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## Abstract

In 1981 Chile adopted its new multi-pillar system, which featured privately managed individual accounts. Starting in 1983 payouts from the accounts were permitted and detailed rules about payouts were put in place. The Chilean scheme therefore gives us an opportunity to examine how pensioners and pension providers react to individual account systems during the payout stage and how regulations shape these reactions. We use aggregate time series data obtained from the pension fund and insurance industry regulators, individual-level data on all annuitants in the system, and interviews with pension providers and regulators for this analysis.

Retirees in Chile have a choice between early versus normal retirement from the system and between annuitization versus programmed withdrawals (PW); lump sum withdrawals are largely ruled out. These choices determine the time stream of benefits and the eventual financial burden that will be placed on the public treasury. Almost twothirds of all retirees have annuitized, but this proportion differs greatly between early and normal age retirees. Currently 60% of all retirees have chosen to retire early, many before age 55. (Early retirement means that they stop contributing and start withdrawing; it does not mean that they stop working). Most (85% of) early retirees have annuitized, while most (66% of) normal age retirees have taken PW. We present evidence that this disparate behavior is explained by incentives and constraints stemming from guarantees and regulations on pensioners and pension providers. These rules have lead workers with small accumulations to take PW at the normal age, with the minimum pension guarantee providing longevity and investment insurance. They lead workers with large accumulations to retire early, with annuities providing insurance. Regulations have given insurance companies selling annuities a competitive advantage in marketing to this group, and they do so aggressively.

Early access to retirement saving through early retirement or front-loaded PW imposes a potential financial burden on the government because of the minimum pension guarantee, which has been rising in real value through time. As a result, the expected public share of the total pension payout grows with a cohort's age and may exceed expectations as cohorts that retired under the new system grow very old. Annuitization mitigates (but does not completely eliminate) this cost to the public treasury. This analysis suggests that, with appropriate incentives, a high proportion of pensioners will purchase annuities in countries with individual account systems. But these countries need to coordinate early withdrawal conditions with minimum pensions and other safety nets, in order to avoid moral hazard problems and unexpected public liabilities.

## Authors' Acknowledgements

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**Payout Choices by Retirees in Chile: What Are They and Why?**

In 1981 Chile adopted its new multi-pillar system, which featured privately managed individual accounts. Traditional defined benefits for old age were eliminated in the new system. Starting in 1983 payouts from the accounts were permitted and detailed rules about payouts were put in place. The Chilean scheme therefore gives us an opportunity to examine how pensioners and pension providers react when individual accounts replace DB systems, and how regulations shape these reactions. Much attention has previously focused on the accumulation stage, but this project is the first full analysis of the payout stage of the Chilean reform.

Retirees in Chile make two key choices: between early versus normal retirement and between annuitization versus programmed withdrawals (PW). These choices determine the time stream of private benefits and the eventual financial burden that will be placed on the public treasury. As life cycle models would predict in an environment with no DB, a high proportion of retirees have annuitized-—almost two-thirds over-all. This is a remarkable number, compared with the experience of other countries. But this proportion differs greatly between early and normal age retirees. Most workers retire as soon as they meet the eligibility conditions--60% of all pensioners have retired early, many before age 55. Most (85% of) early retirees have annuitized, while most (66% of) normal age retirees have taken PW. The central question this paper addresses—how do we explain this disparate behavior?

Our main answer is—guarantees plus incentives and constraints stemming from regulations have shaped these choices. Details of policies matter a lot. Pensioners and pension providers have made rational choices in light of these rules. The rules of the game have lead workers with small accumulations to maximize their retirement income by taking PW at the normal age, with the minimum pension guarantee (MPG) providing longevity and investment insurance. They lead workers with large accumulations to retire early, with annuities providing most of the insurance. With appropriate incentives, it appears that a high proportion of pensioners will purchase annuities. But in Chile these incentives include aggressive marketing by insurance companies and regulations that give these companies a competitive edge.

Annuitization reduces but does not completely eliminate the government's contingent liability. This liability stems mainly from a minimum pension guarantee that has been rising roughly on par with wages in the economy, in contrast to payouts from annuities or PW that remain constant or fall in real terms as the cohort ages. A secondary object of his paper is to identify the features of the system that may make this liability larger than expected. To address this question we examine the time stream of private pensions over the retirement period and the public payments that this implies.

