benefit -tax linkage in the initial social security system, (c) the type of transition tax employed, and (d) whether the welfare of the current generations is protected by compensatory policies.

The upper part of Figure 7 shows that "privatization of social -security can generate substantial long-run increases in output, capital stock, and real wages despite the fact that the initial elderly are compensated for their higher fiscal burden arising from the consumption tax" (Kotlikoff, 1996, p. 370). The capital stock would increase by 6.5 percent after 10 years, 14 percent after 25 years, and 21 percent after 50 years.

The lower part of Figure 7 shows **the efficiency gain** equivalent to a 4 percent increase in the annual consumption and leisure levels for all generations born after year 0. The intuition for these results is simple: An unlinked social-security payroll tax combined with a progressive income tax is highly distortive. Privatization of social-security immediately links marginal retirement saving (whether compulsory or not) to marginal retirement income and reduces the total effective marginal tax on labor supply (Kotlikoff, 1996, p. 370).

"Efficiency gains from privatization are, however, not guaranteed" (ibid). The same model produces a 3 percent **utility loss** for all future generations when (a) the old social -security scheme is perfectly linked at the margin, and (b) income taxation is used to finance transitional benefits. "The efficiency loss here results from the increased labor supply and savings distortions arising from the temporarily higher rate of income taxation" (ibid). Since social security currently provides (at least in Germany, but also in other major countries) partial but incomplete linkage, the effects of privatization should lie somewhere between these two sets of results. Kotlikoff (1996) also shows that using debt to finance part of the transition costs will generally reduce the short - and medium-term effects on saving.

Figure 7: Proportional Consumption-Tax Finance of Benefits and Progressive Income-Tax Finance of General Revenues



Notes: K = capital stock, Y = output, w = real wages, and r = real interest rate.
 Source: Kotlikoff (1996, p. 370).

Comparing these simulation results¹⁴ with the actual performance of Chile is – as noted earlier – premature. However, the overall picture points in this direction: Savings first fell due to government borrowing and to a severe recession, but then increased, also gross fixed capital formation rose, leading to a rise in GDP (see Tables 7 and 9). But the picture is somehow "mixed" because first, there was still high growth in Chile before the Social security reform and a sharp fall shortly after the reform. But overall the average growth rate of the period 1970-1981 was 2.79 percent and for 1982 to 1997 it was 5.38 percent. Also, compared to her neighbors, Chile shows on average higher growth rates (Table/Figure 8). However, as remarked by Marfan/Bosworth (1994, p. 165), "it is surprising that the benefits of economic liberalization are not more evident in an improved efficiency of resource use as measured by either the level of labor productivity or the joint productivity of capital and labor".

Whereas between 1950 and 1973, Chile ranked near the bottom of all the surveyed (seventeen) countries, with an annual rate of growth in output per worker of 2.9 percent (compared to the average for LA with 3.3 percent); of that growth, 1.8 percentage points can be attributed to increased capital intensity (capital per worker or capital-labor substitution) and 1.1 percentage points to technical progress. In the period 1973 to 1989, the performance of output per worker is even worse, falling off to only 0.6 percent a year¹⁵, and 0.4 resp. 0.2 can be attributed to increased capital intensity resp. total factor productivity (see Table 4-1 of Marfan/Bosworth, 1994).

IV. 2. 2. Effects on National Savings Rate

One of the primary reasons cited for privatization of social security is that it would boost the national savings rate and capital accumulation. However, raising the savings rate does not necessarily imply an increase in the welfare of households. In an economy with taxes and market imperfections, households might save to overcome those imperfections, regardless of the tax distortions on intertemporal substitution of consumption (see Engen and Gale, 1997, and the discussion): There may exist unfair private annuity markets, liquidity constraints of households, no insurance against income risks etc.

¹⁴ An OLG model calibrated to the Chilean reform results in an increase in GDP after 200 years of 3 to 5 percent, compared to the base-line scenario, when the transition generation is burdened twice by repaying the implicit debt via higher transitory taxation; cf. Arrau and Schmidt-Hebbel (1993).

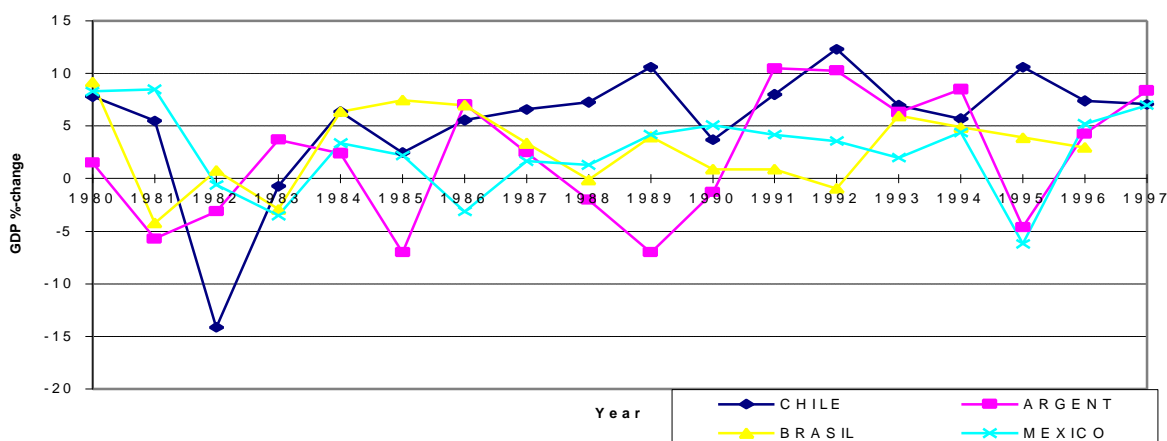
¹⁵ However, the average for Latin America is even smaller, which is due to negative developments in Argentina and Venezuela.

Table/Figure 8: LA-MIX -- GDP at constant prices

GDP, percent change over previous year, calculated from Indices

	CHILE	ARGENT	BRASIL	MEXICO
1980	7.8	1.5	9.2	8.3
1981	5.5	-5.7	-4.2	8.5
1982	-14.1	-3.1	0.8	-0.6
1983	-0.7	3.7	-2.9	-3.5
1984	6.4	2.4	6.4	3.4
1985	2.5	-7	7.5	2.2
1986	5.6	7.1	7	-3.1
1987	6.6	2.5	3.4	1.7
1988	7.3	-2	-0.1	1.3
1989	10.6	-7	4	4.2
1990	3.7	-1.3	0.9	5.1
1991	8	10.5	0.9	4.2
1992	12.3	10.3	-0.9	3.6
1993	7	6.3	6	2
1994	5.7	8.5	4.9	4.4
1995	10.6	-4.6	3.9	-6.2
1996	7.4	4.3	3	5.2
1997	7.1	8.4		7

LA-MIX: GDP percent-change



Source: International Financial Statistics Yearbook (IMF) (1998, pp. 156-157).

Social security provides insurance against many risks (length of life, disability, earnings capacity, income shocks over lifetime, family size etc.), thus, simply noting that other personal saving was reduced after introducing social security, or that it is likely to increase under privatization, is an incomplete if not misleading way in welfare analysis.

Even taken for granted that national savings are lower in countries with a PAYG social security than in a country with a fully-funded social security system (and if there were no payments to the first generation of pensioners), this does not mean that the transition to a funded system is accompanied with higher savings – when the implicit debt is financed by issuing recognition bonds: Assuming government spending remains unchanged, private households have no precautionary motive for saving, receive the same expected value of

future benefits, and face the same expected future taxes, then with no change in national output, current private consumption, and thus national savings would be unchanged. "This occurs because the interest payments on the increased explicit national debt are a transfer from young to old which exactly replaces the transfer under the old, unfunded Social Security system" (Mitchell/Zeldes, 1996, p. 366). Relaxing some of these assumptions could, therefore, change saving (cf. also Appendix C, proposition 4).

The performance of the Chilean economy in the last half of the 1970s shows an excess demand for saving, resulting in raising (domestic) interest rates and an increasing current account deficit. The debt crisis of 1982 interrupted the inflow of foreign financing. In a nutshell, while the recovery in 1975-1981 was mainly financed by credits from abroad, the recovery of 1985-1991 seems to be financed mainly by resources from the growing pension funds (see Morandé, 1998, pp. 222 sqq.).

The national savings rate raised from extremely low levels of around 9 percent of GDP in 1982 to 12.6 percent in 1984, up to 18.9 percent in 1986, and peaked in 1989 with nearly 30 percent, mostly through an increase in public sector savings. In fact, between 1980 and 1985 net savings were negative, and only in 1986 became positive. The increased national savings provide the funds needed for investment, and substitute for external savings, which are highly volatile. In a certain sense, high saving rates have "immunized" Chile to the 'tequila effect' ("Mexican Crisis") in 1995 and 1996.

For the investment rate there is a similar picture: In nominal prices, the investment rate kept relatively constant through the 1970s and early 1980s. In the beginning of the 1980s the investment rate was declining to 11 and 10 percent, to grow from here up to 25.1 percent in 1989; since then the investment rate is oscillating around 23 to 25 percent (see Table 7).

