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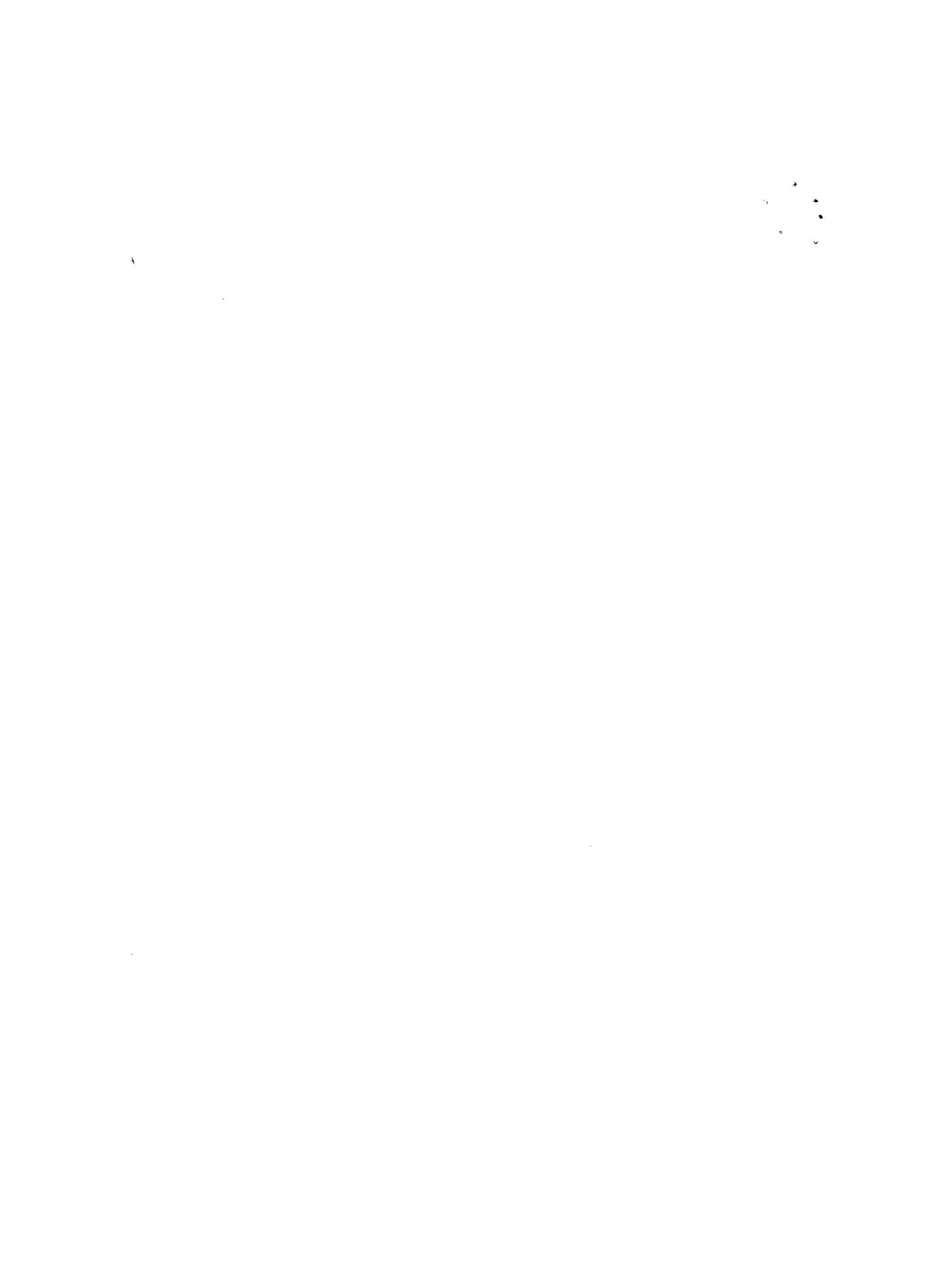
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"FISCAL ISSUES OF SHIFTING FROM UNFUNDED TO FUNDED PENSION"*/

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Fiscal Issues of Shifting from Unfunded to Funded Pensions

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Abstract

The seeming success of the Chilean pension reform of 1981, moving from an unfunded to a funded scheme, and the recent limited imitations of such a reform approach by Australia and Peru, Argentina and Columbia have encouraged institutions like the World Bank to promote funded provisions and the move toward a two-pillar system (public and unfunded plus private and funded) throughout the world. Yet such an unconditional promotion of a (partial) shift from an unfunded to a fully funded retirement scheme is problematic. It resembles the advice to somebody who spends too-high a share of his income on housing rent, urging him to look for a smaller and cheaper flat, but suggesting at the same time to think about buying a flat.

The objective of the papers is to provide policymakers and economists involved in such a pension reform with a better understanding of the fiscal task, and to highlight main fiscal options and constraints. The liabilities towards the current generation of retirees and workers resulting from unfunded pension provisions constitute a huge hidden public debt. Making this implicit social security debt fully explicit, thus reversing the initial redistribution towards the start-up generation, is for most countries quite likely beyond their political, economic and fiscal capacity. Thus, a transition requires various simultaneous steps such as (i) a benefit reform of the unfunded scheme, reducing the implicit debt, (ii) a redesign of the basic tier remaining unfunded to minimize distortions on factor markets, (iii) a design of the timing and form of the debt made explicit and the fiscal flows involved, and (iv) a careful calculation of the compensation amount to render the switching decision by individual workers voluntary but cost effective. Theoretical considerations and the empirical evidence for Chile suggest the feasibility and potential Pareto-efficiency of such an approach, but it may require contractionary fiscal stance.

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I. Introduction

Pension reform is high on the agenda in both developed and emerging market economies throughout the world. Public pension schemes consume a high and rising portion of GDP, are held responsible for many distortions on factor markets, and, unless changed, may become unfinanciable in view of the aging of population which will be accentuated by the retirement of the baby-boom generation after the turn of the century. For this very reason the reform options of the, in general, unfunded public schemes have been investigated by national governments and international institutions for some time (e.g., Heller et al. 1987, Holzmann 1988). The seeming success of the Chilean pension reform of 1981, moving from an unfunded to a funded scheme, and the recent limited imitations of such a reform approach by Australia (1992) and Peru (1993), Argentina and Colombia (1994) have encouraged institutions like the World Bank (1994) to promote funded provisions and the move toward a two-pillar system (public and unfunded plus private and funded) throughout the world.

Yet such a rather unconditional promotion of a (partial) shift from an unfunded to a fully funded retirement scheme is problematic. It resembles the advice to somebody who spends too high a share of his income on housing rent, urging him to look for a smaller and cheaper flat, but suggesting at the same time to think about buying a flat. While such a move may prove very useful because of lower current expenditure and potential capital gains, it requires important shifts in intertemporal consumption behavior. Furthermore, the buyer may be confronted with cash-flow problems (having to pay interest and principal) when exposed to stochastic income realization. A similar problem arises for countries when shifting from an unfunded to a funded scheme, and this demands a close investigation of the change in stocks and flows involved.

The general objective of the papers is to provide policymakers and economists involved in such a pension reform with a better understanding of the fiscal task, and to highlight main fiscal options and constraints. To this end the specific objective the paper is fivefold: (i) To investigate the interrelation between, and scope of fiscal stocks and flows involved in a shift from an unfunded to a funded pension scheme (UF-FF shift). The stocks comprise, *inter alia*, the existing commitment toward current and future retirees staying with the unfunded scheme, and the compensation amount for forgone unfunded benefits/past contributions resulting from a switch from unfunded to funded provisions. The fiscal flows comprise, *inter alia*, the operational deficit of the social security fund resulting from the loss of contributors, and the disbursement of the compensatory amount. (ii) To explore expenditure minimizing procedures for the UF-FF shift and the appropriate timing. For political reasons, a voluntary decision by individuals to switch to the new and funded system is preferable. This requires an understanding of the intertemporal decision making process by

the individual, which, by the same token allows for an endogenous determination of the switching age while minimizing the fiscal costs. (iii) To analyze the importance, and timing, of the reform of the unfunded scheme. Essentially all unfunded pension schemes need to be reformed in parallel with a change in the financing mechanism. The scope of such a reform (e.g., increase in the retirement age) and its timing has a bearing on the transition costs. (iv) To investigate the main options for financing the fiscal flows of such a reform, the potential scope of revenue enhancing measures and effects as a result of the transition, such as the claimed favorable effect on capital accumulation, saving and total factor productivity, and the use of government assets. (v) To present preliminary empirical findings of the Chilean pension reform and the economic and fiscal issues involved.

The structure of the paper is as follows: Section 2 highlights the links between stocks and flows, including the strategies for reducing the implicit debt to be made explicit, and the individual switching decision. Section 3 outlines the main financing options, including the potential sources of financing the transition which may result from enhanced economic growth or the use of government assets. Section 4 summarizes first empirical results of the Chilean pension reform and its impact on economic growth, capital formation and saving, including the financing of the debt made explicit, while Section 5 concludes.

II. Determining the fiscal task: Stocks and flows

As it is well known, an unfunded pension scheme constitutes a commitment toward current retirees and workers, and thus is equivalent to a (hidden) public debt. Shifting to a funded scheme makes this implicit debt explicit, which has eventually to be repaid. The shift between implicit and explicit public debt, and the fiscal flows involved, however, depend on the way how the transition is structured. While most theoretical papers dealing with a shift from unfunded to funded provisions are cognizant of the stock-flow link when addressing the intergenerational welfare and intertemporal macroeconomic issues, most empirical papers on such a reform concentrate on the fiscal flows only when addressing the fiscal and distributional issues involved. This section outlines the main links between stocks and flows to be taken into consideration, supported by limited empirical data, and supplemented by some heuristic simulations.

1. Conceptual considerations

a. The scope of pension liabilities

Given the debt nature of pension obligations, as a first step the scope of this debt has to be assessed since it determines the potential costs of transition.

Current pension expenditures are only a good indicator for existing commitments under steady-state conditions. In the case of an aging population, rising labor force participation and pension coverage or non-mature benefit structure the current expenditure level underestimates the outstanding commitment.

There exist three main definitions of pension liabilities (Franco, 1995):

- (a) Accrued-to-date liabilities: these represent the present value of pensions to be paid in the future on the basis of accrued rights; neither the future contributions, nor the accrual of new rights by them are considered.
- (b) Current workers and pensioner's liabilities: in this case it is assumed that pension schemes continue their existence until the last contributor enters, while no new entrants are allowed; both the future contribution of existing members and their new rights are therefore allowed under current rules.
- (c) Open-system liabilities: these also include the present valued of contributions and pensions of new workers under current rules; the range of options extends from including only children not yet in the labor force, to an infinite perspective.

For an unfunded/fully funded pension shift (UF-FF shift), it is the first definition which is relevant, since it is the value of accrued rights which has to be compensated and thus becomes explicit debt (unless the government defaults on its pension commitments or finances it entirely from current resources). With a given pension system, the main assumptions which determine the level of the accrued pension liabilities (or social security debt, SSD) are the real interest rate, real wage growth, inflation rate, and survival probabilities. For countries where the public pension system has accumulated financial reserves, the existing assets have to be subtracted.

Table 1 illustrates the scope of the SSD for selected OECD country in 1990. The estimates have only illustrative character and constitute a lower limit, since they leave out disability and survivors pension, or mostly disregard social pensions and means-tested and related supplements¹. Nevertheless, those estimates indicate that the hidden public debt, the SSD, is extremely important and dwarfs the explicit financial debt existing in those countries². Comparing the

¹ The overall pension expenditure in most OECD countries are much higher (see, Holzmann, 1988), and national estimates of the (net) social security debt arrive at values which are up to 50 percent above the presented ones (see, Franco, 1995).

² The available estimates for Columbia (1994) and Chile (1981) at the inception of reform exhibit much lower magnitudes, ranging at 60 to 80, and 80 to 126 percent, respectively. See Table 2.

SSD with the annual pension expenditure also confirms a rule of thumb that for reasonable parameter assumptions the ratio is in the range of 15 to 30³.

Table 1: Net Accrued Pension Liabilities and Financial Debt for Selected OECD Countries, 1990
 (in percent of
 GDP)

Country	Gross Liabilities			Existing Assets	Net Liabilities	Pension Expend. 1/	Gross Liability./ Pension Exp.	Financial Liabilities	Total gross Liabilities
	Retired	Workforce	Total						
	(1)	(2)	(3) =(1)+(2)	(4)	(5)=(3)+(4)	(6)	(7)=(3)/(6)	(8)	(9)=(3)+(8)
France	77	139	216	0	216	9,0	24,0	40	256
Germany	55	102	157	0	157	6,9	22,8	44	201
Italy	94	165	259	0	259	10,6	24,4	101	360
(after 1992 reform)	94	148	242	0	242	10,6	22,8	101	343
United Kingdom	58	81	139	0	139	6,6	21,1	35	174
Canada	42	71	113	-8	105	3,9	29,0	73	186
Japan	51	112	163	-18	145	5,7	28,6	70	233
United States	42	70	112	-23	89	5,1	22,0	55	167

Assumptions: Pension benefits are price indexed; real earnings grow by 2 percent; discount rate is selected at 4 percent from 1990 to 2010, declining to 3 percent in 2050.

Source: Van den Noord and Herd (1994), OECD data base, and own calculations.

1/ Only old-age pension expenditure around 1990; figures for Japan include survivors and disability pensions.

b. Reducing the scope of the SSD to be made explicit

Given the average pension expenditure level of OECD countries and many emerging economies in Eastern Europe of 10 percent of GDP and above, this amounts to a SSD of some 150 to 300 percent of GDP, and more, with rising tendency. Moreover, in the case of the Eastern European reform countries the actual expenditure level is often downward biased through benefit and indexation caps for budgetary reasons. Making the debt of such an amount fully explicit, and eventually having to repay it, does not seem feasible. This begs for strategies to reduce the amount of SSD made explicit.

³ The upper estimate of this multiple can be cross-checked under the assumption of wage growth equal to the interest rate, and a constant demographic structure. With, on average, some 15 to 20 years of retirement spell, the accrued obligation amounts to 7.5 to 10 times the annual expenditure. In addition, the accrued obligation with regard to the current working generations have to be taken into account. With some 30 to 40 years of average activity, the accrued obligation amounts to some 15 to 20 times the annual expenditure. Taking both upper estimates for the retired and working generation together results in accrued obligations of 30 times the annual expenditure. Of course, price indexation instead of wage indexation (or a positive interest-wage difference) reduces this estimate.

(i) Strategy I consists in reducing the SSD via a reduction of future commitments through an increase in the retirement age, decrease in the annual accrual factor or change in the indexation procedure (say, from wage to price indexation). In fiscal speech, the government partially defaults on its pension commitments. A reform of the unfunded scheme in parallel with the a partial or full shift to a funded scheme appears required in most countries since the unfunded schemes are essentially financially unsustainable, and a mere shift in the financing mechanism is of little help. So far, all reform countries in Latin America have adjusted eligibility and benefit rules in parallel with a shift in the financing mechanism. In order to reduce the amount of SSD made explicit, the reform has to be implemented but not necessarily effective at the time of the U-F-shift. What is important is that the benefit reform of the unfunded scheme is effective at retirement for those cohorts which should switch.

Figure 1a and b highlight the scope and changes of the SSD under different benefit reform options, and the divergence between stocks and flows. The results are based on a heuristic simulation model which mimics the essential features of a two-tier pension scheme⁴.

Benefit indexation: Starting out with price indexation, with a change to wage indexation in period -10, the SSD jumps immediately by over 20 percent of GDP and continues further to increase for some 30 years till the difference to the baseline scenario reaches almost 40 percent of GDP, or 1/5 of the SSD level. With initial wage indexation, a change to price indexation in period -10 leads to an immediate drop in the SSD level by some 24 percent of GDP before gradually approaching the baseline level after some 40 years.

Retirement age and accrual rate: Changing the retirement age from 60 to 65, or even from 60 to 70 during the period 1 to 20 has an effect on the SSD well before the implementation of the reform. The impact on SSD is substantial. However, the results also reveal that in an earnings-related scheme the effects are somewhat compensated if the accrual rate is not adjusted accordingly (i.e. if individuals working longer and retiring later accrue further pension rights). Linking a strong increase in the RA with a decrease in the accrual rate essentially halves the SSD.