At the start of the reform, the public deficit increased (see Fig./Table 6), because the receipts of the wage tax in the old system were falling caused by the shift of contributors to the new AFP system. This reduction was not balanced by the contributions to the new system, however, because the contribution rates were lower than "combined employer -employee contribution rates" of the old system. Therefore, most of the public deficit is stemming from government's obligations towards "old" retirees. These costs start declining rather rapidly, however, after 1995 because of life expectancy in Chile (cf. Edwards, 1998, p. 27). Nevertheless, the effects of an increase in the public deficit upon macroeconomic savings were nearly compensated by the surplus of the new system. The remaining part reflects the increase in labor income, leading probably to an increase in private consumption. Thus, the increase in the public deficit overvalues the expansionary effect of the social security reform.

Whether the Chilean pension reform has actually increased private savings directly, is still an open question. Marfan and Bosworth (1994) as well as Holzmann (1996) find that, privatization appears to have contributed directly to only a small portion (between 3.3 percent in 1990-92 or between 2 and 3 percent in 1991 -1995) of the rise in national savings to date (see Table 9 for a splitting up of saving and investment).

However, the government undertook a series of economic reforms which probably raised the growth rate, and in turn the savings rate. In the same vein worked the indirect effect of deepening financial markets. Both factors may have risen private, non -pension saving as reported by Morfan and Bosworth (1994). And a significant portion of the increase in national savings was due to increased public saving (see Kotlikoff, 1996).

Table 9: Components of Saving and Investment, Selected Periods, 1974-92

<i>Item</i>	<i>1974-78</i>	<i>1979-81</i>	<i>1982-85</i>	<i>1986-89</i>	<i>1990-92^a</i>
<i>Components of investment^b</i>					
Change in inventories	2.2	6.1	-1.6	1.4	2.1
Fixed capital formation	14.6	17.6	14.0	16.8	19.2
Nonresidential	10.8	13.3	10.6	13.0	15.0
Residential	3.9	4.3	3.4	3.7	4.2
Total investment	16.8	23.7	12.4	18.2	21.3
<i>Components of saving^c</i>					
Foreign ^d	2.6	9.0	8.6	3.7	1.3
National	13.3	11.5	3.6	13.6	18.3
Public sector ^e	11.5	9.3	-2.4	2.8	3.6
Copper and oil funds	0.0	0.0	0.0	1.9	1.9
Private pension funds	0.0	0.3	1.9	2.6	3.3
Private ^f	1.8	1.9	4.2	6.3	9.6
Total saving	15.9	20.5	12.2	17.2	19.6

a. Saving data cover 1990-91 period.

b. Percent of GDP, 1977 prices.

c. Percent of GDP, current prices.

d. Equals the current account deficit.

e. Equals the general government, public firms, and Central Bank, net of the Copper and oil funds.

f. Calculated as a residual.

Source: Marfan/Bosworth (1994, p. 186) .

IV. 2. 3 Comparison of Rates of Return

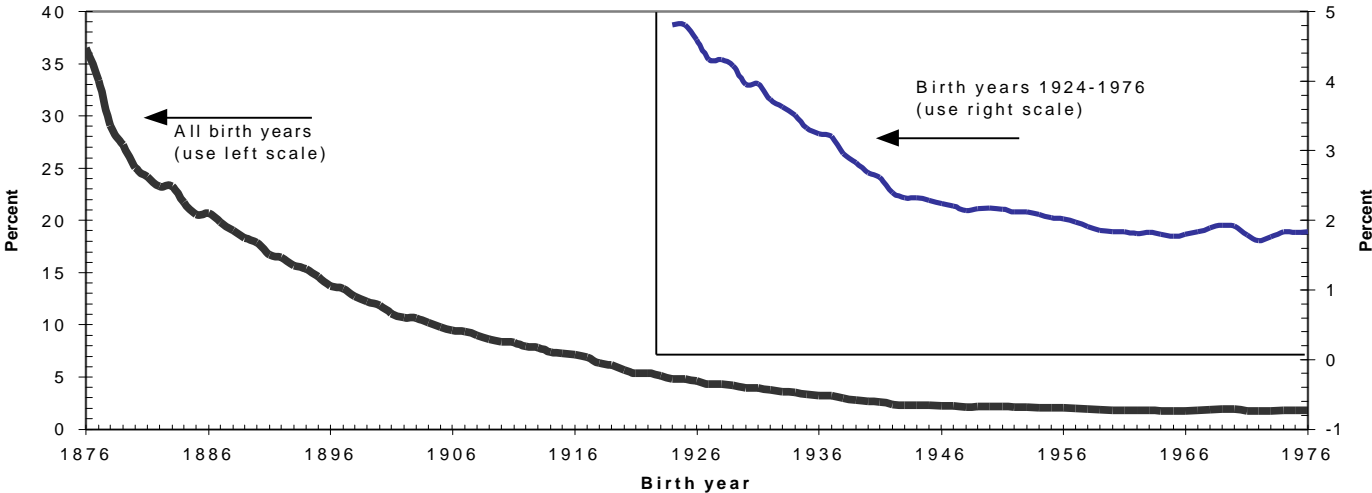
An important and – maybe – decisive question is the comparison of the rates of return between the different schemes. At first view, the Chilean model comes off well: The average real rate of return of the new system (from 1981 through 1997) was around 12 percent, however, there was a difference of 3 percent between higher income groups and lower income groups (cf. Diamond, 1996, p. 73)¹⁶. For a more detailed overview of the rates of return of

¹⁶ Cf. also Diamond (1997, p. 288), where he argues that in Chile "over the first decade of their new ... pension system they found almost a 5 -percentage point difference in the after -tax rate of return between the low earner and the top earner, because of the fixed position of charges".

different AFPs see Appendix B. The question whether such high rates are easy to get with high inflation rates, see Table 7, will not be discussed here. But also the growth rate of real GDP was on average 6 to 7 percent in this period. However, the development of real wages lagged behind.

As argued above, normally the rate of return on equities (stocks) in pension accounts (r) is higher than the implicit return in social security (g) (see Figure 9 and Table 10). However, some caveats should be taken into account: First, a part of the higher returns is a compensation for the higher risk (measured e.g. by the standard deviation or the variance, σ)¹⁷; second, another part serves to finance the "unfunded" obligations of the pensioners, a burden that must always be carried! So, even when the private returns (r) exceed those of the social security system (g), the interests of the recognition bonds as well as the old (social security) pensions have to be paid out of this difference. Thus, the question is whether the risk-adjusted rate of return of the privatized scheme ¹⁸ minus the necessary taxes is still higher than that of the social security system. Furthermore, as reported in Diamond (1998, pp. 50 - 57), depending on the chosen model (with more or less worker choice of portfolio) there may be significant administrative costs (and increased scope for very poor investment choices).

Figure 9: Estimated Real Internal Rates of Return on Social Security Contributions



Source: Leimer, ORS WP# 59, 1994; see Geanakoplos/Mitchell/Zeldes (1998, 143, Fig. 4 -1).

¹⁷ A standard deviation of 20.5% e.g. means that in every (individual) year there is a chance of 1 out of three that the real rate of return is below $(9.4 - 20.5) = 11.1$ percent or above $(9.4 + 20.5) = 29.9$ percent.

¹⁸ There exist several methods to adjust the rate of return to risk. One "easy measure" is the "Sharpe ratio", which converts total returns to excess return by subtracting the risk-free rate, and then divides that result by the standard deviation or sigma, to get a measure of "reward per unit of risk". The "Treynor-ratio" adjusts excess returns for the capital asset pricing model's beta, to get a measure of the "reward to volatility".

Table 10: Annual Inflation-adjusted Rates of Return of Stocks and Bonds (1926-1996)

Asset	Average Yield	Standard Deviation (%)
Real S&P 500	9.4	20.5
Real Long Term government bond	2.4	10.5
Real Interm. Term government bond	2.3	7.1
Real Short Term T-bill	0.7	4.2

Source: Geanakoplos/Mitchell/Zeldes (1998, p. 142, Table 4-5). Database: Ibbotsen & Associates

IV.2.4 Effects on Labor Market Development

Switching from a PAYG to a funded system and from a defined -benefit to a defined -contribution system, which establishes a closer link between contributions and benefits, will improve the efficiency of the labor market ¹⁹. The Chilean reform reduced total payroll taxes considerably, therefore reducing the cost of labor and thus encouraging employment creation.

By relying on a capitalization scheme, the pension reforms also has reduced greatly – if not eliminated – the effective taxes on labor. By reducing labor market distortions and informal labor market activities, by encouraging formal labor market participation and payments of contribution, this will lead to a higher pension coverage of the population and therefore also to higher growth rates. However, the multiplicity of the old Social Security funds (prior to 1981) with frequent double counting makes it difficult to evaluate the labor market effects of the new system. The structure of the overlapping -generations model suggests to consider two different aspects of the labor market effects: on the one hand the labor supply of the young workers, on the other hand the retirement decision of the old generation.

With regard to younger workers, the most important question is the potential rate of evasion, leading to a dependency rate higher than the demographic one, a higher required contribution rate, and, hence, a misallocation of labor to the informal sector, with a less productive technology. The rate of evasion to the informal sector in a funded DC system will be smaller because of the closer link between benefits and contributions.

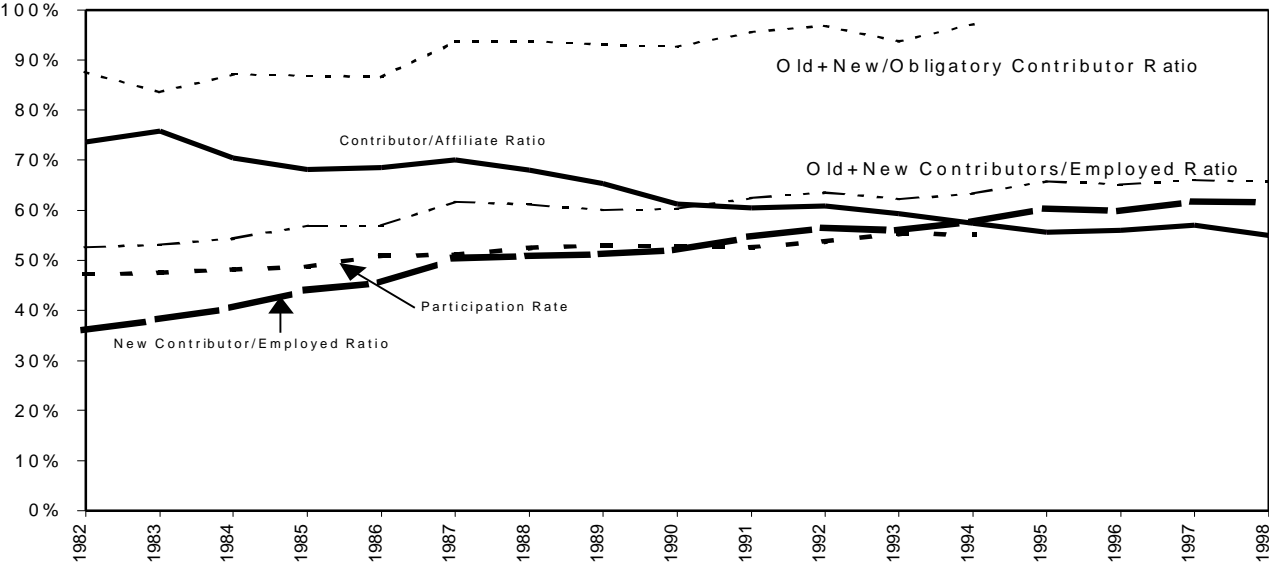
Though it is difficult to compare pre - and post-1981 developments, preliminary evidence from Chile suggests (see Figure 10) that the ratio of actual contributors under the new and old pension schemes to the number of potential mandatory contributors has increased since 1982,

¹⁹ In projections for the U.S., Feldstein/Samwick (1996) estimate that, in steady state, a fully funded DC system would reduce the deadweight loss from the payroll tax by 1% of GNP annually; see also Kotlikoff (1996). For Germany, Homburg/Richter (1990) estimate an annual efficiency gain of reducing the deadweight loss of about 36 billion DM or 1.5 % of GNP.

reaching almost 100 percent. The ratio of contributors under the old and new schemes to all employed (i.e. to all potential contributors) has largely stabilized since 1987 at around 60 percent. The difference between the two ratios reflects a very low permanent take-up rate by the self-employed. As mentioned above, the self-employed prefer not to contribute constantly to the new scheme but to invest in education, housing, consumer durables, or their mostly small enterprises. Furthermore, the overall labor force participation rate has also increased by some 10 percentage points.

"In summary, the new pension scheme seems to have been no obstacle for higher labor market participation and may have generated a higher and more formal labor force participation of the dependently employed. As regards the self-employed, their voluntary contributions status in the new scheme may also have reduced informal labor market activities" (Holzmann, 1996, p. 22).

Figure 10: Coverage Under Old and New Pension Scheme



Sources: Superintendency of AFPs (1999, pp. 130, 131, 211). Holzmann (1996, p. 40, Figure 6). Data in 1998 until September. Employment Data in 1998 is estimated.

Social security affects also the retirement decisions. Fully funded DC plans may mitigate the early-retirement effect because the costs of early-retirement are internalized. Thus there may be an incentive to continue working to raise lifetime income. Then the supply of (experienced) labor and output are both increased. However, the cost-effectiveness and the higher rate of return of the funded system may induce workers to spend some of their

increased income in leisure, taken in the form of early retirement. Unfortunately, there is no empirical evidence on this issue for Chile; however, estimates of the impact of changing social security on average retirement ages generally show small effects.

IV. 3 Finance-theoretic Perspective and Development of Capital Markets

IV. 3. 1 A General Finance-theoretic Perspective

Under a finance-theoretic perspective the differences between fully -funded and PAYG systems almost disappear and dwindle to the difference in incentive effects ²⁰. The investments of the AFPs are – in the first step – almost entirely in government bonds, only in the second step in private shares and bonds. In as much this leads to higher growth rates (via a reduction of capital costs of real investment) is unclear outside the "wonder world" of neoclassics. Furthermore, in the future the pension funds will be decumulated because there is less demand unless future generations will have a higher individual marginal propensity to save. Thus, also in this respect the "biological rate of interest" (Samuelson, 1958) will be working.

However, a natural extension is a stochastic overlapping -generations model. In this setting, the government not only has to issue inflation -indexed bonds but wage -indexed bonds to mimic the wage-indexed social security benefits. Therefore, any proposal – like the Chilean – with only traditional debt and a finite pay-off period is not neutral but "call for a significant redistribution from the transitional generations that pay off the debt to future generations" (Bohn, 1997, p. 202). Furthermore, to analyze alternative investment strategies (of the government or the AFPs), explicit assumptions about the sources of macroeconomic risk are needed. When there is only uncertainty about future productivity ("productivity shocks") then – given a Cobb-Douglas technology – future output, wages, and capital income would be perfectly correlated. Baxter and Jermann (1997) have shown that capital and labor incomes are indeed highly correlated in the long run. Therefore: "Equities are a much more natural hedging instrument for a wage-indexed social security system than government bonds. (Of course, wage-indexed securities would be even better from this perspective)" (Bohn, 1997, p. 204).

An interesting aspect are the effects of alternative AFP investments on capital markets. In principle one would expect that a pension fund to pay for the contributors' own future

²⁰ Behind this are the assumptions that the debt grows in expectation of the rate of population growth plus wage growth, and that the debt has the same contingent payments as Social Security benefits (e.g. wage indexation); cf. Geanakoplos/Mitchell/Zeldes (1998, p. 149) and Appendix C. In other words, the "gap between market returns on Social Security contributions is in effect a perpetual tax that is exactly equal to the initial net transfers in present value terms" (Bohn, 1997, p. 196).

retirement has no real effects. This "neutrality proposition" (see Bohn, 1997, p. 200) is narrower than Ricardian neutrality and it states only that such pension funds are virtually perfect substitutes for private savings. Abstracting from liquidity constraints – and other imperfections of capital markets – individual accounts are irrelevant for macroeconomic analysis.

However, there are other effects relating to the development of capital markets and the relation to economic development. At least three opinions can be distinguished. First, the development of the real economic sector is the leading sector, and financial arrangements and the financial system satisfy this demand automatically. Second, there are economists who note that in economics the role of financial factors in economic growth and development may be badly over-stressed. This opinion sometimes ignores the financial system altogether. The third view – following Joseph Schumpeter – stresses the role of a well-functioning banking or credit system for the enhancement of technical progress by identifying and then financing innovative entrepreneurs. More generally, banks and other financial intermediaries play an important role in financing as well as in controlling or supervising firms ("corporate governance") as long as capital markets are underdeveloped and/or not able to do this function by themselves. Or the liberalization and accelerated development of capital or financial markets will foster the efficiency of resource allocation.

IV. 3. 2 Development of the Chilean Capital Markets

There is some evidence that the level of financial system's development – or the effectiveness of financial markets – has a great explanatory power for future growth rates, rates of capital accumulation and technical progress (cf. Levine, 1997). However, there is a debate how to measure the depth, liquidity and maturity of financial markets. Some indications are given by Roubini and Sala-i-Martin (1992) who introduce financial market aspects in an endogenous growth model through an AK-technology, where A , the rate of return on capital, depends positively on the level of financial market intermediation: $\partial K / \partial t = A(q) \cdot K - C; \partial q > 0$. Here θ is higher the less financial markets are repressed. Estimates suggest nonnegligible and statistically significant effects on the transitional growth rate of 0.5 to 3.1 percent per annum.

Another simple endogenous growth model incorporating potential growth effects of financial market developments is proposed by Holzmann (1996). This model "allows also for other effects since pension reform and financial market developments are usually surrounded by many other policy changes at macro- and microeconomic level" (ibid, p. 7).

Here a "financial market variable" K is introduced, "measuring the depth, liquidity, and maturity of financial markets" (p. 9). This variable is positively related to the savings ratio (i.e. investment ratio in a closed economy) and to an efficiency variable which is responsible – besides an exogenously given rate of labor-augmenting technical change – for the change in technical progress. This efficiency variable depends "also on other variables traditionally quoted in the literature (such as level of export orientation and share of education expenditure in the budget)" (ibid, p. 9).

To test this model and the advanced hypothesis that pension funds should contribute to the deepening of financial markets, higher liquidity, enhanced competition, and better risk allocation in financial markets (and hence significant growth effects), appropriate financial market indicators must be chosen (see Holzmann, 1996, pp. 11 sqq.): FIR (financial interrelation ratio) compares the range of financial instruments with net wealth, approximated by the capital stock; FMR (financial intermediation ratio) compares the scope of financial instruments with the assets of the financial institutions. FIR-1/FMR-1 cover financial liabilities, enhanced by the assets of pension funds, mutual funds, and insurance companies. FIR-2/FMR-2 follows a more traditional approach and covers both the asset and liability side of the financial market. These indicators "are similar in magnitude, but differ somewhat in their composition and thus in trend ... The main difference is due to the scope of bank credits to the private sector (included in instrument measure 1)", which rose sharply up to 1982, but "decreased with the banking crisis" (p. 12).