⁴ The model has been calibrated to reflect emerging market economies with a two-tier pension system consisting of a basic tier and an earnings-related tier. Under the base-line assumption, the life-expectancy (LE) is 70 years, the basic tier amounts to 15 (20) percent of average wage, the accrual rate in the earnings-related tier to 1.5% p.a., and the retirement age is 60. This results in an average replacement rate of some 50% (net of contribution payments), a contribution rate on net wages of some 30 percent, and an expenditure share of some 19% of GDP. The baseline scenario implies a SSD of some 163 percent of GDP, with a real interest/real growth rate gap of 3pp. Reducing this gap to 2pp increases the SSD by 10pp of GDP. For the motivation of the specific model approach and basic model features, see Annex A.

Figure 1a: Social Security Debt under alternative Policy Scenarios

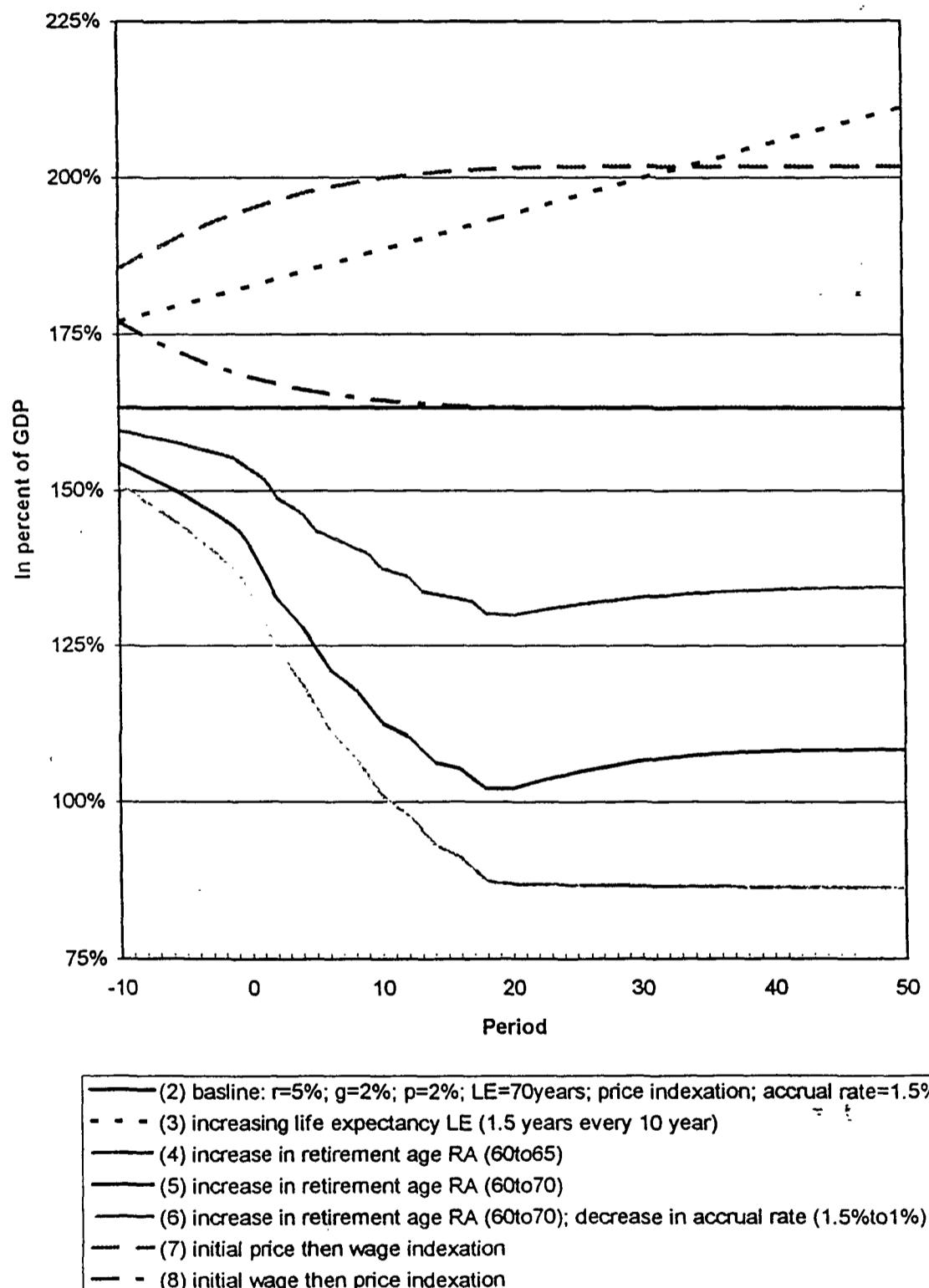
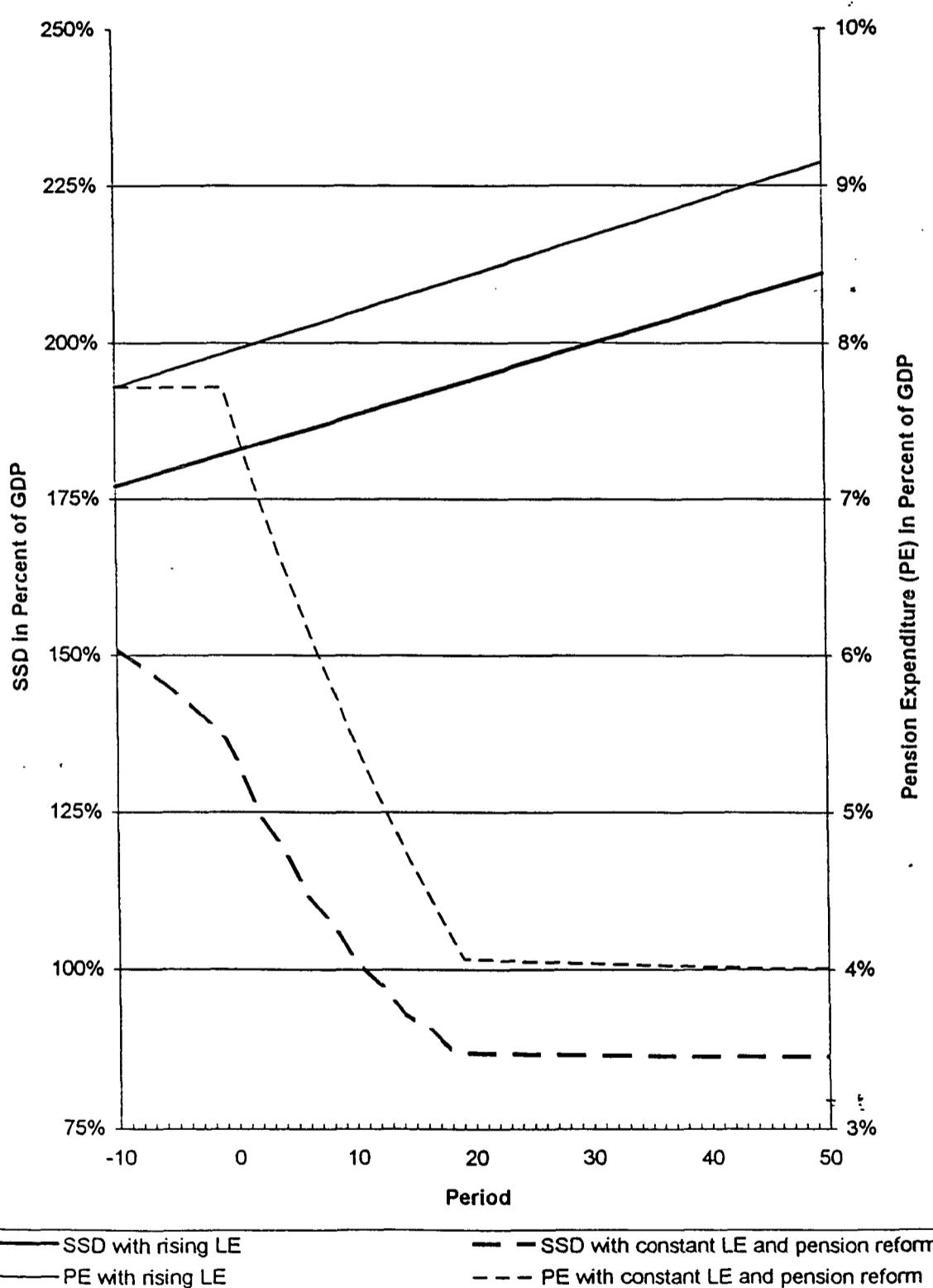


Figure 1b: Social Security Debt and Current Pension Expenditure



Both changes in policy parameters and their effects on SSD are a first indication of the importance to introduce policy changes well in advance of a U-F-shift if the transition costs are to be minimized. Figure 1a also indicates the expected increase of the SSD as a result of rising life expectancy. But again, SSD jumps with the future change in life-expectancy, i.e. the stock effects of future changes are immediately capitalized. Figure 2b exhibits this difference between stock and flow developments with regard to SSD and pension expenditure (each measured as a percent of GDP). While the fiscal flow variable - the pension expenditure - are initially identical, differences in future life expectancy and policy setting have an immediate impact on SSD. The difference amounts to almost 30 percent of GDP.

(ii) Strategy II consists in a partial shift toward a funded system, thus making only part of the SSD explicit. The resulting (mandatory) pension scheme consists of an unfunded and a funded tier, and the distribution between both is determined by fiscal and other considerations. Such an approach is applied in Argentina and is under preparation in some eastern European reform countries such as Latvia, Croatia and, perhaps, Poland.

A partial UF-FF shift has both advantages and risk. The main (potential) advantages are three-fold:

(1) It proportionately reduces the potential scope of the implicit debt made explicit and can thus lead to a manageable fiscal task. While the repayment of, say, 200 percent of GDP in debt appears difficult, or even impossible, the repayment of half of this amount is in the range of the Chilean pension reform.

(2) Basing retirement income on both an unfunded and a funded scheme allows for risk diversification and may be welfare enhancing. It can be argued that the internal rate of return of an unfunded scheme - the natural growth rate - is a stochastic variable which exposes each pension cohort to an income risk. The same can be claimed for the internal rate of return of a funded scheme - the interest rate. Thus, if the covariance of both returns is lower than 1, a mixed financing mechanism reduces the overall income risk and provides positive welfare effects⁵.

(3) Public and earnings-related pension schemes traditionally have a distributional and an annuity component, and it is the mingling of both and the lack of a clear contribution/benefit link which is held responsible for the various distortions inflicted by public and unfunded schemes (see e.g. Schmidt-Hebbel, 1993). Separating both components into an unfunded distribution-oriented tier, and a truly earnings-related funded tier is claimed to reduce the distortions importantly (World Bank, 1994).

However, there are also (potential) risks of a partial shift only which are the following:

⁵ For Austrian evidence of a negative correlation between the internal rate of return of the public scheme and the market rate of interest see Holzmann (1988).

(1) Keeping an unfunded and, perhaps, earnings-related tier does not contain the political pressure for benefit extension, observed in both developed and developing countries.

(2) Unfunded and funded tiers have different rates of return. Temporary lower rates of the funded tier may exert a political pressure for higher benefits under the unfunded tier in order to compensate for; conversely also higher rates may introduce a pressure for higher unfunded benefits from those parts of the population which are little covered by the second tier.

(3) The unfunded tier is much more exposed to the aging of population, and the problem of long-term financing this implies.

(iii) Given the scope of the existing pension commitments, most countries will have to apply both strategies simultaneously in order to keep the resulting fiscal obligations manageable. This raises the question of an appropriate structure for the first and unfunded tier which may allow to circumvent the risks raised above.

A microeconomically ingenious approach to structure the basic and unfunded tier was recently developed and implemented in Sweden (and also voted for introduction in Latvia); it was the following characteristics:

The new pension system is a „notionally defined contribution“ one. The system starts by giving everyone paying the social security contribution an account. As contributions for the pension system are paid, the account is credited, as if it were a saving account, and the accumulated capital earns a „rate of return“ equal to the growth of the average wage on which the contribution is collected. At retirement, the pension paid is equal to the accumulated capital (inclusive of the notional interest rate) divided by the expected post-retirement life span of all those of that persons age. The pension is price-indexed.

This approach has various advantages, in particular: (1) the system provides incentive for formal labor force participation since any contribution evasion leads at the end to a lower benefit level; (2) the system is largely immune against political trickering, since any special treatment of groups has to be followed-up by explicit contribution payments; (3) individuals have an incentive to stay on the labor market and to extend their working lives; and, last but not least (4) the system adjusts endogenously to an increase in life-expectancy, since any increase will automatically lead to lower pension benefit giving rise to an incentive to retire later.

The main problem of this approach is the reserve accumulation it requires against temporary employment shocks, and most importantly, against the aging of population. Since the system is an unfunded one, but promises a rate of return based on average wage growth, expected changes in beneficiary/contributor ratios require corresponding financial reserves if future transfers from the state

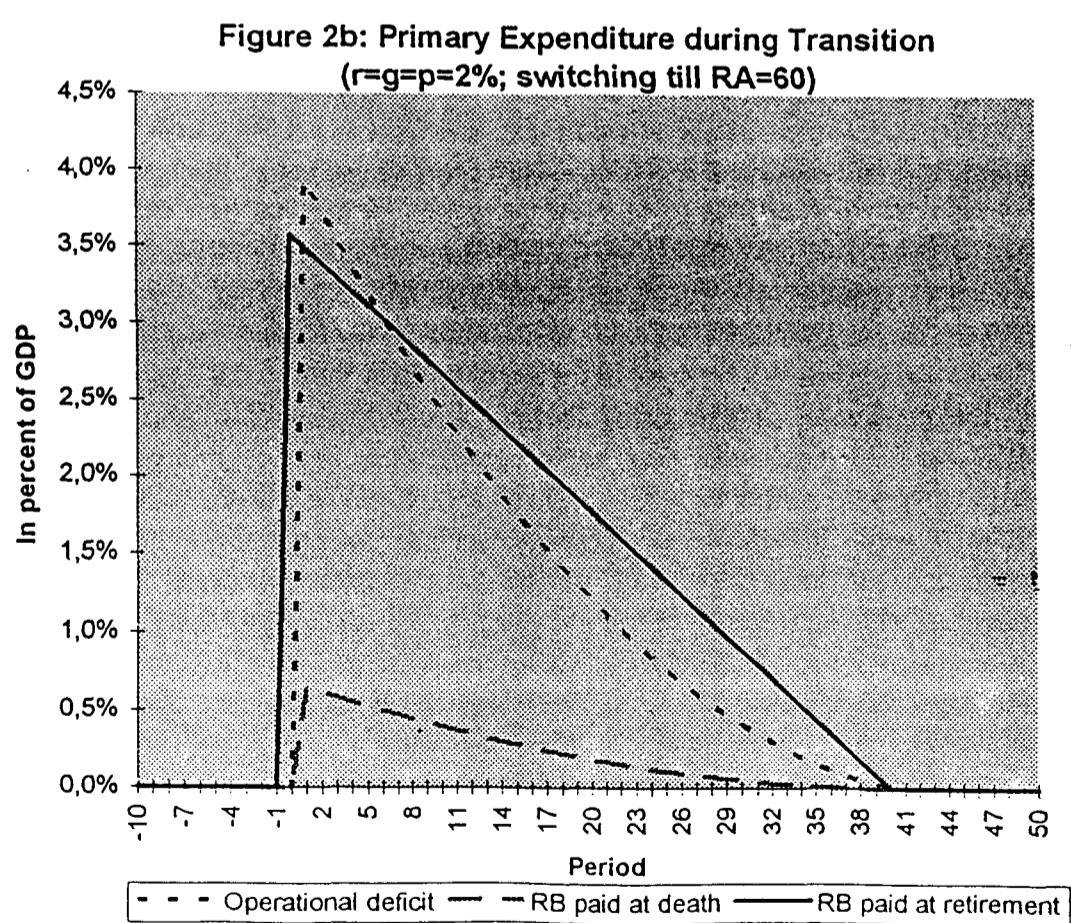
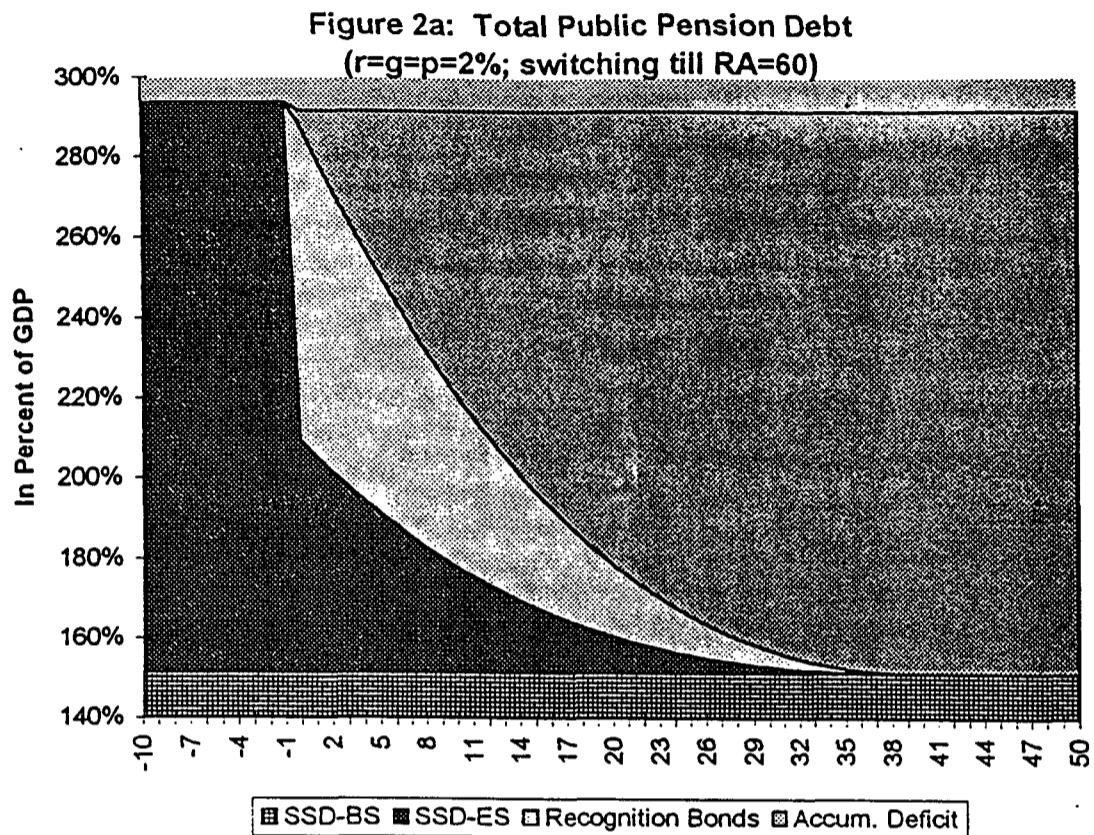
budget should be prevented. While the calculation of a long-term expenditure-covering contribution rate is technically relatively easy, the actual accumulation of reserves and the receipt of a market-based rate of return may constrained by political pressure for an alternative use of these funds.