Specific stock market development indicators are used to measure the impact on real economic activity: MCR (market capitalization ratio) equals the value of listed shares divided by GDP; VTR (total value traded ratio) measures the total value of shares traded on the stock market exchange divided by GDP; TOR (turnover ratio) equals the value of total shares divided by market capitalization; and SMI (stock market index) equals the average of these three indicators.

Holzmann (1996) uses these financial market indicators as proxies for financial market deepening and liquidity. As indicators for competitiveness and risk allocation he suggests to use "asset mispricing", e.g. the systematic deviations of actual returns from those implied by reference models (e.g. capital asset pricing [CAP] and arbitrage pricing [AP] model).

The results of Holzmann's study (1996) can be summarized as follows: "Essentially all investigated FMIs (Financial Market Indicators) exhibit a strong upward movement once the banking crisis of 1981-1983 has been solved ... The almost linear rise in the stock market

index (SMI), starting in 1985 corresponds to the year of the first participation of pension funds in stock market activities" (p. 14).

The correlation of AFP assets and FMIs, and of AFP shares in total traded shares and MCR, is very strong (cf. Fig. 11). "This empirical evidence is consistent with the claim that pension funds made the financial markets deeper and more liquid" (p. 15).

Figure 11. Pension Fund Assets and Financial Market Indices



Source: Holzmann (1996, p. 39, Figure 3).

With regards to the contribution of pension funds to enhanced competitiveness and risk allocation, the available data only allow for a very cursory investigation. Figure 12 presents yearly data for the asset mispricing indicators based on AP, CAP and ICAP (international asset pricing model) and indicators of pension funds assets. "If pension fund activities improve the performance of the finance market, the mispricing should decrease with enhanced fund activities" (p. 15): The correlation shows the correct sign, is statistically significant at the 5 percent error level, and ranges between -0.27 and - 0.52.

Furthermore, there is evidence that the pension funds' activities have contributed to a more sophisticated financial market: they helped to develop indexed annuities, they are important providers of funds to key sectors such as mortgage bonds to housing finance, enterprise bonds, and increased holding of traded shares. Holzmann (1996, p. 15) cites also evidence that pension funds are operating efficiently. "In a competitive environment this may contribute indirect proof of the overall efficiency of the financial system" (ibid).

V. Intergenerational Redistribution and Risk-Sharing

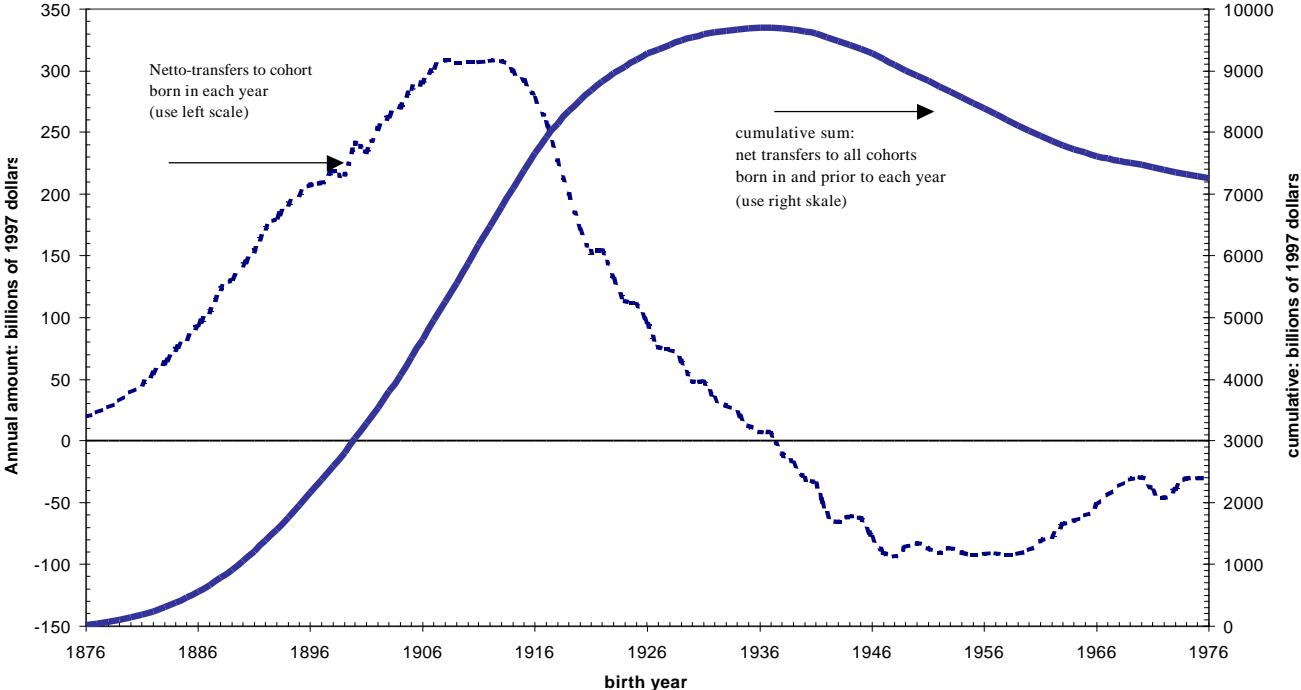
There is no such thing as a free lunch, therefore, any shift back from an unfunded PAYG to a fully-funded system is generally burdensome for the transitional generations

(intergenerational redistribution). For a clear picture of this, see Figure 13 for a "generational balance" of the U.S.A. pension system. This is so because in a PAYG scheme the first generation(s) receive(s) a "gift" or benefits in excess of her (their) contribution that future generations have to pay back ²¹.

In a standard overlapping-generations model any increased redistribution from young workers to old retirees reduces the disposable income of young workers, reduces thus their need to save for old age income, and hence raises the equilibrium rate of interest. This in turn may crowd out capital investment and bring the economy on a growth path with lower per capita income. Therefore, less redistribution from young to old will put the economy on a higher per capita income growth path!

Furthermore, as Bohn (1997, p. 203) has observed, "reduced population growth per se has positive macroeconomic effects": Reduced population growth raises the capital-labor ratio which reduces the real return on capital while increasing the wage rate. Hence, a slowdown in population growth tends to reduce interest rates and to raise per capita incomes.

Figure 13: Social Security Net Intergenerational Transfers



Source: Leimer (1994) tax increase balanced budget scenarion, and author's calculations. All figures are present values as of 1997; see Geanakoplos/Mitchell/Zeldes (1998, p. 145, Fig. 4-2).

²¹ Cf. also the argument in note 18.

To assess the second bundle of problems related to **intergenerational risk-sharing** a stochastic overlapping-generations model seems to be the best tool for analyzing the allocation of macroeconomic risks across generations (see Appendix C). To use this model, however, it has to be calibrated and then simulations could be run (see for such an exercise Bohn (1997)). In an OLG-model the older generation owns all the wealth, so they bear all the capital risk. If the Social Insurance fund will balance the system when there is a downturn or upturn in the stock market by changing the taxes on the young workers and not by changing the benefits of the older generation, then this shifts capital -market risk from the old to the young. This effectively lets the unborn young generation take a position in the current stock market. Private markets cannot accomplish this because it is impossible to write contracts with the unborn generation. Given that capital income is riskier than labor income (see, however, note 1 of Appendix C) such a policy leads to more efficient intergenerational risk - sharing. Here, however, the analyses will be less sophisticated, and touch only upon four different points.

The **first** point to be raised is related to the "risk shifting" of the transition from a DB (defined benefit) to a DC (defined contribution) plan and from a public to a private system. This point relates to the "insurance function" of social security vs. private funds: It is of importance that the Chilean AFPs are rather "savings institutions" than insurers (they have to buy insurance e.g. for invalidity and survivors' benefits with insurance companies against a premium). Furthermore, while closing the individual account the balance can be used to buy an annuity with a life insurance company or – as described above – to a phased withdrawal.

However, this leads to the **second** point which in turn has several facets. On the one hand, the incomplete liquidization (i.e. before normal retirement) tends to reduce the rate of participation of self-employed – which are members of the AFPs on an optional basis. To save for a house or a commercial investment is more attractive for the young than participating in a pension scheme (cf. Gillion and Bonilla, 1992). On the other hand, allowing early withdrawal (see the Singapore scheme) leads to the problem that the balance will be consumed early, and then the individual may fall into the "poverty trap". As always, a possible solution is to allow early dissolving (or partial dissolving) only according to rules governing for example life insurance policy with a "dread disease" clause.

Somehow related to this point is a **third** problem, namely that the current systems of social insurance pay the benefits in the form of an annuity, which is indexed to inflation or wage income (or even both), providing insurance against living too long and against inflation (and against "relative poverty"). However, private markets for annuity insurance are (or may be)

plagued by adverse selection: those expecting to live longer are more likely to purchase annuities. To get around this problem two possibilities exist: First to mandate a national risk pool (i.e. not to allow insurers to use information about expected lifespan) or requiring annuity purchase at a young age (cf. Mitchell and Zeldes, 1996, p. 364).

The insurance against inflation (or even "relative poverty") is possible when the government – as in the case of Chile – issues indexed bonds (indexed to inflation or – even better – to wage income growth)²².