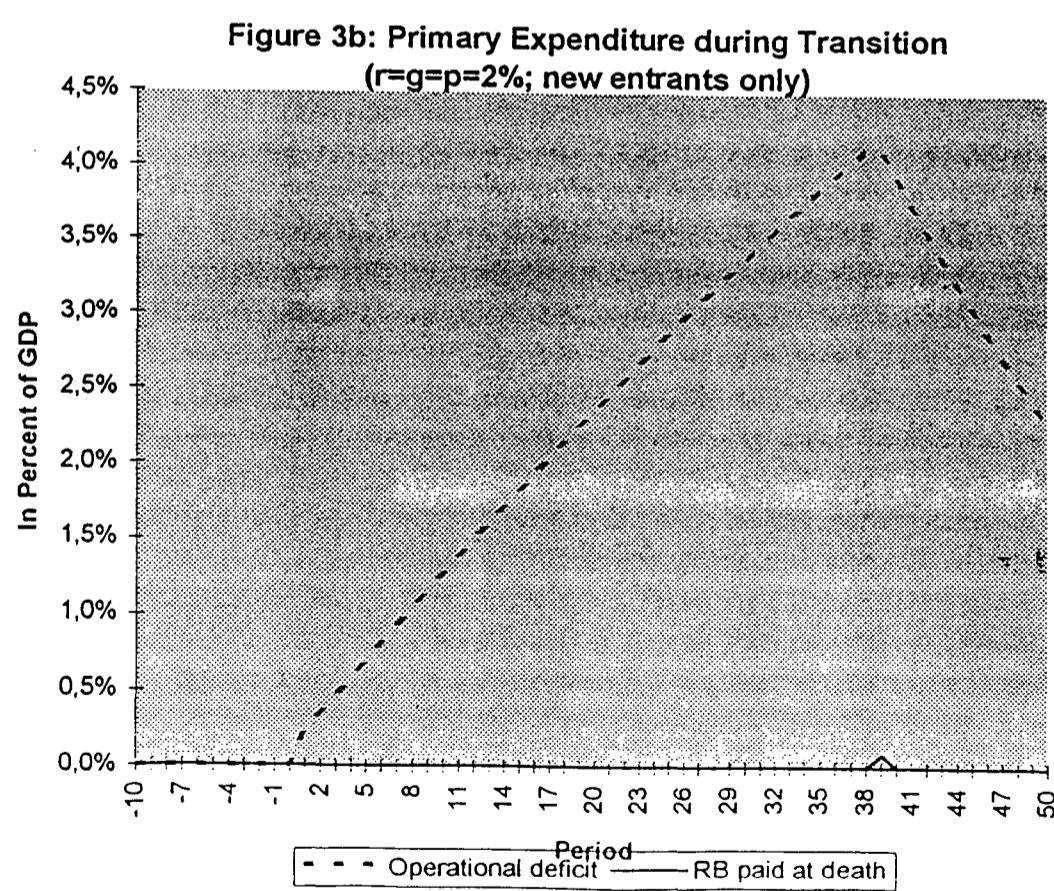
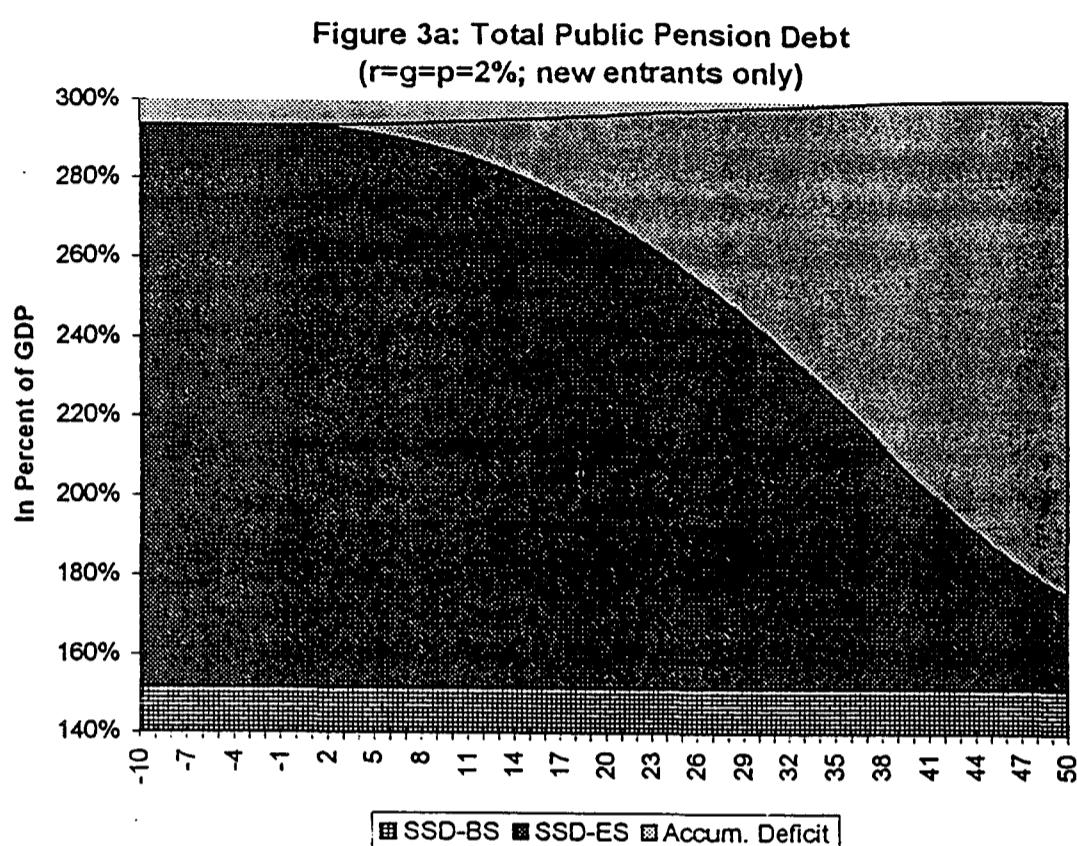
c. Speed of transition and cash-flow considerations

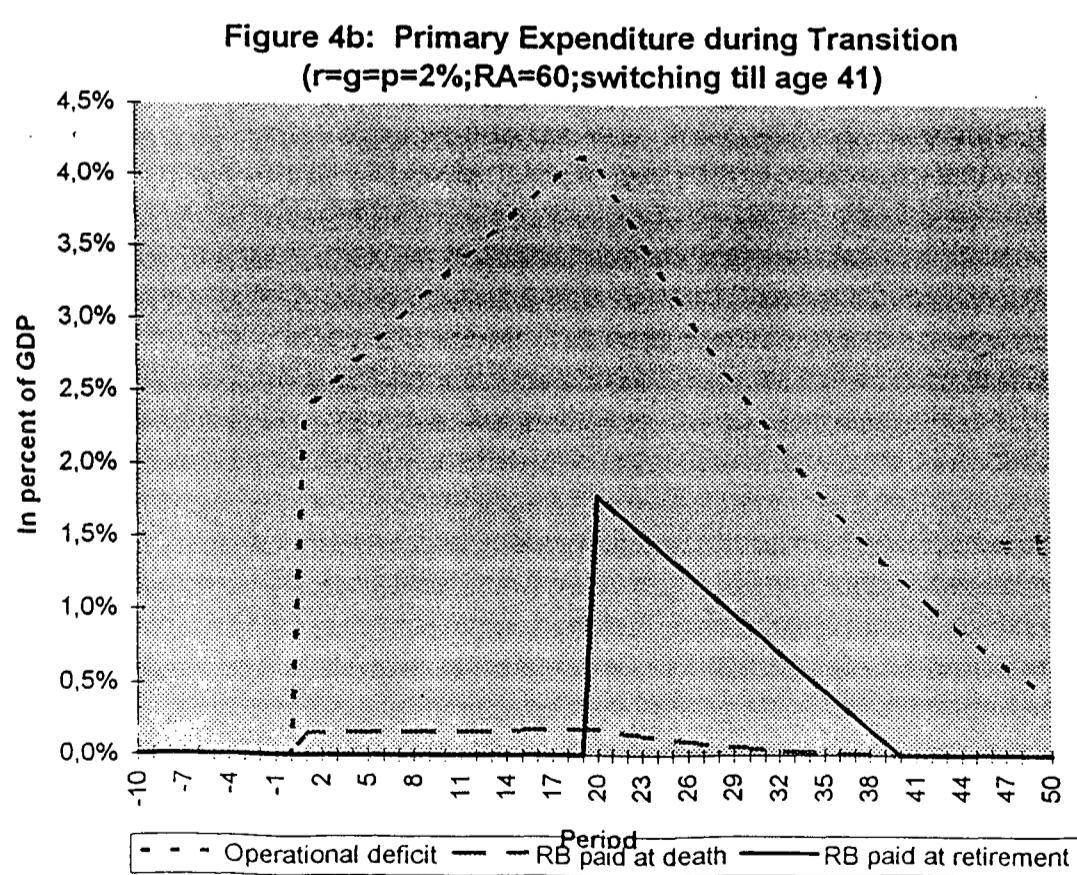
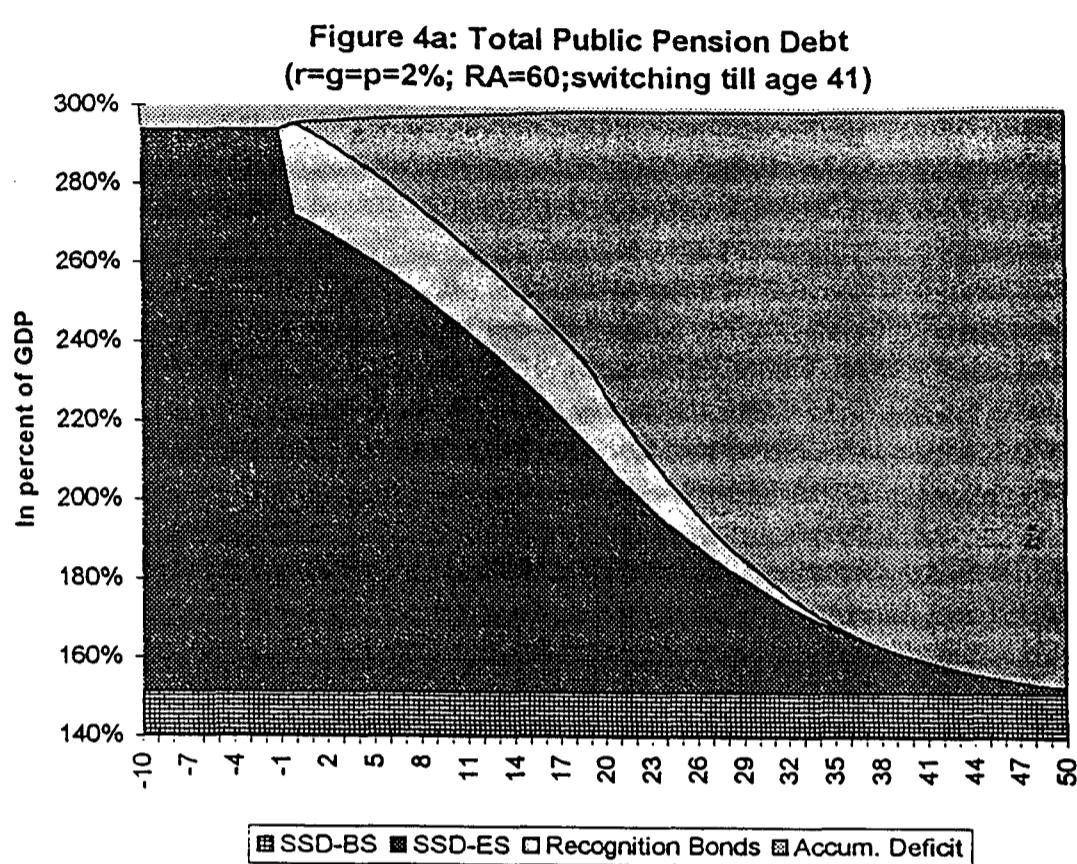
(i) The speed of transition is determined by the decision at which age a switch to the funded scheme should take place. There are two extreme options: Under the radical option, all commitments - for those who have just entered the labor force to those who are already retired - are compensated. Thus, the total SSD is made explicit in one stroke and has to be financed on the financial market; the cash flow requirements equal the SSD. Under the minimal option, only the new entrants to the labor market participate in the funded scheme. This reduces the cash flow requirements to the rising operational deficit (the difference between revenue and expenditure), since the expenditure remain for many years while the contributions decrease continuously. As a result, the transition is only completed once the last eligible person dies (in some 80 to 90 years). Most reforms will choose a switching age among the current working generation, say age 40, as a compromise between considerations to speed-up transition and cash-flow limitations.

Figure 2a to 4a highlight the change in the composition of the total public pension debt under different assumptions about the age of the switching cohort and over time. The decision takes place in period 0 and the switch in period 1. Since the interest rate equals the growth rate, the overall debt level remains unchanged, only the composition of debt becomes different. The corresponding b-Tables exhibit the cash-flow requirements of those changes (exclusive of interest payments on the accumulated deficit).

In Figure 2 all workers below retirement age shift to the funded (earnings-related) scheme and are compensated for by recognition bonds (RB). The affiliation to the basic scheme remains unchanged for all workers. As a result, almost 2/3 of the SSD of the earnings related scheme is exchanged against RB. The overall amount of RB decreases with the retirement of each cohort and the redemption of each bond. The corresponding cash flow requirement is presented in Table 2b. The primary expenditure consist of three elements: the operational deficit since the earnings-related system is left with no contributors but all retirees, the RB disbursed to the retiring cohort in each year, and the value of RB of those workers dying before retirement (and for which it is assumed that this value is handed over to the family). It is assumed that the cash-flow requirement as well as the corresponding interest expenditure are deficit financed. The cash-flow requirement is extremely front-loaded and peaks in the first year of transition.







In Figure 3 all workers (except the entrants of period 0) remain with the old system. As a result, RB are negligible. The change in the debt composition essentially takes place between SSD and accumulated deficits. The cash-flow requirement is very much back-loaded and peaks after 40 years. The transition is completed only after 80 years.

In Figure 4 a medium scenario is presented since only workers 40 years of age and below switch to the new system. Since their acquired rights under the unfunded scheme are relatively low so is the level of RB issued for compensation. Consequently the „recognition bond carrot“ is slim and long. As a result of this intermediate switching approach, the cash-flow requirements are largely centered, peaking after 20 years.

Figure 2 to 4 demonstrate the trade-off between the speed of transition and the timing of the cash-flow requirement. The faster the envisaged transition, the more the cash-flow requirement is front-loaded.

(ii) For political considerations, the switching decision should be left to the individual. For cash-flow and economic considerations, the approximate switching cohort should be known in advance. This requires knowledge of the individual/cohort decision process, which also allows the determination of expenditure-minimizing compensation for all switchers. Put differently, setting the switching age exogenously (say, all below age 40 have to join the funded scheme) either does not conform with individual preferences and thus undermines the political support of the reform. Or it reflects individual preferences but is at least as expensive as the individual voluntary decision. The Annex outlines the individual decision process and the main policy parameters to determine the expenditure-minimizing compensatory amount.

(iii) Cash-flow considerations are also important for the timing of the disbursement of the compensatory amount. The highest cash-flow requirement occurs if the compensation is paid at switching age. It amounts to the disbursement and financing of the corresponding SSD for all switchers. An intermediate cash-flow requirement takes place if the compensation (inclusive of interest payments) is paid only at retirement (such as the recognition bonds in the Chilean reform). In this case, the payment is distributed over the span of all switching cohorts and under a model-like setting the bonds mature with each switching cohort retiring. The minimum cash-flow requirement occurs if, further on, the recognition bonds are annuitized at retirement (similar to the compensatory pension in the Argentinean reform). In this case the cash-flow requirement is restricted to the sum of the annuity payments and spread to the year when the last pensioner dies.

Table 2 attempts to summarize the reform-induced changes in the composition of the SSD for Chile and Colombia. Both reforms entail a similar estimated level of the SSD to be made explicit, and in both countries the corresponding fiscal flows are predominantly generated by the operation deficit.

Table 2. Shifting from Unfunded to Funded Pensions: The Restructuring of SSD

	Chile (1981) (in % of GDP)		Columbia (1994) (in % of GDP)	
Social Security Debt of unreformed system 1/	n/a		125,7	
- reform of unfunded scheme	n/a		-37,6	2/
- reformed unfunded scheme	n/a		-4,5	
Social Security Debt made explicit o/w	126,0	in percent 100%	83,6	in percent 100%
operational deficit 3/ compensation amount 3/	99,9 26,1	79% 21%	69,2 14,4	83% 17%
n/a: not available				
1/ Calculated from accumulated deficits under alternative scenario simulations and the assumption of interest rate equal to the economic growth rate. See Schmidt-Hebbel (1994).				
2/ Includes effects from higher contribution rates beside increased retirement age and changes in benefit structure.				
3/ Calculated from the discounted flow projections under the assumption that the interest rate equals the economic growth rate.				
Sources: Arrau (1992), Schmidt-Hebbel (1994), and own calculations.				

d. Transition and financial market reactions

A temporary widening of the fiscal deficit which results from a (partial) UF-FF shift and which merely reflects a redistribution of total debt between implicit and explicit liabilities should have little effect on the pure interest rate. The capital stock and national saving are only marginally effected by such a deficit; any additional credit demand by government is supplied by the saving of the newly established funded provisions. Also, there should be no negative direct impact on the balance of payments.

With regard to reaction of the (international) financial markets, and a change in the risk premium in response to higher fiscal deficit and debt levels, however, the question goes unanswered. Since the total public debt remains unchanged, - *a priori* - one would expect any risk premium to remain unchanged too. Yet, financial markets may not be interested in the total debt, but only in the financial debt since any risk premium reflects the default probability of the latter. The result will thus depend on the assessment of the default probability by financial markets with regard to both kinds of debt (implicit and explicit), and their interaction.

If financial markets perceive that governments will never default on her pension obligations (i.e. introduce a reform of the unfunded tier which reduces her commitments towards current retirees and workforce), with a rising SSD the risk of a default on her financial debt should increase since the set of policy reaction to repay the debt is reduced (there is less scope for tax increases, but scope for inflation tax since pension benefits are secured in real terms). Accordingly, a rise in the SSD should increase the risk premium on financial debt, while a decline should reduce it. On the other hand, if financial markets are convinced that the government will first default on the pension commitment before defaulting on her financial obligations, the level of the SSD and thus any change should be inconsequential for the imposed risk premium on financial market debt. In such a case, however, a reform of the pension system which reduces the implicit debt, but increases its stock of financial debt would tend to increase the risk premium, with negative impacts on the budget and the economy. If the default on both kinds of debt is considered equally likely, the risk premium should be driven by the size of the total debt.

There is no empirical evidence on all three conjectures. The concentration of the drafters of the Maastricht treaty on the financial debt (and deficit) when formulating the fiscal criteria for a participation in the EMU (the European Monetary Union) to be started in 1999 is consistent with the second conjecture, since no regard is given to important differences in SSD among the member countries (see Table 1)⁶. If this conjecture were true and the European Union would strictly control for financial debt and deficit only, this would also have important consequences for reform attempts of some Central and Eastern

⁶ The Maastricht treaty as the latest step in the process of European integration schedules the completion of the European internal market by introducing a common currency around the turn of the century. To be allowed to participate in the European Economic and Monetary Union, a member state of the EU must fulfill five conditions signaling nominal economic convergence, the famous convergence criteria. Three are monetary (on inflation, long-term interest rates and exchange rates) and two are fiscal criteria: a "sustainable government financial position" deemed necessary for participation in EMU is checked by observing how public deficit and public debt, both measured in percent of GDP, stand relative to official reference values of 3 percent and 60 percent. Contrary to the monetary criteria, the fiscal criteria are not only entry conditions for joining EMU, but they are also valid as fiscal restrictions once a country participates in EMU. For most EU countries, the fiscal criteria constitute the binding constraint. For a critical assessment of the Maastricht fiscal criteria, see Holzmann et al. (1995).

European countries against their endeavor to join the EU in the near future. A few of those countries (Latvia, Croatia, and Poland) are making plans for a partial UF-FF shift, but are afraid of adverse financial markets and/or EU reactions. Similar concerns are also raised with regard to the reaction of IFIs (like the International Monetary Fund) to a reform-induced widening of the fiscal stance.

III. Options for Financing the Transition

Shifting from an unfunded to a funded scheme raises the issue of the repayment of the implicit debt of the unfunded pension scheme and the burdening of the transition generation, or of all future generations. For this reason countries have generally rejected this reform option since both a higher explicit debt level or budgetary financing through a contractionary fiscal stance were excluded. However, the welfare economic issue of a „Pareto-superior transition“, - i.e., making at least one generation better and no other worse off - receives a different assessment once economic externalities of the reform are taken into account. The fiscal issues of Pareto-efficient financing of the debt conversion has to be set against the background of intergenerational redistribution, changes in efficiency of taxation and macroeconomic effects. This section outlines the main financing options under both neoclassic and endogenous growth considerations, including the use of privatization proceeds.

1. Debt and budgetary financing in a neoclassic world

Whatever the transition path chosen, radical or minimal, an UF-FF shift will burden at least one generation unless the economic benefits generated by such a reform allow for a full compensation of the transition generation(s). In the conventional neoclassic world, an unfunded pension scheme is Pareto-efficient even when the interest rate permanently exceeds the natural growth rate if the given scheme does not create economic distortions; e.g. it is financed via lump-sum taxes and provides lump-sum transfers. Although only the first generation gains and all later generations are worse off, there exists no mechanism to reverse the situation without the welfare position of at least one generation deteriorating (Breyer 1989). The result is intuitively and immediately understandable, since it amounts to an application of the second basic theorem of welfare economics: any lump-sum redistribution of income entails an allocation which is different but also Pareto-efficient (Homburg 1990).

(i) There are two well known fiscal alternatives to finance a transition - pure debt financing and pure budgetary financing - with known and less known effects:

Under pure debt financing, all the SSD made explicit is added to the financial debt since no debt repayment takes place. Nevertheless, the budget is

affected since a higher revenue or lower expenditure level is required to finance the interest service of the increased financial debt. Otherwise the explicit (and thus total debt) growth without bounds (in absolute terms and in percent of GDP). In this case the burden of transition is distributed over all future generations. Only in the case of the (real) interest rate, r , at the level of the (real) growth rate, g , will no additional tax financing be required, and the total debt ratio in percent of GDP remains constant, and the financial debt ratio will approach the total debt ratio asymptotically. However, if $r = g$, there are little arguments for a UF-FF shift since then an unfunded scheme can fully mimic a funded one, eliminating all potential distortions an unfunded scheme is usually considered to be fraught with⁷.

Furthermore, in case of a small open economy, with given interest rate, the double-sided effect of a high interest/economic growth rate differential becomes visible. While a higher interest rate (discount rate) reduces the SSD and thus the deficit to be swapped, a higher difference requires a stronger rise in the tax rate, or leads to a faster rise in the explicit debt ratio if the interest burden is capitalized. In the short run, the first effect dominates, in the long-run the second effect.

Under pure budgetary financing (through higher revenue or lower expenditure, keeping the sustainable fiscal position constant), the government combines a pension reform with a contractionary fiscal policy. The later policy reverses the initial intergenerational distribution, and burdens the transition generation in favor of all future generations. In the setting of a traditional OLG-model, such a policy causes first-order increases in the level of national saving, capital, output and real wages. These increases rise with the share of pensioners in the population and the degree of closeness of the economy, and falls with the prevalence of voluntary intergenerational transfers (see, for example, Schmidt-Hebbel, 1993).

(ii) The costs of transition can be reduced or even eliminated under both debt and budgetary financing if the new pension scheme exhibits lower negative externalities compared to the unreformed scheme. Lower negative externalities can be motivated by the many distortions an unfunded scheme may exert on intertemporal consumption or on labor supply decisions, resulting in an excess burden. Through the UF-FF shift, the reduction or elimination of the excess burden may be used to repay the implicit debt of an unfunded scheme within finite time (Homburg 1990). Since public pension schemes and the way they are financed, quite definitely entail numerous distortions, a change in the funding mechanism may thus actually improve welfare. The conclusion rests, however, on the assumption that the funded scheme is less distortionary than the unfunded one, a

⁷ A nondistortionary pension scheme requires actuarial neutrality which can be achieved in an unfunded scheme only if the implicit rate of return (the natural rate of growth) equals the rate of interest (i.e., the golden rule of growth holds; see Breyer-Straub 1993, and Perraudin and Pujol, 1995).

result which is not necessarily linked with the funding procedure but is related to the benefit structure and the benefit/contribution link (Holzmann, 1994a and 1995b).

Simulation studies with OLG-models à la Auerbach-Kotlikoff (1987) suggest that the welfare gains resulting from the elimination of labor market distortions are comparatively small. A model calibrated on the German pension system exhibits long-term welfare gains of some 9 percent of life-time resources of future generations if the transition generation is not compensated. With compensation, the long-term welfare gains are reduced to some 1.5 to 2 percent of life-time resources of future generations (Raffelhüschen 1993). Furthermore, in the latter case the study assumes that tax burden to finance the interest costs of the transitional public debt is allocated on a lump-sum basis⁸.

(iii) The considerations in traditional OLG-models highlight the critical assumption for a Pareto-efficient transition in a neoclassic model setting, namely that the general taxation (income or consumption tax) is at the margin less distortionary than social security contributions (payroll taxation). This is not necessary the case in a closed economy, even less so in an open economy. Furthermore, the net efficiency gain declines with the incidence of worker-consumption myopia.

In a closed economy setting, the results depend on the particular structure of preferences. Simulations results indicate that for particular parameter combinations a shift between wage and income taxation produce predominantly, but not always efficiency gains (Auerbach and Kotlikoff, 1987), and Auerbach, Kotlikoff and Skinner (1983) conclude from second-best theory that income taxation will not always be efficient than wage or payroll taxation.

In an open economy, the probability of net efficiency gains is likely to be further reduced. With capital much more mobile than labor, the effective taxation of capital income is reduced or even eliminated so that the tax incidence falls essentially on the less mobile factors of production (labor and land). In consequence, shifting from payroll taxation to general taxation as part of the pension reform may not change the tax incidence and the distortionary effects, only the way taxes are levied.

Furthermore, given the state of tax administration in many emerging market economies, levying income or consumption taxes compared to social security

⁸ Other studies exhibit similar low and distant welfare gains even if the transition generation is burdened twice by repaying the implicit debt via higher transitory taxation: 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 baseline scenario (Arrau and Schmidt-Hebbel, 1993), a result similar to simulations for the U.S. economy (Auerbach and Kotlikoff, 1987). A full or even partial double burdening of the transition generation, however, may be excluded for political reasons.

contributions may prove more difficult and give rise to more distortions than eliminated on the labor market.

Summing up, under a traditional neoclassic setting, the financing of an UF-FF shift is technically feasible but difficult to justify in economic terms: the long-term welfare gains are small and can be achieved only at the burden of the transition generation unless net-efficiency gains through the corresponding shift in the mode of taxation are realized. The likelihood for those gains, however, are small. Thus additional positive economic effects of such a pension reform are required in order to justify such a shift in welfare economic terms, and provide the necessary financing in fiscal terms. They may be found in the impact on economic growth.

2. Debt and budgetary financing under (endogenous) growth effects

There are four main avenues a UF-FF shift which may introduce positive externalities, leading to a higher growth rate than otherwise: (1) higher and more productive employment; (2) a higher national saving rate; (3) a higher rate of capital accumulation; and (4) a higher rate of technical progress. While effect (2) and (3) are identical in a closed economy, in an open economy they can diverge. All four effects (or a subset) can interact and strengthen each other once considerations of endogenous growth are taken into account.

The central economic benefit which is claimed to result from a UF-FF shift is its impact on financial market developments, which in turn influences positively capital formation, saving and economic growth⁹. In addition, an improved financial market may result in higher productivity, leading to a temporary rise in technical progress. Furthermore, embedding those considerations in endogenous growth theory, improved financial markets may permanently lead to a higher growth rate than otherwise were the case. In consequence, the enhanced economic resources may allow for a Pareto-efficient repayment of the SSD made explicit.

(i) For the link of pension reform, financial market development and economic growth, the channels of economic effects and their empirical magnitude are important. Yet, the modeling of financial markets and investigations of their welfare economic and growth implications are still in its infancy.

The claim that the effectiveness of financial markets and the level (or rate of growth) of real activity are closely related, however, is not new and empirical

⁹ At the labor market level, the type of pension scheme (UF/FF) and the perceived contribution/benefit link can determine the distribution of labor supply between the formal and informal sectors. If the latter is less productive, a pension reform which moves labor supply to the formal sector will enhance overall productivity and in an EG-model can lead to a higher growth path (Corsetti 1994).

investigations have been undertaken for decades¹⁰. Against the background of neoclassic growth theory, however, these studies could argue only for temporary efficiency effects resulting from financial market developments. More recent developments in growth theory allow for level as well as growth path effects.

However, these recent models concentrate on specific aspects of financial markets and their impact on real activity: for example, financial markets provide liquidity, allowing a shift from current liquid, but unproductive, assets toward less liquid, but more productive assets (Bencivenga and Smith, 1991, Levine, 1991, Bencivenga et. al. 1995). Or, financial markets promote the acquisition and the dissemination of information allowing for better resource and risk allocation (e.g. Diamond, 1984, and Greenwood and Jovanovic, 1990). Or, financial markets permit agents to increase specialization, shifting away from specialized and less productive technologies (Cooley and Smith, 1992, Saint-Paul, 1992).

All these models cover important aspects of financial markets and their impact on real activity, providing important analytical insight on issues raised by the literature for decades. However, they all fall short of providing a comprehensive framework of the different effects of financial markets and of empirically testable relationships. This still awaits future work. Various recent empirical papers demonstrate the link between financial variables, financial sector reform and economic growth and efficiency (such as Levine and Zervos, 1995; Johnston and Pazarbasioglu, 1995), but their econometric specifications are little linked to an underlying theoretical model.