The **fourth** point to raise relates to poverty, i.e. the aim of social security to protect against poverty in old age (or even to secure – e.g. as the German system – a relative income position in retirement, cf. Hauser, 1999). Privatization of social security implies that a large part of income redistribution – a characteristic of most social security systems – is no longer possible. On the one hand, there is *intragenerational* earnings insurance, and private systems will provide less of this type, because adverse selection is strong in "earnings insurance". In general, the benefit formula is structured to provide a higher rate of return to low lifetime earners than to high lifetime earners. "This is justified on the grounds that a social insurance plan can pool over the entire population certain risks that are difficult to insure privately" (Geanakoplos/Mitchell/Zeldes, 1998, p. 154). This is true in particular for shocks of earnings, disability, unemployment, length of life, inflation and poverty.

On the other hand, social insurance is also *intergenerational risk-sharing* (because the benefits of the current old are positively related to the earnings of the current young), and this is absent in private markets. Therefore, the retirement income of the "working poor" is based no longer on a progressive social insurance benefit function. [As a side -remark: However, poor people die – on average – earlier than rich one, hence they could bequeath relatively more of their funds to their children!] However, the government could supplement the contributions of the poor – either upon retirement (by a minimum pension) or earlier (by supplementing contributions). Then the overall result depends very much upon the share of the poor population. Before the reform, in Chile more than 90 percent of workers got only the minimum pension. Under the new system there are only little information available at the moment (see Table 11).

In Chile, the minimum pension is not set as a constant fraction of the minimum wage and is adjusted to inflation occasionally, its current level is 73 percent of the minimum wage and around 25 percent of the average wage. This level is, however, quite low! But as row 6 in

²² It should, however, be noted that the privatized system offers new opportunities to hedge other household risks in private capital markets, and they confront less political risk.

Table 11 shows, the old ratio of age pension to a verage income raised from 27 percent in 1983 to 44 percent in 1991 and then fell to 32 in 1998, and the early retirement pension ratio to average income fell from 90 percent in 1988 to 50 percent in 1998. The influence of the great recession of 1982/3 is clearly visible in these figures. In a certain sense, most of these pensioners live still "on the pockets of the state"!

This proposition is supported by results of Marcel/Solimano (1994) with respect to income distribution: During the Pinochet administration (1974-1989) the income share of the lower two quintiles decreased by 1.5 percentage points compared to the period 1960 -1973, while the share of the highest quintile increased by 4.7 percentage points. Essentially, this change in the income distribution is due to the increase in unemployment after 1974, and the decrease of the real minimum wage.

**Table 11: Average Amount of Pensions Paid through the System (3)
(Data up to December each year, 1998-Ch\$)**

Years	Old-Age	Early Retirement	Total Disability(2)	Real Average Imposable Income(4)	Ratio Old-Age/Real Av. Impos. Income	Ratio Early Retirement/Real Av. Impos. Income
1982			204,899	181,823		
1983	42,676		173,478	157,031	27,18%	
1984	47,205		143,663	143,177	32,97%	
1985	45,306		132,849	134,68	33,64%	
1986	53,052		131,095	145,914	36,36%	
1987	55,829		129,195	140,336	39,78%	
1988	63,135	138,402	135,187	154,569	40,85%	89,54%
1989	70,443	121,595	135,187	167,638	42,02%	72,53%
1990	70,881	125,979	132,556	174,272	40,67%	72,29%
1991	80,674	137,229	138,109	181,898	44,35%	75,44%
1992	84,327	141,909	137,818	192,981	43,70%	73,54%
1993	82,427	141,326	134,894	209,358	39,37%	67,50%
1994	86,978	148,969	137,601	220,885	39,38%	67,44%
1995	88,677	146,872	139,252	234,317	37,84%	62,68%
1996	87,671	145,725	132,743	244,997	35,78%	59,48%
1997	88,805	141,791	127,859	259,142	34,27%	54,72%
1998(1)	86,259	135,775	126,241	268,978	32,07%	50,48%

(1) Data up to September 1998.

(2) Does not include transitory Disability Pensions.

(3) Excludes pensions corresponding to a first payment.

(4) Corresponds to overall contributors (salaried and self-employed).

Source: Superintendency of AFPs (1999, p. 214 and p. 224).

VI. Summary and Conclusions

The Chilean pension reform and the subsequent "second-generation reforms" in other Latin-American countries show that pension reforms are politically feasible and successful. (For

summaries see e.g. James (1997); Mitchell/Barreto (1997); and Queisser (1999). However, their economic benefits have been overestimated.

(Partial) privatization of classical PAYG social security systems, combined with funded individual pensions, have certainly different positive effects on the economy. First of all, this reform may lead to a separation of pensions, contributions and (individual or institutional) wealth from current political decisions. However, politicians as well as trade unionists will find very quickly new political fields which they can concentrate their efforts. Second, this reform may increase efficiency of labor markets because the distorting effects of contributions will be lower. This in turn may increase economic growth. Third, because of increasing (private) savings, capital accumulation and hence growth rates tend to increase. Fourth, this reform may have great positive effects for the development of capital markets which has itself positive effects on economic growth. In all these aspects, the Chilean reform model has done well. However, these advantages are mixed up with the effects of the total reform programme (e.g. in Chile). A direct discrimination is therefore very difficult. The Chilean reform, however, shows that most of the positive effects are connected with raising the retirement age. A second effect on savings is caused by the big savings effort of the Chilean government and the tax increases to finance the pension system reform.

These advantages must be confronted with the costs – not to mention the political questions: Privatized annuities have remarkably higher administration and selling costs than traditional (DB) systems. And there are some intriguing aspects of adverse selection (cf. Diamond (1998); NASJ (1998); Murthi/Orszag/Orszag (1999)).

To summarize, Chile instituted a two-pillar system, a first pillar paying a guaranteed minimum pension, and a second mandatory pillar offering a private DC account. The first pillar is financed with general tax revenue. The minimum benefit level is independent of the contribution amount, however, eligibility depends – in order to reduce moral hazard that otherwise might induce evasion – on both age and years of membership in the new system. For the second pillar Chile uses payroll taxes, and older workers were given some "credit" in the form of recognition bonds for contribution under the old system.

With regard to the Chilean reform, the new Chilean AFP system has strengths and weaknesses (see Vittas, 1995) to take into account as lessons for other countries contemplating similar reforms:

- The system emphasizes personal responsibility and the direct link between contributions and benefits. It is simple and transparent.

- However, the great discrepancy between the number of affiliates and the number of active contributors seems to be a great problem not guaranteeing universal coverage.
- Adding the contributors to the old system, the total coverage of the Chilean pension system rose from 53 percent of total employment to 65 percent in 1995. The relatively low "coverage" is one of the most important weaknesses of the system. It can be explained, however, by the great informal sector of the labor market, the small number of self-employed in the AFPs, and the (still existing) moral hazard created by the government guarantee of minimum pensions.
- The state guarantees with respect to the minimum pension and the minimum rate of return as well as the inflation-proofness are nevertheless remarkable features.
- Despite this minimum level, the relationship between workers' private account accumulation and what happens to these accounts in the event of disability, death, or very low income on old age is still open. In this case, most of the accumulation is done in early years with the result that, e.g. the costs weigh higher (cf. Diamond, 1998, p. 54).
- Furthermore, the level of the minimum pensions seems to be too low to secure a decent life during retirement. It is only targeted at about 25 percent of the average wage. Furthermore, how many workers will retire with the minimum pension is still an open question.
- Even this emaciated first pillar may imply that government sector liabilities can prove to be too high compared to the tax base. Therefore, the system's future financial viability has to be looked at carefully.
- The flexibility in moving in and out of individual AFPs is of great advantage, however, the high frequency leads to excessive marketing and administrative costs.
- The volume of the pension funds managed by AFPs has risen steadily from 10 percent of GDP in 1985 to more than 42 percent in 1997. The total amount of resources of the funds reached US-\$ 30 billion by the end of 1997.
- The tight investment rules and regulation of the AFPs solved some problems at the start. However, the rule to build only one fund per AFP and one account per worker hinder the diversity of the offers. Nevertheless, there is a remarkable difference in the rate of returns between low life-time earners and high life-time earners before and after tax.
- Three major forces have driven the portfolio composition of the pension funds: the evolution of investment limits, the increase in the size of the pension funds, and the development of domestic capital markets as well as new investment instruments.

- The average rate of return of the pension funds portfolio has reached 12 percent in real terms (with great fluctuations, however). Whether this is "exceptionally good" is difficult to say in a period of high inflation, high growth rate, and high real interest rates and starting financial development. In a certain sense, these high rates reflect the good economic circumstances. Since 1995, the situation has changed, on the one hand because of the Mexican crisis, on the other hand because of the significant fall in the terms of trade (e.g. copper prices). Therefore, it is not yet clear how much this reflects good investment opportunities, and how much it reflects greater risk and excess demand for limited domestic assets (i.e. most portfolios have shares of only a very small group of companies; cf. Edwards, 1996, p. 15).

It is more difficult to evaluate the macro-economic benefits with regards to the impact on private savings, overall economic efficiency, and the development of capital markets.