(ii) To introduce potential growth effects of financial market developments in an EG-model in a simple manner, borrowing from Villanueva (1993), the following structure is proposed (and tested for Chile, see below):¹¹

$$\begin{aligned} [1] \quad \partial K / \partial t &= s(\kappa, \dots)Y - \delta K, \quad \text{with } \partial s / \partial \kappa > 0 \\ [2] \quad \partial T / \partial t &= \alpha(\kappa, \dots)K / L + \lambda T, \quad \text{with } \alpha > 0. \end{aligned}$$

The saving ratio (i.e., investment ratio in a closed economy) is positively related to variable measuring the depth, liquidity, and maturity of financial markets, summarized in the parameter κ . Further variables which may influence the

¹⁰ See, for example, Goldsmith (1969), McKinnon (1973 and 1993) and Shaw (1973).

¹¹ The other equations of this growth model are traditional and specify the Output Y via a production function with constant returns to scale on capital K and labor N (man-hours in efficiency units)

$Y = F(K, N) = Nf(k)$,
an exogenous growth rate n of population/employed (in man-hours L)

$\partial L / \partial t = nL$,
a definition equation between N and L via the technical-change multiplier T

$N = TL$, and
the capital coefficient
 $k = K/N$.

$\partial(\cdot) / \partial t$ is the time derivative and δ the rate of depreciation of capital.

domestic saving rate are public saving behavior or tax regulations. Also the change in technical progress dT/dt is not only dependent on the exogenously given rate of labor-augmenting technical change λ , but also on an efficiency variable α , which is directly related to the capital/labor ratio. $\alpha(\kappa, \dots)$ depends on the financial market variable κ and also on other variables traditionally quoted in the literature (such as level of export orientation and share of education expenditure in the budget). λ captures other growth effects not explicitly detailed in the model.

In this model, the steady-state growth rate of the economy depends positively on the level of κ

$$\begin{aligned} [3a] \quad [(dY/dt)/Y]^* &= s(\kappa, \dots) f(k^*) / k^* - \delta \\ [3b] &= \alpha(\kappa, \dots) k^* + \lambda + n = g^*(k^*) \end{aligned}$$

with k^* the steady-state capital intensity measured in efficiency units of labor. The model leads to the traditional result for $\alpha = 0$. With $\alpha > 0$, however, a higher saving rate leads not only to an increase in the optimal capital/labor ratio (as in the traditional growth models), but also to a higher steady-state growth rate, which in traditional models is not influenced by the saving rate.

A further important property of the model under an optimal consumption plan (i.e. $\partial c^*/\partial s = 0$) is that both that steady-state growth rate and optimal net return on capital are higher than the exogenous rates of technical progress and population growth:

$$[4] \quad f'(k^*) - \delta = g^*(k^*) + \alpha(\kappa, \dots) k^* = \lambda + n + 2\alpha(\kappa, \dots) k^*$$

Under such a golden-rule condition, the optimal rate of return is higher than $\lambda + n$ when $\alpha > 0$ because of two factors: the impact of higher savings (i.e., capital accumulation) on the equilibrium growth rate, and the required compensation of capital for a higher equilibrium output growth induced by the efficiency term $\alpha(\kappa, \dots) k^*$. Compensating the transition generation by the conventional rate of return of an unfunded scheme only (i.e., by $\lambda+n$), while using part of the additional growth differential (i.e. between $\alpha(\kappa, \dots) k^*$ and $2\alpha(\kappa, \dots) k^*$) for financing the transition allows, in principle, for the construction of a Pareto-superior UF-FF transition.

(iii) For the repayment of the public debt, however, additional fiscal considerations are required. Additional resources resulting from higher growth can be captured by the government only in a non-distortionary manner if lump-sum taxation could be applied. In such a case, all additional resources (compared to the benchmark of no pension reform) could be used to repay the SSD in a Pareto-

efficient manner. In case of distortionary taxation, the empirically relevant case, however, an essentially constant tax rates on an enhanced tax base allow to capture only part of the enhanced economic resources if an increase in tax-related distortions should be prevented. Thus, in order to maximize consumption utility (through consumption smoothing) while minimizing tax distortion (through tax smoothing) would speak in favor of a temporary widening of the reform induced fiscal stance, and gradual repayment in the years thereafter.

3. The use of privatization assets

Many industrialized and emerging market economies have important government assets (enterprises, land, etc.). In principle, the privatization proceeds can be used to co-finance the transition. In economic terms, government assets (GA) are exchanged against government liabilities (SSD): Selling those assets in emerging markets often proves difficult, which has led to various proposals to swap the GA against SSD. Compared to a free distribution of assets to the population via vouchers, as it is done in several Eastern European reform countries such as the Czech Republic and Russia, the net-asset position of government would remain unchanged, whereas under the first approach, the net-asset position would deteriorate and would have to be compensated via future increased taxes. While such a swap in accounting terms is easy, it poses important problems with regard to intergenerational equity, liquidity and corporate governance, and the scope of the swap is likely to be limited.

Very tentative calculations for Eastern Europe suggest a potential range of some 3 to 70 percent of social security debt which could be compensated for by government assets (Holzmann, 1994a). Empirical data on Hungary and Poland indicate that a reasonable ratio is rather to be found in the lower range, around some 5 to 10 percent. The 1994 plan in Hungary was to transfer assets worth some Forint 400 billion to the Social Security Fund (roughly equivalent to the level of pension expenditure, or 12 percent of GDP, or 10 percent of privatisable assets). The Polish privatization plan originally envisaged a transfer of 20 percent of government assets the Social Security Fund(s). According to the latest plan, the assets to be transferred could amount to PLN 50 billion (as valued by the Ministry of Privatization), or only PLN 25 billion (as estimated by the Ministry of Finance). This compares with pension expenditure of PLN 35.7 billion in 1994 (some 15 percent of GDP) or an estimated SSD of around PLN 900 (some 380 percent of GDP). In consequence, only some 5 percent (or less) of the SSD could be swapped.

These estimates are of similar magnitude as calculated for some Latin American reform countries. To co-finance the Colombian pension reform, Schmidt-Hebbel (1994) quotes estimates of the percent value of privatization

revenue of 10 percent of GDP; this compares to the long-term financing requirements of 83,6 percent of GDP (the SSD made explicit).

In summary, very tentative calculations suggest that only a relatively small portion of current public pension obligations could be exchanged even if major parts of socialized enterprises are handed over to pension funds. In the meantime, all reform countries have initiated various privatization procedures, thus further reducing the potential scope for the swap.

IV. Financing the Transition: The Chilean Experience

The experience of the Chilean pension reform of 1981 has received wide international attention as by many domestic and foreign observers this reform is held co-responsible for the excellent economic performance since the mid-1980s¹². Yet, the claimed link between the UF-FF shift, financial market developments, capital formation and saving, and economic growth has been little subject to empirical investigation. This section reports on the preliminary findings by the author which are presented more comprehensively in a parallel paper (Holzmann 1995b), and investigates the role of public finance during the transition.

1. Pension reform and financial market development

A central claim about the effects of the Chilean pension reform, echoed internationally, is its contribution to the development of the financial sector (see, for example, IMF, 1995). The general hypothesis is that rising investment needs of the pension funds, the instruments thereby created, and competitive set-up of the privately managed pension funds made the financial market deeper, more liquid and more competitive. An inspection of the data and very simple empirical testing seemingly confirms the claim on market deepening.

In order to determine a link between pension reform and financial market developments, and in the following to investigate the impact of financial markets on main macroeconomic aggregates three financial market indicators (FMI) are constructed and used in the econometric analysis:

¹² In a nut-shell, the Chilean reform consisted of a shift from a conventional unfunded and defined benefit plan to a funded defined contribution plan, in replacing public administration of the program with private administration of competing pension funds (AFPs), and in separating the social assistance element from the mandated saving element of retirement provisions. Government involvement remains high with regard to supervision and regulation of the new mandatory but funded scheme, the guarantee of minimum benefits, and the financing of the transition. Otherwise, the market is allowed to play its role. For a detailed survey and analysis of the Chilean pension reform in English see Diamond and Valdés-Prieto (1993).

(i) The FIR (financial interrelation ratio) compares the scope of financial instruments with net wealth of the economy (approximated by the capital stock).

(ii) The FMR (financial intermediation ratio) compares the scope of financial instruments with the assets of the financial institutions.

For both FMIs, two alternative measures of financial instruments and thus indices are considered (FIR-1/FMR-1 and FIR-2/FMR-2).

(iii) A composite stock market index SMI which is the average of three stock market indicators (share trading/equity stock ratio; share trading/GDP ratio, and equity stock/GDP ratio). Such an index concept has recently been used in a cross-country study to measure the impact of stock market developments on real economic activity (see Levine and Zervos, 1995).

Essentially all investigated FMIs exhibit a strong upward movement once the banking crisis of 1981/83 has been solved (Figure 5 and 6). The financial interrelation ratios (FIR) show a strongly rising tendency which well exceeds the reported level for prior decades¹³. The financial intermediation ratios (FMR) exhibit a similar development, with FMR-2 reflecting the strong increase in bank credits to the private sector, ultimately leading to the banking crisis, and the consolidation afterward. 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. Prior to this date the investment rules allowed only for the purchase of debt instruments. At the end of 1994 pension funds assets constitute almost 40 percent of all outstanding financial instruments, and the total pension fund assets at the end of 1994 amount to 41 percent of GDP (Figure 7).

The correlation of AFP assets and FMIs, and of AFP shares in total traded shares and share trade/equity stock ratio, is very strong with coefficients in simple regressions close to 1 and R^2 of 0.9 and above (not shown). At a monthly level, there is also a strong correlation between the turnover in asset trade (in bonds, shares, etc.) and the level of assets held by the pension funds at the end of month (as a proxy for turnover since no such data are available), with a break around the turn of 1984/85. Before 1985, the correlation is zero or negative, except for the trade in assets with fixed return ($\rho = 0.65$); this corresponds to the period when pension funds were restricted to the holding of debt instruments. For the period 1/1985 to 6/1995 the correlation between the monthly turnover in each asset and the stock of pension fund assets at month-end is always above 0.9. This

¹³ No strictly comparable FIRs could be established for the pre- and post 1975 period. However, the available data for Chile suggest a long-term decrease in the FIR-2 from 63% (1940), 32% (1950), 29% (1960), with a slight increase to 39% (1971) prior to a major shake-up of the economy (see Cerdá and Zeballos, 1975). The increase in the FIRs between 1975-1980/81 corresponds to a period of accelerated growth and very fast and little regulated financial market liberalization, being held responsible for the banking crisis of 1981/83.

Figure 5. Financial Market Indicators

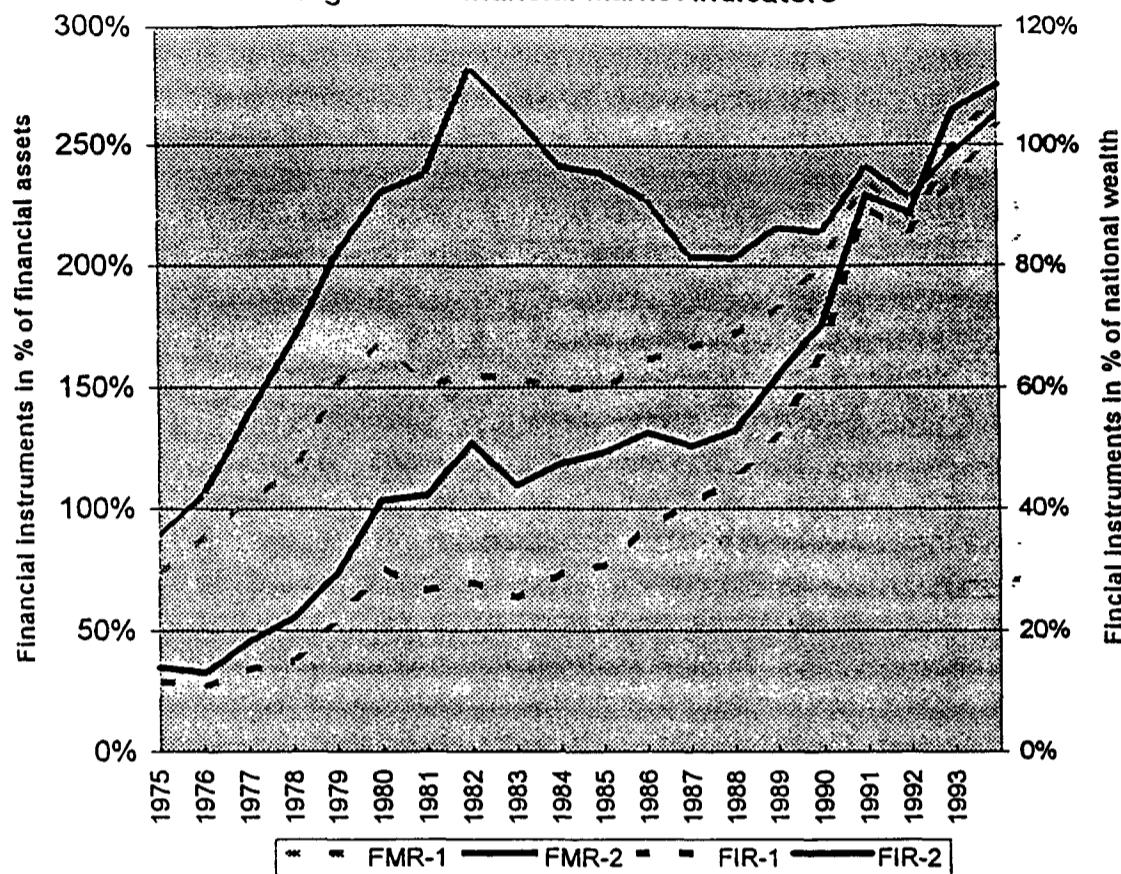
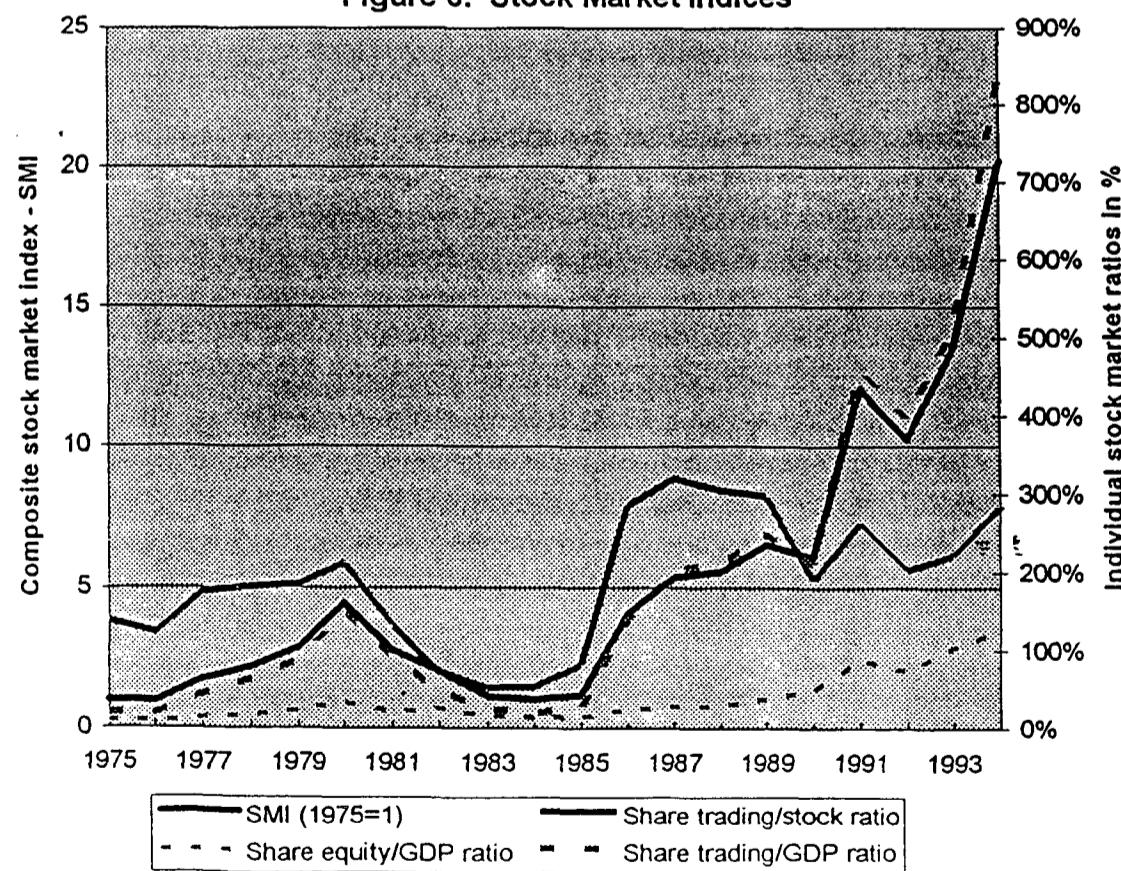


Figure 6. Stock Market Indices



empirical evidence is consistent with the claim that pension funds made the financial markets deeper and more liquid.