- The direct effect of the pension reform on household saving is difficult to ascertain because the pension reform was part of a thorough -going economic reform. Furthermore, the impact depends upon the way the transition period is financed: If it is not financed by debt this means an increase in taxes on current generations; there may be also a fall in consumption; besides this the contribution rate fell from 22 percent to 13 percent raising consumption. So overall, whether the reform has increased private savings, is still an open question. However, the increase found by some research is not very significant.
- With respect to overall economic efficiency the same reasoning applies: Chile achieved better growth performance than her neighbours in the late 80s and 90s. However, only part of it may be attributed to the pension reform.
- The accumulation of pension funds and their investment in financial markets has led e.g. to the development of a housing market and a private market for mortgage bonds. Furthermore, the insurance markets have flourished, leading to a fall in premium rates. The pension funds also contributed to the privatization of public enterprises. Their investments led to better performance in stock and other financial assets markets. And new financial instruments have been introduced to meet the growing demand of pension funds.

The Chilean example and other reforms not only in Latin America, but also in Europe (cf. Gern, 1998), have shown that reforms of Social Security are possible and politically feasible. However, one should not expect "economic miracles".

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Appendix A: A Short Review of the Development of the AFP Industry

I.

The number of functioning AFPs in the market increased from 12 in 1981 over 21 in 1993, and then a merger process took place resulting in 8 AFPs in 1999. Between these years, different changes took place (see Superintendency, 1999, pp. 112 sqq.).

The 12 starting pension funds were Alameda, Concordia, *Cuprum*, El Libertador, *Habitat*, Invierta, *Magister*, *Planvital*, *Provida*, San Cristóbal, *Santa Mariá*, and *Summa*, of which the AFPs in italics still exist.

Up to 1985, the number remained unchanged, when Alameda and San Cristóbal merged, forming *Union*. In 1983 and 1987, two legal reforms to change DL 3500 were enacted, which influenced in different ways the entry barriers of AFPs to the industry. In 1983, the required cash reserve was reduced from 5 to 1% of the administrated pension funds. In 1987, the minimum equity capital for establishing an AFP was lowered from 20 million UF (equivalent to US-\$ 631,345) to 5 million UF (US-\$ 157,836).

Starting from these changes, the number of AFPs changed in the following way:

- In 1986, 1988 and 1990, *Protección*, Futuro and Bannuestro entered the industry; however, Bannuestro was wound up in the following year.
- In 1992, six AFPs began operating: Banguardia, *Bansander*, *Fomenta*, Laboral, Previpan and Qualitas.
- During 1993, three AFPs joined the market: *Aporta*, Genera and Norprevisión (which changed its name to Valora). In the same year, Invierta and *Planvital* merged.
- In 1994, Armoniza initiated operations, but Laboral was wound up.
- In 1995, *Provida* and El Libertador merged as well as *Santa Mariá* and Banguardia, and Qualitas and Previpan merged with Valora. During the same year, Genera was wound up.
- In 1996, three mergers took place: *Planvital* merged with Concordia, *Magister* with Futuro, and Valora with Armoniza called Qualitas.
- During 1998, four mergers have taken place: *Provida* merged with *Union*, *Summa* with *Bansander*, *Magister* with Qualitas, and finally *Aporta* with *Fomenta*.

- In January 1999 *Provida* merged with *Protección*, so that in the year 1999 there existed only 8 AFPs (see also Table B1).

II.

Competition can take place on three different levels, in the relevant market itself and in the markets for substitutes and in markets on a lower or higher level. In consequence, the working of competition in the market in a narrower sense cannot be judged appositely if not all these levels of economic activity are taken into account. In other words, one has to take into account at least also the market situation of suppliers (e.g. life insurance companies, banks, brokerage firms; see Superintendency, 1999, pp. 118 sqq.).

Furthermore, competition in a market (in a narrower sense) depends upon the growth rate of this market, of the industry, and of the macro economy. About the macro economic development and the industry of financial intermediaries, some remarks are in the main text.

The growth of the relevant market of AFPs was large in the beginning years when the number of affiliates grew rapidly: growth rates of affiliates were 10, 18 and 12% in the first 4 years, then decreased up to 1992/3 to 1 %, then 1993 to 1995 the growth rates were 5.5 % and 6.3 %.

Beginning with 1995 the market was almost saturated (see the figures in Table 4). According to the Superintendency (1999, p. 117) 5,959 affiliates (both salaried and self-employed) joined the system in September 1998 while 59,854 affiliates changed from one AFP to another during that same month.

Also, barriers to entry or to exit a market play a significant role for competition. However, neither absolute cost advantages (e.g. in acquiring capital via close connections to a large bank) nor economies of scale or scope are of importance in this industry. Therefore, only advantages of product differentiation may be of relevance. These advantages are related to preferences of customers for known products, or to brand loyalty which can be built up by marketing and other services. Important advantages can also result from distribution channels or networks. These investments are product specific and can be viewed as sunk costs in case of a market exit. Hence, this exit barrier is an entry barrier for newcomers. However, the partial or total buying of the stock of contracts by mergers and acquisitions or of the distribution network are possible. This can be seen clearly in this industry after the legal barriers to entry have been lowered in 1983 and 1987.

Competition can be carried through with three different means: price, product (or quality) and preferences. In highly regulated markets, prices (i.e. contribution) and products (e.g. through rate of return regulation and limits to investments) are almost irrelevant. Furthermore, the commission structure of AFPs and the consequences for the individual rate of return are – even for experts – not transparent. In those situations, the "fight for clients" goes via "services" or selling efforts, taking into account that transferring from one AFP to another does not imply any direct cost for the affiliates.

III.

Taken together, these arguments support the hypothesis that the market concentration will first decrease and then – after the market reaches a certain degree of maturity – will increase. To verify this hypothesis, the Herfindahl Index is used¹. This index (H(y)) shows clearly a decrease from 0,216 to 0,125 in 1994. From 1995 the Herfindahl index (H(y)) increases. This is also true for H(x) which measures the concentration by contributors: From 1990 this index decreases from 0,203 to 0,178 in 1994, and then increases up to 0,207. Therefore, the hypothesis seems to be supported.

Given an observed value of $H=H$, one can ask, how many firms of equal size would be necessary to generate the same level of concentration. This number is called "equivalent number" of firms and is given by $N=1/H$. This number allows comparisons among different markets at a given point in time, and may suggest whether a given market is becoming more or less concentrated. The results are given in Table A1. The numbers show that at the highest eight equally large firms (with a market share of about 12.5 percent) could have served the market giving the same degree of concentration.

¹ The Herfindahl Index is defined by $H = \sum [q_i / Q]^2$, $i=1, \dots, n$, where q_i is "output" of firm i , Q is total "output" of the industry, therefore q_i/Q is the "market (net) share" of firm i , n is the number of firms in the industry.

Table A1: Market Concentration per No. of Contributors¹ and Size of Pension Fund²

Year	Herfindahl-Index H(x) (percent of contributors)	Herfindahl-Index H(y) (percent of pension funds)	1/H(x)	1/H(y)
1981	n/a	0,216	n/a	4,6
1982	n/a	0,194	n/a	5,2
1983	n/a	0,18	n/a	5,6
1984	n/a	0,171	n/a	5,8
1985	n/a	0,179	n/a	5,6
1986	n/a	0,182	n/a	5,5
1987	n/a	0,178	n/a	5,6
1988	n/a	0,172	n/a	5,8
1989	n/a	0,167	n/a	6,0
1990	0,203	0,158	4,9	6,3
1991	0,184	0,147	5,4	6,8
1992	0,181	0,136	5,5	7,4
1993	0,182	0,13	5,5	7,7
1994	0,178	0,125	5,6	8,0
1995	0,181	0,131	5,5	7,6
1996	0,184	0,134	5,4	7,5
1997	n/a	0,139	n/a	7,2
1998	0,207	0,166	4,8	6,0
1999	n/a	0,208	n/a	4,8

¹ Corresponds to the number of active affiliates who contributed in September, for remunerations earned in prior months.

² In Millions of September 1998-US\$.

Annual data from 31 December of the respective year, except for 1998 (September).

Source: Superintendency of AFPs (1999, p.116), <http://www.safp.cl>,

Superintendencia de AFP, No.2 (1981-1996); (1997, p. 85) and own calculations.

Concentration can be measured also by concentration ratios, e.g. the market share of the biggest company (CR1), of the three biggest (CR3) or the five biggest (CR5) or the ten biggest companies (CR10). When we take N, the equivalent number of firms, and divide the total "output" by this number, then results the market share of the "equivalent" firm. A (e.g. fivefold) multiple of this "equivalent market share" – called the equivalent concentration ratio (ECR) – can be compared with the actual (e.g. five firm) concentration ratios. The results of this comparison are shown in Table A2.

Table A2. Concentration Indices and Equivalent Concentration Ratios (for 1998)

Variables	
CR 1	23,52%
CR 3	61,42%
CR 5	85,51%
CR 10	100,00%
ECR 1	16,60%
ECR 3	49,80%
ECR 5	83,00%

Data Source: Superintendency (1999, p. 115).
Own calculations.

Appendix B: The Rates of Return of the AFPs

The figures given on page 15 (and Figure 5) reflect the rate of return (of a share¹) deflated by UF (unit of account = unidad de fomento) as measured by the Superintendency of Pension Funds Administrators (cf. Superintendency, 1999, pp. 151 -152). Even this rate fluctuates very much: between 30.9 percent in 1991 to -2.6 percent in 1995. Although, the average rate amounts to 11.0 percent (over the years 1981 to 1998), the standard deviation is 9.36, meaning that in two out of three cases the rate of return can be either 20.36 or 1.64 percent.