With regard to contribution of pension funds to enhanced competitiveness and risk allocation, the available data only allow for a very cursory investigation. Figure 8 presents yearly data for the asset mis-pricing indicators (based on the arbitrage pricing, the capital asset and the international asset pricing model, AP, CAP, and ICAP, respectively; see Korajczyk, 1994) and indicators of pension fund assets¹⁴. The correlation between the mis-pricing and pension fund indicators is the correct sign, is statistically significant at 5 percent error level, and ranges between -0,27 and -0,52.

As regards the contribution of pension funds to the development of financial instruments, such as indexed annuities, the provision of funds to key sectors, such as mortgage bonds to finance housing, the importance of enterprise bonds which are mainly held by pension funds, and the increased holding of traded shares by the pension funds, the evidence suggests a strong impact of pension fund activities for the development of a more sophisticated financial market. With the gradual relaxation of regulations for pension fund investments, their portfolio also has become more diversified, with central bank liabilities still constituting almost 40 percent of AFP's assets (Figure 9). Various evidence suggests that pension funds are operating efficiently and the selected portfolio, given the restrictions on asset investments which are only gradually lifted, is on the (restricted) efficiency frontier (Walker 1991a and 1991b, Zuñiga-Maldonado, 1992). In a competitive environment this may constitute indirect proof of the overall efficiency of the financial system.

Yet, all this evidence does not establish watertight proof that the establishment of pension funds has been the decisive factor, or even only an important component, for the impressive development of financial markets since the mid-1980s. The empirical evidence is only consistent with the claim. The healthy growth and development of financial markets after 1983 may simply reflect changes in legislation, and the learning from experiences and mistakes of the late 1970s and early 1980s¹⁵. Since the counterfactual of the development of financial markets without pension reform cannot be established, and empirical evidence from other countries with similar reform is not at hand, it may actually be impossible to prove. Hence, in order to increase confidence in the claim, further evidence with different approaches is required.

¹⁴ This data is used in Levine and Zervos, 1995, and the access granted by Ross Levine is gratefully acknowledged.

¹⁵ For an analysis of the experience and mistakes of financial market liberalization during this early period of economic reform see De la Cuadra and Valdés-Prieto (1992a, and 1992b), and Valdés-Prieto (1992).

Figure 7. Pension Fund Assets and Financial Market Indices

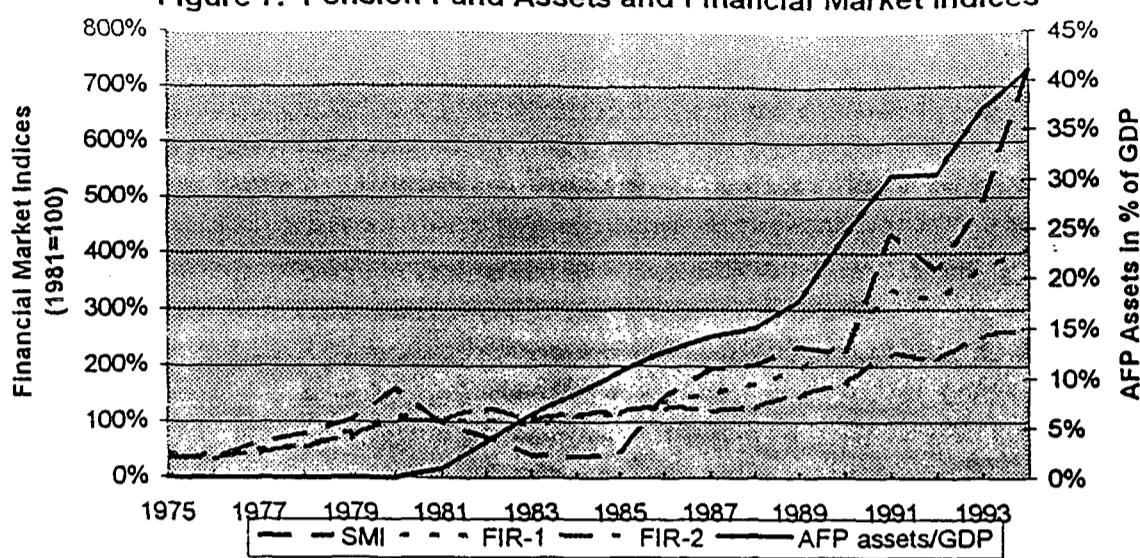


Figure 8. Pension Assets and Financial Assets Mis-Pricing

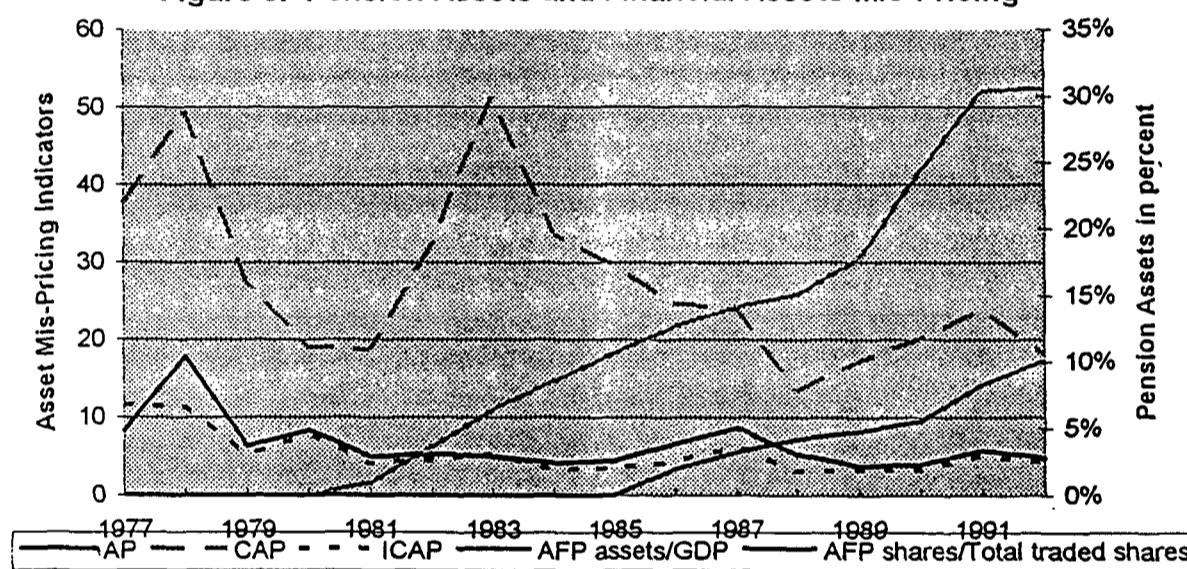
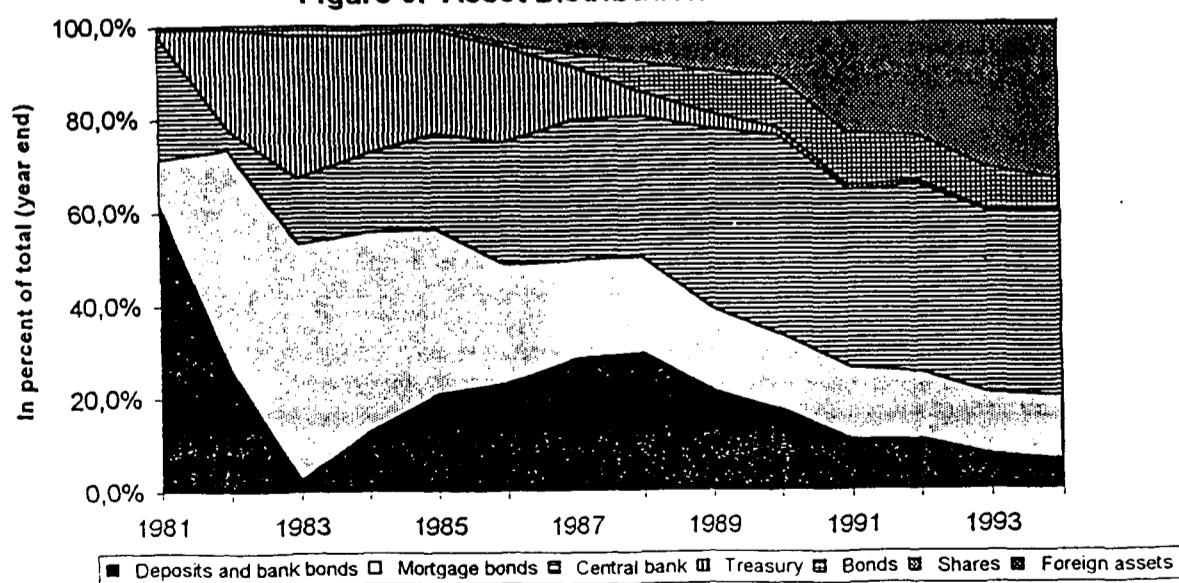


Figure 9. Asset Distribution of AFPs



2. Total factor productivity and financial market developments

In order to investigate the relation between economic growth and FMIs the model of Section III.2 is used. The model assumes that the change in labor productivity - $\partial T/\partial t$ - is determined by an exogenous component λ and an endogenous component $\alpha(\kappa, \dots)K/L$ which is positively dependent on the financial market indicator κ . Since technological progress has to be labor augmenting in order for a model to have a steady-state with constant growth rates (Barro and Sala-i-Martin, 1995), we can immediately use total factor productivity (TFP) for our specification¹⁶. Hence, in a linear approximation, TFP should exhibit a positive dependence from κ :

$$[5] \quad TFP_t = a_0 + a_1 D(L)\kappa_t + a_2 X_t + u_t$$

with $D(L)$ an appropriately chosen lag-structure for κ since the effects can be expected to be distributed over various periods, and X representing other variables able to capture further impacts, most importantly cyclical effects.

In view of the cyclical development during the period under investigation and the high likelihood that the stock of factors (capital and labor) do not correctly reflect factor services, the level of unemployment and its change is used to proxy cyclical effects, leading to a very satisfying statistical fit for the reduced sample period 1975-1994 (Table 3)¹⁷. Since TFP may follow an adjustment process, estimations with a one-period lag were also undertaken, with somewhat mixed results. Adding the financial market indicators improves the overall fit, yielding for most lagged FMI-variables (with an Almon-lag type structure)¹⁸ coefficients which are significant at a 5 percent level and below, while reducing the significance of the constant. The low t-value for stockmarket index (SMI) may be due to high multicollinearity between the unemployment rate and the SMI, but alternative specification and estimation techniques (such as IV) were not

¹⁶ To estimate TFP, a simple growth-accounting exercise is undertaken, calculating it as the residual of the well-known equation (with logarithmic approximation to account for discrete time):

$TFP_t \approx \log(A_{t+1}/A_t) = \log(Y_{t+1}/Y_t) - (1-\beta)\log(K_{t+1}/K_t) - \beta\log(L_{t+1}/L_t)$
with β , the labour share of income, which is held constant at 0,65 for data reasons.

¹⁷ The parameter estimates for the ΔFMI and ΔSMI variables slightly differ from previously presented estimates due to data revisions and the normalization of the respective sample average to 1. The normalization allows for a direct parameter comparison between different financial market indicators and a straightforward interpretation of the parameter value.

¹⁸ The approach uses the data structure of the Almon lag to calculate a composite variable $\Delta FMI(l,s) = l^1\Delta FMI_t + 2^2\Delta FMI_{t-1} + \dots + l^s\Delta FMI_{t-s}$. Thus $\Delta FMI(2,2) = \Delta FMI_t + 4\Delta FMI_{t-1} + 9\Delta FMI_{t-2}$. This approach results from economic, econometric, and data considerations. Economically one would assume that improvements in the financial market, measured by changes in the level of FMI, will have little immediate impact, but that the impact follows with a lag, and the strength of the impact growing over time for some periods. However, a direct application of the traditional Almon procedure is prevented by the short period of observation, with increasing s under the full Almon approach reducing the degree of freedom on a pro-rata basis. In addition, $\Delta FMI(l,s)$ for l and $s=1,\dots,3$ proved to be highly correlated. Finally, unless very strict conditions are met, the Almon procedure will yield biased and inconsistent estimates.

Table 3: Total Factor Productivity and Financial Market Developments

Endogenous variable: TFP	Constant	TFP(-1)	Unempl. Rate	$\Delta UER(-2)$	FMI(-1)	
EQ(1a)	0,049 (4,37)		-0,512 (4,76)	-0,579 (4,40)		$R^2=0,858$ $DW=2,21$
EQ(1b)	0,055 (4,38)	-0,125 (1,66)	-0,566 (4,77)	-0,569 (4,42)		$R^2=0,871$ $DW=1,77$
EQ(2a)	0,021 $FMI_1=\Delta FIR1$		-0,331 (2,39)	-0,661 (5,16)	0,011 (1,85)	$R^2_c=0,891$ $DW=2,19$
EQ(2b)	0,025 $FMI_1=\Delta FIR1$	-0,175 (1,47)	-0,374 (1,72)	-0,679 (2,87)	0,013 (2,32)	$R^2_c=0,916$ $DW=1,48$
EQ(3a)	0,029 $FMI_1=\Delta FIR2$		-0,407 (3,64)	-0,700 (5,17)	0,010 (1,93)	$R^2_c=0,894$ $DW=2,13$
EQ(3b)	0,0349 $FMI_1=\Delta FIR2$	-0,132 (2,28)	-0,462 (1,53)	-0,703 (3,96)	0,010 (2,02)	$R^2_c=0,908$ $DW=1,75$
EQ(4a)	0,040 $FMI_1=\Delta SMI$		-0,440 (3,12)	-0,428 (4,65)	0,004 (0,80)	$R^2_c=0,866$ $DW=2,20$
EQ(4b)	0,043 $FMI_1=\Delta SMI$	-0,171 (2,78)	-0,475 (1,81)	-0,592 (3,46)	0,005 (1,23)	$R^2_c=0,888$ $DW=1,58$
EQ(5a)	0,034 $FMI_1=\Delta FMR1$		-0,427 (4,65)	-0,548 (5,24)	0,009 (2,73)	$R^2_c=0,916$ $DW=2,52$
EQ(5b)	0,042 $FMI_1=\Delta FMR1$	-0,260 (5,54)	-0,509 (3,69)	-0,541 (7,67)	0,012 (5,01)	$R^2_c=0,964$ $DW=2,48$
EQ(6a)	0,049 $FMI_1=\Delta FMR2$		-0,562 (6,28)	-0,645 (5,92)	0,005 (2,67)	$R^2_c=0,914$ $DW=2,51$
EQ(6b)	0,055 $FMI_1=\Delta FMR2$	-0,119 (5,48)	-0,613 (1,86)	-0,645 (6,38)	0,005 (2,70)	$R^2_c=0,926$ $DW=2,43$

OLS; period of estimation: 1979-94, with lagged variables for FMI estimator starting as of 1975. Absolute t-value in parenthesis.

successful. The estimated parameter values prove to be robust for different specifications and time periods of estimation (not shown), and the lagged impact of financial market indicators (compared to including contemporaneous effects, which prove statistically totally insignificant) gives confidence in the causality.

Taken at face value, the results would suggest strong effects of financial market developments on TFP. Using the point estimates and assuming an equilibrium unemployment rate of 5 percent, the exogenous technical progress would amount to some 1 percent, to which 1+ percent of technical progress generated by financial market developments are added, yielding a long-term annual TFP of 2+ percent. The estimated FMI-effect of 1+ percent is likely to proxy other effects, which may be highly correlated with financial market developments, such as reductions in exchange rate restrictions and increasing openness of the economy. Given data restrictions, the separation of these effects is not possible currently.

The magnitude of parameter estimates for the SMI variable in EQ(4) invites comparison with the estimates for the cross-country study quoted above. Their point estimate is 0.007 (with a t-value of 1,96) compared to our result of 0.004 to 0.005. While the statistical closeness of the point estimates may be spurious, the coincidence, however, is surprising.