However, this aggregated (and weighted) average hides fluctuations within the year as well as between the different Pensions Funds. Table B1 gives an overview of the yearly rates of return of the AFPs, the unweighted and the weighted average. Also, the standard deviations and the coefficients of variation are calculated.

In any year, the standard deviations and the coefficients of variation are relatively small indicating that there seems to be an "uniform investment strategy". This may be the result of the "minimum rate of return" regulation², because fund managers who deviate too far from the industry's average get "penalized" if downward and not appropriately rewarded if upward deviations occur. This is evidenced in Table B2 which shows the diversification of the investment portfolios of the AFPs for 1998. The only "real" difference can be seen in the partition of bonds and other fixed-income securities between government and corporate, but not between stocks and bonds.

Furthermore, the last three rows of Table B1 show that the performance of the individual AFP over the years, despite some relaxation with regards to investment limits, is also very similar: it fluctuates between 11.4 (Cuprum) and 10.5 percent (Provida) for those AFPs which are working from the beginning.

¹ "The Pension Fund is expressed in a unit of measurement known as 'share' ... Changes in the value of the share reflect the yield of the investments of Pension Funds" (Superintendency, 1999, p. 151, note 61).

² The real rate of return of the AFP must not be lower than the lesser of (1) the average real rate of return of all AFPs in the last 12 months minus 2 percentage points, and (2) 50 percent of the average real rate of return of all AFPs in the last 12 months. If there is an "excess return" this must be placed in a fluctuation reserve, from which funds are drawn in case the return falls below the minimum rate. If this reserve plus the cash reserve (1% of total assets) are not high enough, the government makes up the difference and the AFP is wound up.

Table B1: Real (UF) Rates of Return of AFPs, 1982-1998

	Alameda	Concordia	Cuprum	Libertador	Habitat	Invierta	Magister	Planvital	Provida	San Cristobal	Sta. Maria	Summa	Union	Proteccion	Futuro	Aporta	Armoniza	Banguar-dia	Bansander	Fomenta	Genera	Previpan	
1982	29,8	30,1	25,4	23,1	25,6	25	27,6	24,4	29,5	27,5	30,2	28											
1983	21,4	24,7	18,5	20,2	24,4	20,7	20,5	22,2	20,3	20,7	20,9	22,5											
1984	4,4	2,1	3,2	3,3	2,7	3,4	5	3,5	4	3,9	3	2,8											
1985		13	13,7	13,2	13,3	13,3	13,5	13	13,5		13	14,3	13,6										
1986		12,7	15,5	13,5	12,5	11,9	12,4	11,5	11,8		11,8	12,4	13,4	10,6									
1987		4,8	8,5	5,8	5,5	5,5	4,5	5,2	5,1		5,1	5,2	6,3	7									
1988		7,3	7,8	6,9	6,4	8,7	7,1	7,2	6,3		5,9	6,4	7,1	7,7									
1989		7	9,5	8,2	6,8	9,1	6,9	8,9	5,9		6,5	7,3	8,7	8,2	4								
1990		16,2	18,2	16,6	15,9	19,4	15,8	18,7	13,3		14,6	18,1	17,2	17,7	17								
1991		28,7	30,4	30,8	30,4	27,9	34,3	32	25,8		30,1	33,1	30,9	32,7	31,2								
1992		2,8	3,6	3,4	2,8	0,9	3	3,6	3,1		2,9	3	2,8	4,2	4,1								
1993		16,7	16,1	16,3	15,9		16,7	17	15,9		16,3	16,9	16,4	16,8	14,6			15	15,8				14,8
1994		18,6	19,5	17,5	18,1		18,2	19,9	17,9		18	17,1	18,5	18,8	17,2			15,7	18,8	21,1	17,4		18,8
1995		-2,4	-1,8		-2,8		-3,3	-2,6	-2,5		-3,3	-2,1	-2,6	-2,1	-4,6	-2,6	-3,1		-2	-2,8			
1996			3,6		3,8		3,5	3,3	3,4		3,7	3,2	3,5	3,5		4,1			3,3	2,9			
1997			4,3		5,7		4,4	4,7	4,6		4,5	4,7	4,6	4,7		3,9			3,8	6,2			
1998			-2,7		0,4		-1,4	-1	-0,1		-0,8	-1,9		-2,1		-1,9							
Mean		13,02	11,4	13,75	11,0	13,3	11,1	11,3	10,5		10,73	11,2	10,8	9,82	11,9	0,88			7,94	6,85			
St. Dev.		9,74	9,08	7,87	9,28	8,5	9,87	9,44	8,83		9,62	9,95	8,43	9,25	10,9	3,14			7,96	8,83			
St. D. /Mean		0,75	0,8	0,57	0,84	0,64	0,89	0,84	0,84		0,9	0,89	0,78	0,94	0,91	3,58			1	1,29			

Source: Superintendencia de AFP, Monthly Bulletin, various issues.

Table B2: Investment Portfolio Diversification by Type of Instrument and AFP, 1998

AFP	Total Portfolio								
	Stocks			Bonds and other Fixed -Income Securities				Others	Cash and Equi- valents
	Chilean	Non- Chilean	Total Stocks	Govern- ment	Corpo- rate	Non- Chilean	Total Bonds		
Aporta									
Fomenta	12.89	0.00	12,89	38.90	41.58	1,35	81.83	5.25	0.03
Cuprum	15.40	0.00	15.40	44.88	31.25	5,50	81.63	2.89	0.08
Habitat	14.91	0.01	14.92	43.87	34.46	4,48	82.81	1.74	0.53
Magister	17.03	0.00	17,03	33.54	41.97	1,56	77.01	5.52	0.38
Planvital	15.61	0.00	15.61	40.26	36.28	4,46	81.00	3.07	0.32
Protección	14.68	0.00	14.68	34.18	42.34	5.97	82.49		0.02
Provida	14.72	0.00	14.72	38.31	36.62	6.82	81.75	3.37	0.16
Santa Maria	14.73	0.00	14.73	39.81	36.01	6.12	81.94	3.29	0.04
Summa									
Bansander	14.68	0.00	14.68	43.29	33.03	6.00	82.32	2.98	0.02
Mean	14.90	0.00	14.90	40.96	35.44	5.63	82.03	2.88	0.19
Variance	1.18	0.00	1.18	16.05	16.38	3.96	2.95	1.45	0.04

¹ As a percentage of total Portfolio assets.

Source: Superintendencia de AFP, Bulletino Estadistico, no. 148 (1999), pp. 221 -223.

B3: Pension Funds Portfolio Evolution

Instruments	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Government	28,10%	26,00%	44,50%	42,10%	42,40%	46,60%	41,40%	35,40%	41,50%	44,10%	38,30%	49,90%
Deposits and Papers of Financial Institutions	61,90%	26,60%	2,70%	12,20%	20,40%	22,90%	27,40%	28,50%	20,80%	16,30%	11,70%	9,40%
Mortgage Bonds	9,40%	46,00%	50,70%	42,90%	35,20%	25,50%	21,30%	20,60%	17,70%	16,10%	13,40%	14,20%
Bonds and equities of Financial Institutions	0,00%	0,00%	0,00%	0,60%	0,40%	0,30%	0,70%	1,00%	0,70%	1,10%	1,50%	1,60%
Corporate Stocks	0,00%	0,00%	0,00%	0,00%	0,00%	3,80%	6,30%	8,10%	10,10%	11,30%	23,80%	24,00%
Corporate Bonds	0,60%	0,60%	2,20%	1,80%	1,10%	0,80%	2,60%	6,40%	9,10%	11,10%	11,10%	9,60%
Shares of Investment Funds	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,20%
Foreign Instruments	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
Cash	0,00%	0,00%	0,00%	0,50%	0,50%	0,10%	0,40%	0,00%	0,00%	0,10%	0,10%	0,10%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

¹In percentage up to December of each year.

Source: Superintendencia de AFP (1997, p. 63).

Appendix C: An Overlapping-Generations-Model with Different Pension Systems (and Uncertainty)¹

The model follows the structure of the OG -model of Blanchard and Fisher (1989, chap. 3). In particular three questions will be analyzed here: First, the introduction of a fully funded pension system and its effects on private savings. Second, the effects of a transition from a PAYG to a FF system on private savings; third, the welfare implications of the repayment of the implicit debt of the existing pension system, and the burden of the transition period.

All of these problems are analyzed under the favourable assumption, that the market rate of return of capital is higher than the natural rate of growth (i.e. productivity growth plus population growth) or equivalently labor income growth.

I. The Basic Model

The economy consists of individuals and firms. The **individuals** live for two periods and consume $c_{1,t}$ in their first period of life, and $c_{2,t+1}$ in their second period of life. Since there is uncertainty with respect to the future, the utility of an individual over his "life cycle" is

$$u(c_{1,t}) + E(1+\rho)^{-1}u(c_{2,t+1}),$$

with $\rho > 0$ as the subjective time discount rate, E the expectations operator, and $u' > 0$, and $u'' < 0$.

The individuals work only in their first life period: They offer (one unit of) labor inelastically and receive the wage $w_t > 0$. They consume part of their labor income and save the remainder, invest their savings to finance their consumption in their second life period.