3. Capital formation, saving, and financial market development

In the economic policy discussion both capital formation and domestic savings are generally claimed to be positively influenced by a pension reform-induced deepening of the financial market (see, for example, IMF, 1995). In a closed economy the overall effect should be identical, but may lead to different distribution between public and private sector investment and saving balances. For example, with given public capital formation, a stronger impact on private capital formation than on private saving has to be compensated by public saving if the private investment should take place. In an open economy, foreign saving may additionally compensate for sectoral investment/saving imbalances.

Traditional wisdom is, that the influence of financial market deepening on both capital formation and saving is positive (McKinnon 1973, Shaw 1993). However, further theoretical considerations and international empirical evidence suggest that it can go both ways, or be zero.

A positive relation between FMI and capital formation (measured by the change in real capital stock) is suggested by considerations of better access to financing (i.e., reduced borrowing constraints), enhanced incentives to undertake longer-term investment projects, and better risk allocation. However, a more efficient market with reduced transaction costs and higher rate of return for all

Table 4. Capital Formation and Financial Market Developments

Endogenous variable: K%	Constant	K%(-1)	UER	FMI(-1)	
EQ(7)	0,030 (5,10)	0,79 (9,11)	-0,21 (5,14)		R ² _c =0,945 DW=1,63
EQ(8) FMI_{t-1}=ΔFIR1	0,026 (4,78)	0,526 (3,74)	-0,175 (4,38)	0,008 (2,19)	R ² _c =0,962 DW=1,92
EQ(9) FMI_{t-1}=ΔFIR2	0,033 (6,33)	0,565 (4,64)	-0,247 (6,38)	0,007 (2,28)	R ² _c =0,963 DW=2,21
EQ(10) FMI_{t-1}=ΔSMI	0,028 (4,18)	0,770 (8,47)	-0,195 (3,92)	0,001 (0,70)	R ² _c =0,947 DW=1,68
EQ(11) FMI_{t-1}=ΔRMI1	0,026 (5,17)	0,746 (10,3)	-0,193 (5,55)	0,004 (2,61)	R ² _c =0,966 DW=2,00
EQ(12) FMI_{t-1}=ΔRMI2	0,038 (6,95)	0,684 (8,88)	-0,295 (6,78)	0,005 (2,85)	R ² _c =0,969 DW=2,37

OLS; period of estimation: 1979-94, with lagged variables for FMI estimator starting as of 1975. Absolute t-value in parenthesis.

Table 5. Private Savings and Financial Market Developments

Endogenous variable:S _{privat} /GDP	Constant	UER	ΔUER (-2)	FMI(-1)	
EQ(13)	0,274 (18,7)	-1,53 (11,4)	0,662 (3,94)		R ² _c =0,904 DW=1,43
EQ(14) FMI_{t-1}=ΔFIR1	0,309 (10,0)	-1,75 (7,87)	0,811 (3,98)	-0,013 (1,31)	R ² _c =0,914 DW=1,72
EQ(15) FMI_{t-1}=ΔFIR2	0,302 (14,7)	-1,66 (10,9)	0,844 (4,52)	-0,013 (1,86)	R ² _c =0,924 DW=1,75
EQ(16) FMI_{t-1}=ΔSMI	0,306 (11,2)	-1,78 (8,12)	0,814 (4,00)	-0,010 (1,26)	R ² _c =0,913 DW=1,76
EQ(17) FMI_{t-1}=ΔFMR1	0,308 (23,6)	-1,68 (16,3)	0,859 (6,89)	-0,018 (4,12)	R ² _c =0,961 DW=2,96
EQ(18) FMI_{t-1}=ΔFMR2	0,267 (21,5)	-1,37 (10,5)	0,761 (5,30)	-0,008 (2,85)	R ² _c =0,942 DW = 1,89

OLS; period of estimation: 1979-1994, with lagged variables for FMI estimator starting as of 1975. Absolute t-value in parenthesis.

investment projects may also lead to a redirection of the holding of wealth by economic agents in the form of existing equity claims and to invest less in the initiation of new capital investments (Bencivenga et al. 1995).

First econometric testing for Chile suggests that the change in capital stock follows an adjustment process, with the lagged variable entering very significantly, and this is also influenced by cyclical effects, or expectations about future developments, measured by the unemployment rate (Table 4). Entering the lagged FMI variables (again with an Almon-type lag) leads to an improvement in the equation fit and to coefficients which are consistent in sign and significant at a 5 percent level and below, except for SMI. The SMI variable leads to insignificant coefficients, which may reflect the same multicollinearity problems as noted above.

Again, taking the point estimates for the FIR/FMR variables at face value, the long-term increase in capital stock is some 5+ percent, reduced by an assumed long-term unemployment rate of 5 percent by 1 percentage point, but increased by the enhanced financial markets by around 0,5+ percentage points, or some 1/8 of its „natural“ level. This result hints to non-negligible effects of financial market developments on the formation of the capital stock which have to be added to the effects of TFP in their growth consequences¹⁹.

With regard to the relation of FMI and saving the same theoretical qualifications about the a priori sign and strength apply. Financial market developments may induce higher (private) saving via the provision of attractive saving outlets, but may also reduce it due to higher real interest rates and the dominance of conventional income effect over the substitution effect; better risk diversification providing a given rate of return and risk level with lower savings, thus changing the form of saving but not the level; the availability of annuities (allowing for higher old-age consumption and reducing the amount of unintended bequests, Auerbach et al. 1992); or improved access to consumer credits (allowing for a better consumption smoothing)²⁰.

Preliminary econometric testing suggests that the negative effect of financial market developments on private saving prevails (Table 5). The basic specification of the private saving rate, with the constant and unemployment variables as the explanatory variables is generally improved if FMIs are added. All FMI variables enter negatively with significant parameter at a 5 percent level and below (except again SMI). This finding is consistent with international evidence on the impact of financial market liberalization and private saving behavior (IMF, 1995).

¹⁹ Our reported point estimates of FMI on capital accumulation of 0,004 to 0,008 are close to the estimate in the cross-country study of 0,011 (with a t-value of 2,38); see Levine and Zervos, 1995.

²⁰ See Masson et al. (1995) for empirical references.

Yet, in view of the rising domestic and private saving in Chile in recent years, the result is surprising and requires a closer look at the components and developments of saving.

4. Pension reform and domestic saving

Inspecting the structure and development of capital formation and its financing over the last 25 years exhibits a strong rise in the private saving rate since the mid-1980s, the high importance of public saving and the relative fall in importance of foreign saving (Figure 10). Domestic saving reaches levels not achieved since, at least, 1970.

To gauge the impact of pension reform on domestic saving a different disaggregation, consistent with SNA, is proposed. To this end, a balancing item is calculated which consists of the private savings generated (in an accounting sense) by the new scheme reduced by the fiscal costs (i.e., public dissaving):

(i) The saving generated consists of two flows: (1) the net contribution payment to the new scheme (essentially the 10 percent premium revenue); in the SNA these premiums are considered as private saving; and (2) the returns on assets generated by the new scheme. These returns are not equivalent to the change in assets by the AFPs (net of contribution payment) since the asset increase comprises both capital gains and flow effects. We are only interested in the latter which is part of private saving in SNA. Both flows were estimated from available data²¹.

(ii) The financial costs (public dissaving) consist also of two flows: (1) the deficit in the old scheme due to the loss of contributors. This deficit was approximated by the state transfer to the old scheme (excluding assistance pension financing); and (2) expenditure for recognition bonds as reported in the statistics of social security.

Table 6 reports on the data, indicating that the contribution of pension reform to domestic saving was negative between the inception of reform in 1981 until 1988. The positive balance since 1989 is essentially due to higher returns on capital investment, while the flows from premiums in percent of GDP remains largely constant at around 2.5 percent; also the fiscal costs exhibit in 1990 only a shift of some 0.8 percent of GDP (due to improved pension indexation by the new

²¹ The premium payments until 1989 are available from Iglesias et al. (1991). For outer years they were calculated from the wage bill and the number of contributors, corrected for indicated underpayment of premiums for the period until 1989.

The flow returns on AFP assets were calculated by the average yearly stock and a representative interest rate of the financial market.

In principle, the flows ought to be corrected for savings generated in the up-stream insurance companies and dissavings by benefit payout. Both data were not at hand.

Table 6. Pension Reform and Saving Effects in SNA

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
(in percent of GDP)														
Total effect (net)	-0,2%	-2,2%	-1,7%	-1,0%	-0,1%	-0,8%	-0,2%	-0,5%	1,9%	3,7%	3,0%	2,2%	2,9%	2,4%
Private saving generated	1,3%	2,6%	3,1%	3,8%	4,5%	3,9%	4,7%	4,2%	6,4%	9,0%	8,3%	7,3%	8,3%	8,0%
Flows - Net contribution 1/	0,9%	1,7%	1,5%	1,6%	1,6%	1,7%	1,6%	2,0%	2,2%	2,3%	2,4%	2,4%	2,4%	2,5%
Flows - Net saving 2/	0,4%	0,9%	1,5%	2,2%	2,9%	2,3%	3,1%	2,2%	4,2%	6,7%	5,9%	4,9%	5,8%	5,5%
Fiscal costs of reform	-1,5%	-4,8%	-4,8%	-4,8%	-4,6%	-4,7%	-4,8%	-4,7%	-4,5%	-5,3%	-5,3%	-5,1%	-5,4%	-5,6%
Deficit coverage 3/	-1,5%	-4,7%	-4,6%	-4,6%	-4,3%	-4,3%	-4,4%	-4,2%	-4,1%	-4,8%	-4,8%	-4,6%	-4,8%	-5,0%
Recognition bonds	0,0%	-0,1%	-0,2%	-0,2%	-0,3%	-0,4%	-0,5%	-0,5%	-0,4%	-0,5%	-0,4%	-0,4%	-0,5%	-0,7%

1/ Pension contributions to AFPs minus benefit payments.

2/ Change in pension assets net of capital gains.

3/ State contribution to social security pension funds (net of payments for social assistance).

Sources: National statistics, and own calculations.

Figure 10. Capital Formation and Financing

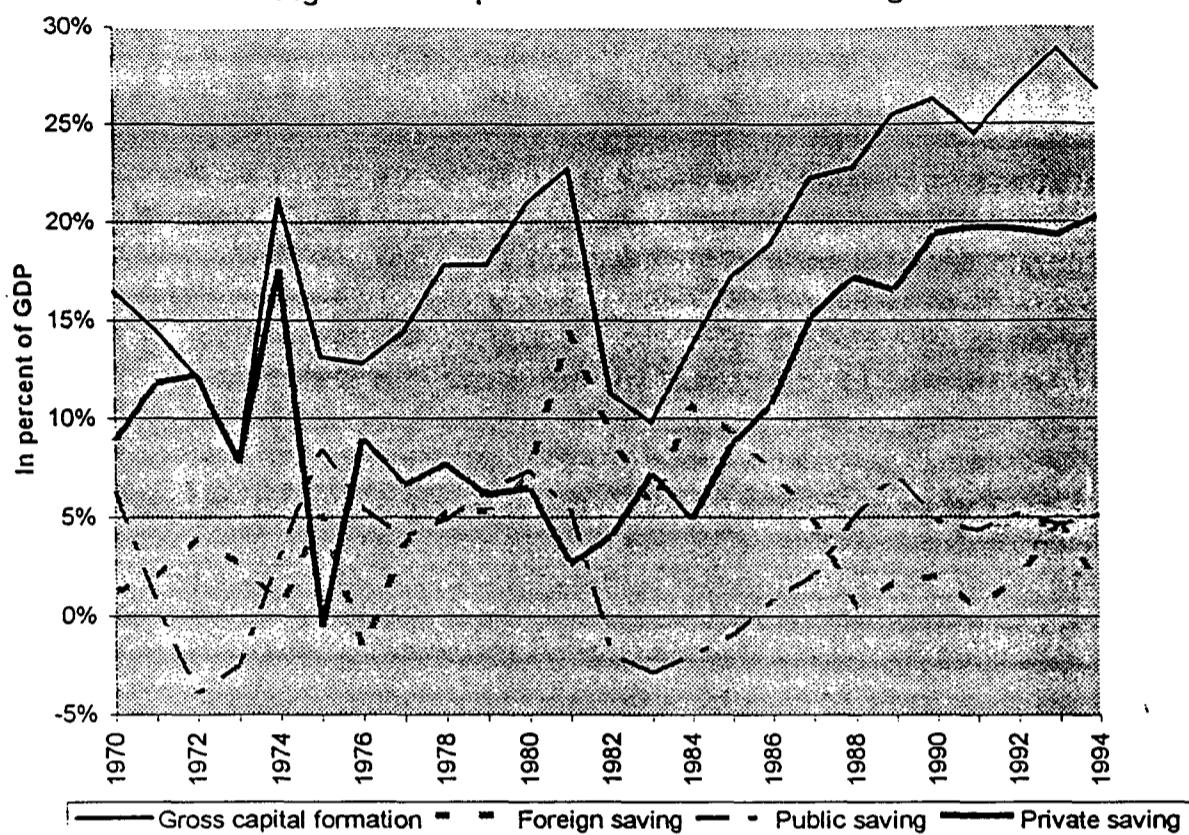
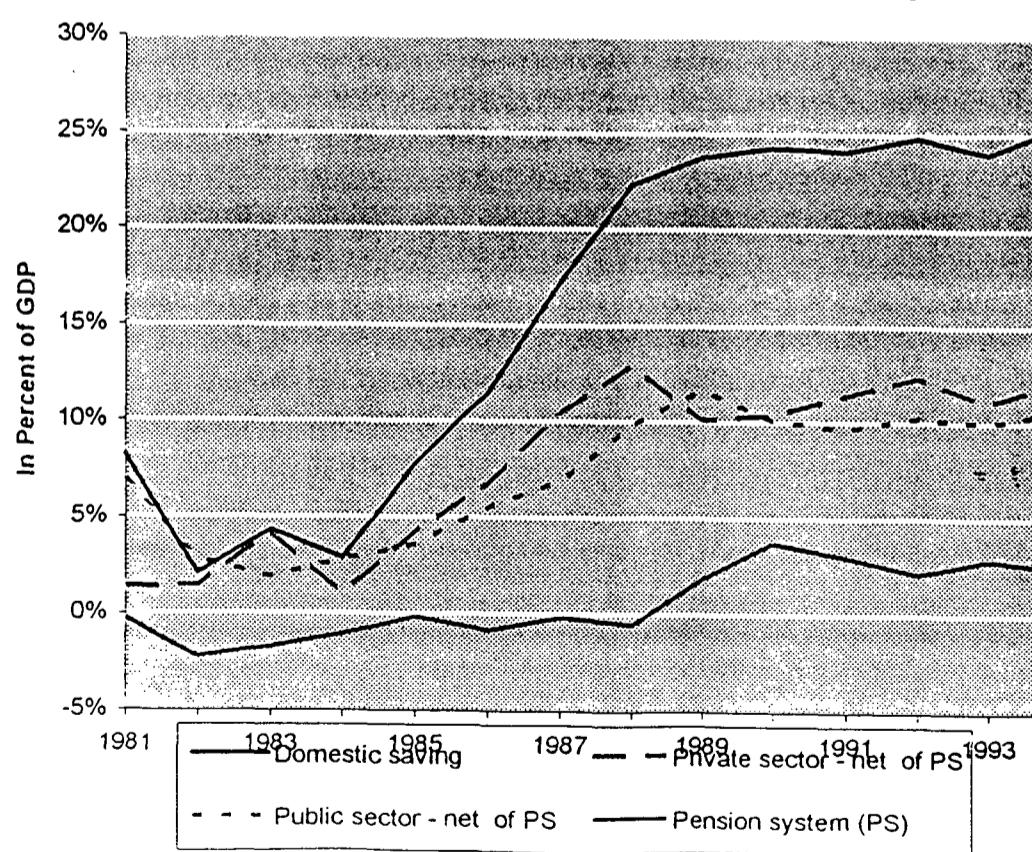


Figure 11. Pension Reform and Domestic Saving



government), compensated by higher returns on assets in that year (due to a stricter monetary policy).

Figure 11 disaggregates domestic saving along different lines and according to (i) the saving balance of pension reform; (ii) the private sector saving net of the pension system; and (iii) the public sector saving net (i.e., plus) of the fiscal costs. The striking message of this disaggregation is the parallel rise of each net-saving item and the leveling off in the period 1988-90. Since then private and public saving net of the pension system remains largely constant at almost identical levels of closely above 10 percent of GDP. The positive net-contribution of the new pension to domestic saving comes in much later, essentially after both public and private saving (net of the pension system effect) have peaked. This confirms the econometric evidence that there was no direct and positive impact of pension reform on private and domestic saving²².

5. Financing the transition: The importance of public saving

The preliminary empirical evidence for Chile suggests that the pension reform had a positive impact on financial market developments which in turn has positively impacted on economic growth via enhanced technical progress, enhanced capital formation and quite likely also via enhanced labor market performance²³. Taking our parameter estimates at face value and with mere growth accounting, the pension reform may have increased the economic growth rate by over 2 percent: 1,3 percent from increased TFP, 0,3% from enhanced capital accumulation (i.e. 0,35 times 0,8%), and 0,5% from enhanced labor force participation (i.e. 0,65 times 0,8% if a similar parameter is assumed)²⁴. Speculating on the self-enforcing endogenous growth effects, the impact may have reached 3% and more (i.e. the total difference between the pre and past reform economic growth rate). However, even such high estimates of a reform-induced growth effect are insufficient to finance the costs of transition out of enhanced economic resources.

The estimates of Table 6 indicate annual fiscal costs of the pension reform of some 5 percent of GDP, consisting of around ½ percent of GDP due to the redemption of the recognition bonds, and 4 ½ percent of GDP to cover the

²² However, pension reform may have had two opposing effects on national saving. Inasmuch as the reform contributed to economic growth (through increased TFP and capital formation) the impact on saving was perhaps positive. A recent IMF study indicates a significant relation between the private saving rate and growth rate (Masson et al. 1995). Such an effect may have been fully or partially compensated by the direct negative of the UF-FF shift on private saving. For an estimation of the net effect, see Holzmann (1995).

²³ The data does not allow for the estimation of the labor force change as a function of financial market developments. The available data on labor market developments after the reform, however, signal a rise in pension coverage by some 10 percentage points, indicating higher official labor market participation, and an increase in the overall labor force participation rate; see Holzmann (1995).

²⁴ This may be a low estimate: Since 1980 the growth rate of labor force was 1,7 percentage points p.a. above the growth rate of the working population.

operational deficit. Hence, even if all the growth rate differential of, say, 3 to 3 ½ percent could have been used to finance the transition, a gap of 1 ½ to 2 percent would have remained. Yet, with a public revenue/GDP ratio of 32% in 1981 only 1/3 of the growth rate differential, i.e. some 1 percent of GDP could be used, leading to a shortfall of 4 percent of GDP with unchanged public revenue and expenditure levels.

Figure 12 highlights the contribution of fiscal performance and public saving to support the transition from an unfunded to a funded pension scheme. Reportedly, the Chilean authorities preceded the inception of the pension reform for some years with a deliberate strengthening of the fiscal stance, leading in 1980 to a positive balance of general government of 4.4 percent of GDP and a public saving rate of 7.4 percent of GDP, respectively. The ensuing decline in both the fiscal stance and public saving as a result of the reform start to be compensated immediately in the following years, reaching again a positive public saving rate in 1985 and a balanced fiscal stance in 1988. In view of the declining share of current revenue as a percent of GDP due to various tax reforms and tax rate cuts, strengthening of the fiscal stance was achieved by program reforms and expenditure cuts (see, Larrain, 1991, Marshall and Schmidt-Hebbel, 1994). The new democratic government which came into office in 1989 has stabilized the expenditure level but not reversed it.

Tentative empirical estimates indicate that private saving is not influenced by the net saving created by pension reform but that it reacts negatively to public saving (Table 7). The latter result, which is both valid for public and corrected public saving (S^*_{public}), allows for different interpretations: a Riccardian/Barro-type reaction of the private sector, (partially) compensating any saving/dissaving by the public sector; or a Keynesian-type reaction, where a higher public saving is achieved at the expense of the disposable income of the private sector, reducing the private saving rate. Since current tax revenue in percent of GDP has been falling constantly since the mid-1970s, the latter hypothesis is less likely.

The negative coefficient of private saving response to public saving effort of around -0.5 is consistent with past and recent empirical findings for developed and developing countries (Corbo and Schmidt-Hebbel, 1991; Masson et al. 1995).

Figure 12. Fiscal Performance, 1970-93

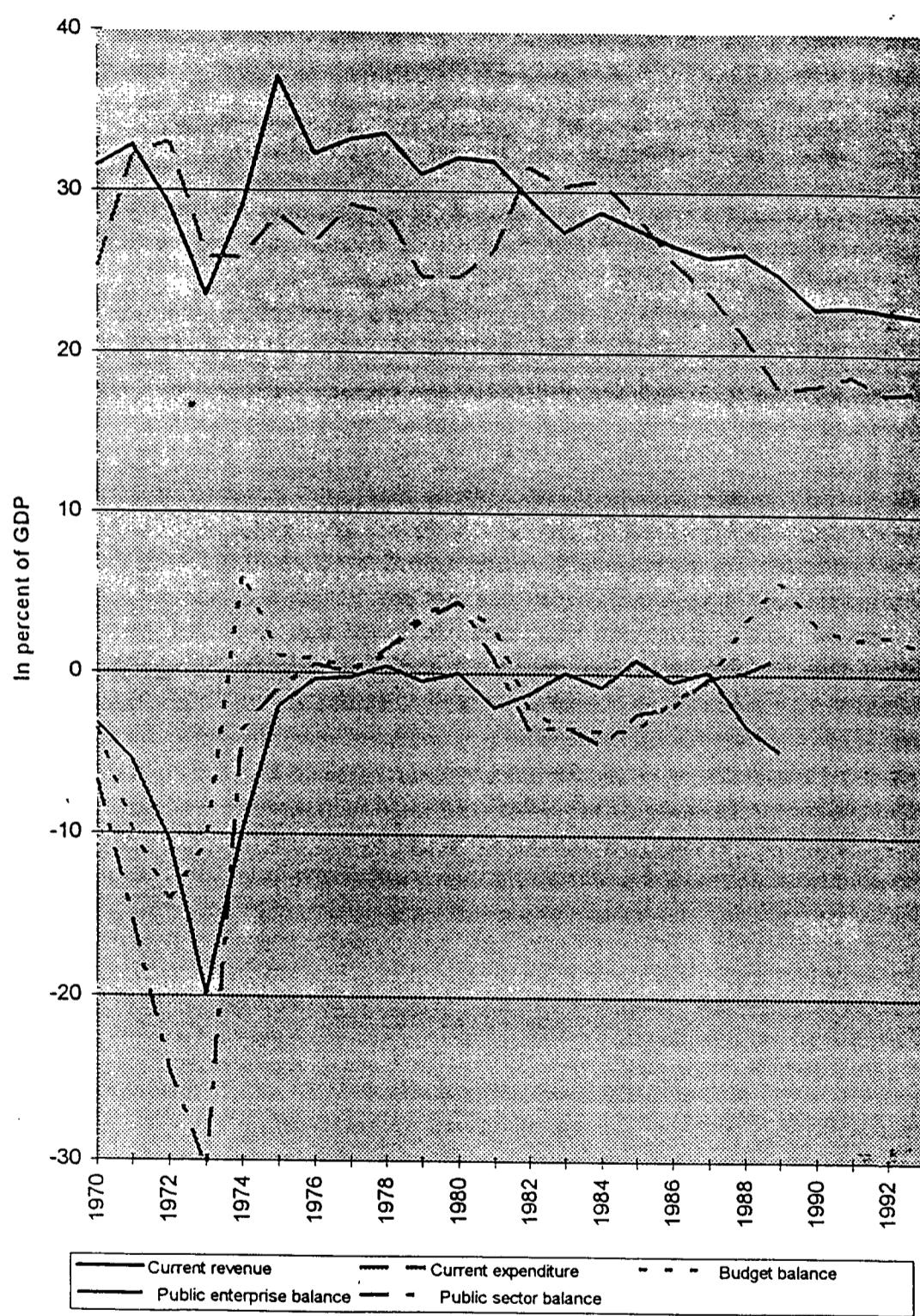


Table 7. Private and Public Savings Interaction

Endogenous variable: S_{privat}/GDP	Constant	UER	$\Delta UER (-2)$	S_t/GDP	
EQ(19) $S_t = S_{pension}$	0,274 (18,7)	-1,53 (11,4)	0,662 (3,94)		$R^2_c=0,904$ $DW=1,43$
EQ(20) $S_t = S_{public}$	0,284 (8,609)	-1,63 (5,47)	0,687 (3,35)	-0,193 (0,30)	$R^2_c=0,904$ $DW=1,45$
EQ(21) $S_t = S_{public}^*$	0,319 (18,7)	-1,84 (13,7)	0,698 (5,46)	-0,546 (3,44)	$R^2_c=0,951$ $DW=2,33$
EQ(22) $S_t = S_{public}^{**}$	0,391 (6,45)	-2,13 (6,58)	0,841 (4,63)	-0,821 (1,97)	$R^2_c=0,927$ $DW=2,20$

OLS; period of estimation: 1977-1994. Absolute t-value in parenthesis.

In summary, the data and preliminary estimates for Chile suggest a major contribution of the UF-FF shift to economic growth. These enhanced economic resources allowed the repayment of a (small) part of the SSD made explicit via enhanced public revenue (at constant tax rates), and compensated the current population partially for the contractionary fiscal stance. The latter led to no permanent increase in fiscal debt as the initial and reform induced deficit position was quickly reversed. As a result, part of the transition is financed by the current generation and not shifted to future generations (which the increase in the growth rate may have permitted). However, this contractionary fiscal stance has importantly contributed to the increase in national saving, was even required since the private sector seemingly compensates roughly 50 percent of an increase in the public saving rate by own dissaving, and may have fostered the overall macroeconomic performance through a crowding-in of private investment.

V. Concluding Remarks

The transition from an unfunded to a funded pension scheme creates a formidable task for fiscal policy. The liabilities towards the current generation of retirees and workers resulting from unfunded pension provisions constitute a huge hidden public debt. Making this implicit social security debt fully explicit, thus reversing the initial redistribution towards the current generation, is for most countries quite likely beyond their political, economic and fiscal capacity. Thus, a transition requires various simultaneous steps such as the (i) benefit reform of the unfunded scheme, reducing the implicit debt, (ii) a redesign of the basic tier remaining unfunded to minimize distortions on factor markets, (iii) a design of the

timing and form of the debt made explicit and the fiscal flows involved, and (iv) a careful calculation of the compensation amount to render the switching decision by individual workers voluntary but cost effective.

Theoretical considerations and the Chilean experience strongly suggest the feasibility and potential Pareto-efficiency of such an approach. The unfunded-fully funded shift can importantly contribute to financial market developments which in turn impacts very positively on total productivity, capital accumulation, labor market performance, thus economic growth. The latter can generate enhanced economic resources which allow to repay the debt made explicit. While a long-term increase in the economic growth rate allows, in principle, a medium-term increase in the explicit public debt to be repaid in the future out of enhanced resources, negative financial market reactions to a higher explicit fiscal debt and macroeconomic considerations may warrant a more contractionary fiscal stance from the very beginning. As suggested by the Chilean example, this requires major reforms of other public expenditure and revenue programmes.

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ANNEX A: The applied simulation model

In order to investigate the impact and effects of pension reform on the economy OLG-models à la Auerbach-Kotlikoff have been established as a main instrument and are widely used (for example, Arrau, 1991, Cifuentes and Valdes-Prieto, 1994, Schmidt-Hebbel, 1994, Perraudin and Pujol, 1994). Those OLG-models provide important insights into economic intertemporal interactions, but have also severe limitations. Primarily, in their current structure they allow only for one control variable - consumption. This excludes the investigation of other decision processes, such as on switching between funded and unfunded schemes. Secondly, the models are based on a deterministic life-time (say, till age 75). Nondeterministic life-times and hence the use of survival probabilities are important to gauge the full effects of different indexation procedures or the actuarial effects on switching-decisions. Thirdly, the current OLG-models do not allow one to investigate the effects of aging on the SSD and the transition costs. Last, but not least, the model-type is a very cumbersome and time consuming instrument to investigate different options of pension reform.

For these reasons a somewhat different model type is applied, which may be described as an overlapping cohort model in an open economy (i.e., we assume a given interest rate, wage profile, etc.). This spreadsheet based model views the period -50 to +120, with cohorts aged 21 to 100. It consists of a demographic module (using synthetic survival probabilities), a labor market module (allowing for formal and informal activities), a simple output market module (allowing the calculation of GDP), a pension module (covering both funded and unfunded pensions), and a fiscal module. It is highly parameterized and allows for the investigation of a wide range of assumptions, both economic and pension related. Most importantly, it allows for the endogenous and expenditure minimizing selection of the switching age as a result of a cohort decision process.

The model allows the analysis of a wide range of reform options and their fiscal implications. The draw-back of spreadsheet-based model implementation is the long calculation time for each simulation²⁵.

²⁵ A full interative simulation takes some two hours on a Pentium based note-book.

ANNEX B: The Individual Switching Decision

For the decision to switch from an unfunded to a funded system it is assumed that at the decision date T (end of period), each cohort of age A (composed of identical individuals) compares the present value of life-time resources LTR at retirement age RA under the unfunded and funded schemes:

$$(1) \quad PV(LTRU(A)_{RA}) \Leftrightarrow PV(LTRF(A)_{RA})$$

The life-time resources under the unfunded scheme consist of the gross-wage compensation minus the contributions to the basic and earnings-related system while active, and the basic and earnings-related benefits while retired.

$$(2) \quad LTRU(A)_{RA} = \sum_{a=21}^{RA-1} w_a (1 - c_{a,a}^{ub} - c_{a,a}^{ue}) S(a) (1+r)^{RA-a} + \\ + \sum_{a=RA}^{100} (b_{a,a}^{ub} + b_{a,a}^{ue}) S(a) (1+r)^{a-RA}$$

$$(3) \quad LTRF(A)_{RA} = \sum_{a=21}^{A-1} w_a (1 - c_{a,a}^{ue} - c_{a,a}^{ub}) S(a) (1+r)^{RA-a} + \\ + TR(A)_{RA} + \\ + \sum_{a=A}^{RA-1} w_a (1 - c_{a,a}^{ub} - c_{a,a}^{fe}) S(a) (1+r)^{RA-a} + \\ + \sum_{a=RA}^{100} (b_{a,a}^{ub} + b_{a,a}^{fe}) S(a) (1+r)^{a-RA}$$

with w the gross wage; c the contribution rate for the unfunded basic (ub), unfunded earnings-related (ue), and funded earnings-related (fe), respectively; r the interest rate; S the survival probability (from age A to age a); and b the corresponding benefits.

The first term of equation (2) can be further disaggregated into net wage till age A-1 and from age A to retirement age RA. Since the net-wage till the decision age A is the same under both options, they cancel out in both equations; the same is true for basic contribution and benefit above the decision age A. Consequently, the decision problem can be reduced to

$$(4) \quad - \sum_{a=A}^{RA-1} w_a c^{uc}_a S(a) (1+r)^{RA-a} +$$

$$+ \sum_{a=RA}^{100} b^{uc}_a S(a) (1+r)^{a-RA}$$

$> = <$

$$TR(A)_{RA} -$$

$$- \sum_{a=A}^{RA-1} w_a c^{fc}_a S(a) (1+r)^{RA-a} +$$

$$+ \sum_{a=RA}^{100} b^{fc}_a S(a) (1+r)^{a-RA}$$

The last two expressions in equation (4) define the contributions and benefits under the funded scheme. Under an actuarial system, they should cancel out. Hence, the decision problem can be further reduced, while defining one option to specify the transferred amount:

$$(4a) \quad - \sum_{a=A}^{RA-1} w_a c^{uc}_a S(a) (1+r)^{RA-a} +$$

$$+ \sum_{a=RA}^{100} b^{uc}_a S(a) (1+r)^{a-RA}$$

$> = <$

$$TR(A)_{RA} = S(A) [\sum_{a=21}^{A-1} w_a c^{uc}_a (1+\rho^I)^{A-a}] (1+\rho^II)^{RA-A}$$

In this specification, the rate of return ρ^I on passed contributions till the decision age, and the rate of return ρ^II on the transferred amount (say, recognition bonds) till retirement can be chosen as policy parameters to steer the switching decision and to minimize fiscal outlays.

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