The savings of the "young workers" in period t built up the capital stock, which is used in period $t+1$ together with labor supplied by the new young workers. The number of individuals born at the beginning of period t and working in this period is N_t . The growth of the (working) population is given exogenously with the rate n , so that $N_{t+1} = (1+n)N_t$. The growth factor of aggregate (labor) income is hence $G_{t+1} \equiv w_{t+1}N_{t+1} / w_t \cdot N_t$.

The **firms** act competitively and produce output using a neoclassical production function (i.e. the INADA conditions apply). Output per worker is then given by $y_t = f(k_t)$, with k_t measuring the capital-labor-ratio or capital per head. The firms take the wage rate and the rental price (cost) of capital (r_t) as exogenously given while maximizing their profits.

The maximization problem of a representative individual is hence:

$$\text{Max } u(c_{1,t}) + E(1+\rho)^{-1}u(c_{2,t+1})$$

$$\text{s.t. } c_{1,t} + s_t = w_t$$

$$c_{2,t+1} = s_t(1+r_{t+1}).$$

Denoting by V_t the utility obtained by solving the above problem, the first order condition is

¹ To introduce uncertainty in an interesting sense is beyond the scope of this Appendix. Therefore it is assumed that there are productivity shocks that have common effects (e.g. with a Cobb -Douglas technology) on output, wages, and capital income, i.e. all these variables are perfectly correlated. Therefore, there is no advantage of risk sharing between generations. Furthermore, when the productivity shocks are identically and independently distributed, this is also true for the exogeneous as well as for the endogeneous variables. In particular, the savings propensity is independent of time and of the state of nature. See, however, Bohn (1997).

$$(1) \quad \frac{dV_t}{dc_t} = u'(w_t - s_t) - E(1+q)^{-1}(1+r_{t+1})u'(s_t(1+r_{t+1})) = 0$$

implicitly giving the following "savings function":

$$(2) \quad s_t = s(w_t, r_{t+1}),$$

where $0 < s_w < 1$, but the sign of s_r is ambiguous because of the opposite income and substitution effect.

The result of the maximization problem of the firms yields the following first-order conditions

$$(3) \quad f(k_t) - k_t - f'(k_t) = w_t$$

and

$$f'(k_t) = r_t.$$

Equilibrium in the goods market requires that demand for and supply of goods are equal or equivalently that the demand for capital by firms equals the supply of capital by consumers

$$K_{t+1} - K_t = N_t \cdot s(w_t, r_{t+1}) - K_t,$$

where the left hand side shows net -investment as a change in the capital stock, and the right hand side shows the savings of the young generation minus the de -savings of the old.

Eliminating k_t and division by N_t results in

$$(4) \quad (1+n)k_{t+1} = s(w_t, r_{t+1}).$$

II. An Economy with a Fully Funded Pension System

In a fully funded pension system, the state (or the pension funds) collect in period t the premium d_t from the young workers and invests the sum in the capital stock. In the same period the funds pay pensions to the retirees $b_t = (1+r_t)d_{t-1}$ whose premium were invested in period $t-1$. Equations (1) and (4) now change as follows:

$$(5) \quad u'(w_t - (s_t + d_t)) - E(1+q)^{-1}(1+r_{t+1})u'((s_t + d_t)(1+r_{t+1})) = 0$$

$$(6) \quad s_t + d_t = (1+n)k_{t+1}.$$

A comparison between eq. (1) and (2) and eq. (5) and (6) shows that when k_t fulfils these eq. then it fulfils also those eq., as long as $d_t < (1+n)k_{t+1}$.

Proposition 1: As long as the premium of a fully funded pension systems is not higher than the voluntary savings which would exist when there is no pension system, the introduction of a fully funded system does not change the level of privat savings.

All individuals receive the same rate of return on the premium as well as on their savings, therefore, they are indifferent towards the allocation between s_t and d_t . They adjust only their "voluntary" savings s to take into account the "forced savings" d .

III. An Economy with a PAYG Pension System

In a pay-as-you-go pension system the income in period one diminishes by τ , the payroll tax rate paid into the (social insurance) pension fund, resulting in a pension b_t in the second period. This tax rate is non-distortionary since the labor supply is inelastically given. Furthermore, there is no public borrowing, i.e. the system pays for itself: By paying τw_t an individual acquires a claim against an equal share of next generation's income, i.e.

$\tau w_{t+1} N_{t+1} / N_t = \tau w_t G_{t+1}$. Hence, the pensions paid in period t are equal to the premium paid in this period: $b_t = (1+n)d_t$, when the premiums of the young workers to the pension fund remain constant over time – the condition in a steady state –, then the interest rate is (only) n and not r . Therefore, the constraints of the maximization problem now read as follows:

$$c_{1,t} + s_t = (1 - \tau)w_t$$

$$c_{1,t} = w_t - (s_t + \tau w_t)$$

$$c_{2,t} = s_t(1 + r_{t+1}) + \tau w_t G_{t+1}$$

However, when there is no wage increase, the growth factor is simply $(1+n)$. Hence, eq. (1) and (4) change as follows:

$$(7) \quad u'(w_t - (s_t + d_t)) - E(1 + q)^{-1}(1 + r_{t+1})u'(s_t(1 + r_{t+1}) + d_{t+1}(1 + n)) = 0$$

$$(8) \quad s_t(w_t, r_{t+1}, d_t) = (1 + n)k_{t+1}$$

It is easy to show that the rate of savings as well as the capital stock per head are decreasing functions of the necessary premium rate. To show this, differentiate eq. (7) with respect to the premium (assuming that $d_t = d_{t+1}$) and holding the wage rate and interest rate constant:

$$(9) \quad \frac{\partial s_t}{\partial d_t} = -\frac{u_1'' + E(1 + q)^{-1}(1 + r)(1 + n)u_2''}{u_1'' + (1 + q)^{-1}(1 + r)^2 u_2''} < 0.$$

Differentiation of eq. (8) holding k_t constant results in

$$(10) \quad \frac{\partial k_{t+1}}{\partial d_t} = \frac{\partial s_t / \partial d_t}{1 + n - s_t f''} < 0.$$

The numerator is negative, the denominator is positive when there is a unique and stable equilibrium (see Blanchard/Fisher, 1987, pp. 95 sqq.). This leads to

Proposition 2: Introducing a PAYG pension system reduces both private savings and the stock of capital per head.

IV: Transition: Replacing an Unfunded with a Fully Funded Pension System

Suppose now that a PAYG system is replaced by a fully funded system. Then the government has an obligation to pay the pensions of the current generation of retirees. This "debt" is financed by borrowing from the new young generation of workers at the market rate of interest. The value of this obligation is unaffected by the change of the system, therefore, the amount the state borrows per worker (z_t) must be the same as the premium every young

worker had to pay under the old PAYG system (d_t). Assuming that the interest rate is unaffected by this system's change, eq. (1) and (4) become

$$(11) \quad u'(w_t - (s_t + z_t)) - E(1+q)^{-1}(1+r_{t+1})u'((s_t + z_t)(1+r_{t+1})) = 0$$

$$(12) \quad s_t = (1+n)k_{t+1}.$$

Assuming $d_t = d_{t+1}$, eq. (7) and (8) are identical to eq. (11) and (12) except that the portion of savings going to finance the consumption of the current generation of retirees now earns a rate of return of r_{t+1} , rather than n . This increase (throughout it is assumed that $r > n$) generates a pure income effect that will tend to decrease current period savings.

Proposition 3: The transition from an unfunded PAYG pension system to a fully funded pension system generates an immediate income effect that lowers private savings.

The state (or the pension funds) has to refloat continuously this debt, when there is no "fiscal consolidation". Hence, to repay in period $t+1$ the amount borrowed in period t , the state has to borrow $z_{t+1} = z_t(1+r_{t+1})/(1+n)$ from each young worker in period $t+1$. The first-order conditions change to

$$(13) \quad u'(w_{t+1} - (s_{t+1} + z_{t+1})) = E(1+q)^{-1}(1+r_{t+2}) \cdot u'((s_{t+1} + z_{t+1})(1+r_{t+2}))$$

$$(14) \quad s_{t+1} = (1+n)k_{t+2}.$$

Assuming $r > n$, the debt per worker increases in every period, hence the savings for capital accumulation will (in partial equilibrium) decrease resulting in a reduced capital stock (in each future period relative to what it would otherwise have been). Eq. (13) shows that the increases in z are fully offset by decreases in s , until voluntary savings disappear (given that individuals are indifferent between buying government bonds and investing in capital stock).

However, this is a partial equilibrium result, because the interest rate was held constant. When the capital stock falls, the interest rate will increase and the wage rate will decrease, both trends will influence the level of savings.

The answer is obtained by differentiating eq. (14) with respect to z_{t+1} , to obtain

$$\frac{dk_{t+2}}{dz_{t+1}} = \frac{\partial s_{t+1} / \partial d_{t+1}}{1+n - s_r f''(k_{t+2})}.$$

As before (see eq. 10) the numerator is negative and the denominator positive when $s_r \geq 0$ so that the equilibrium is unique and stable. Hence, an increase in government borrowing per worker decreases the stock of capital in equilibrium.

Proposition 4: Financing the transition (only) by borrowing (e.g. by "recognition bonds") leads to a growing debt per head since z_t increases at the rate $(1+r)/(1+n)$. Furthermore, the decrease of the capital stock will lead to a n increase in the interest rate and generate additional savings, in the end the explosive path of z_t will exhaust output. Therefore, some adjustment in the fiscal balance will be required to ensure stability of the economy.