We use three types of data sources: First, aggregate time series data on annuities and programmed withdrawals for normal old age and early retirement, 1983-2002, were obtained from the insurance regulator (SVS) and the AFP regulator (SAFP) (see Appendix for details). Second, we obtained from SVS individual-level data on all annuitants giving gender, size pensions and dates of birth, retirement and death. In this paper we use this data set to report descriptive statistics on annuitants, such as age of retirement, size of pension and expected versus actual mortality rates across groups. A forthcoming paper will analyze in greater detail the individual-level data on annuitants and insurance companies. Unfortunately, reliable individual-level data on PW pensioners were not available—which is itself part of the story. Third, we held extensive discussions with insurance companies, AFP's and regulators in Santiago, and we obtained annuity quotes from several companies for 2003 and 1999, from which we calculated money's worth ratios.

Part I outlines the rules that shape pension payouts in Chile. Parts II and III focus on the choices between annuities and PW and between early and normal retirement. We examine choices by regulators who set the rules of the game and by pension providers and retiring workers who respond to these rules. We analyze who annuitizes and why? Who retires early and why? Part IV discusses implications for the government's fiscal liability. The Conclusion presents lessons for the payout stage in other countries such as the US that have or are considering individual account systems.

## I The Rules of the Game: constraints and choices that shape the time-stream of pension payouts

A major object of the accumulation stage of old age security programs is to prevent individuals from failing to save enough for their old age, so they later become a burden to the public treasury. One might expect that regulations at the payout stage would have a similar objective of delaying consumption to prevent individuals from outliving their savings. In particular, the existence of the minimum pension guarantee (MPG) in Chile raises a potential moral hazard problem and a contingent liability for government.

At the same time, delaying consumption too much may result in over-saving. Allowing contributions to stop and withdrawals to start after adequate saving has been achieved prevents this from happening and may encourage older workers to stay in the labor force. It may mitigate pressures from unemployed older workers, who want access to their savings. This was an important factor in Chile during the 1980's, when unemployment exceeded 10%. It reduces perverse redistributions from poor to rich and from unhealthy to healthy individuals that occur if everyone has to retire at the same age and annuitization with everyone in a common pool is required.

Moreover, regulators may be subject to political pressures to allow front-loaded payouts, beyond the point that is justified by economic arguments. Empirical evidence from other countries indicates that some people are myopic, have a high discount rate and, for precautionary reasons, might prefer to hold their savings in a liquid form even if they don't immediately consume it. Allowing early access should increase the system's popularity and induce workers to regard contributions as their own property rather than a tax. Furthermore, in Chile, where different bodies regulate AFP's providing PW pensions versus insurance companies providing annuities, these regulators may face a trade-off between tight rules that prevent imprudence versus looser rules that give their industry a competitive advantage.

This paper describes how regulators have walked this tightrope and how pension providers and pensioners have reacted to these regulations. Because of policies that postpone withdrawals and encourage annuitization, retirement accumulations should last the expected lifetimes of most workers; but because of policies that permit early access, with guarantees, many retirees who live longer than expected, and their surviving spouses, will pose a burden to the public treasury.

**The options**

Accumulations in the new Chilean pension system started in 1981 and retirement payouts were permitted from 1983 on. Payouts, like investments, are tightly circumscribed. Lump sum withdrawals are not permitted except under narrowly specified circumstances—the remaining accumulation must be large enough to produce a pension that is at least 70% of the worker's average wage over the past ten years. Very few workers have met this requirement. Workers cannot access their funds for house purchase, education or medical expenses, as in some other countries.[1] Basically, workers must choose between annuitization versus programmed withdrawals (PW). It is an all-or-nothing choice, with one company. The choice of annuities can be deferred 2-3 years through a program called "temporal withdrawals" and retirees who start with PW can switch to annuities later on.[2] Additionally, workers must choose their age of retirement, subject to eligibility conditions that will be described below. These are likely to be the kinds of choices that are offered in many reforming countries.

**The minimum pension guarantee (MPG)**

Regardless of the options chosen, government promises to keep the pension at or above the minimum pension guarantee (MPG). This guarantee is available to all workers who have contributed at least 20 years. If the worker's own accumulation is not enough to cover a lifetime pension at the MPG level, the government provides a subsidy to bring it to that level. The MPG reduces the worker's longevity risk from early access. But the reduced risk to the pensioner is matched by an increased risk to the public treasury, which is left with a contingent liability. The MPG is financed out of general revenues, not the payroll tax. To be eligible, workers must attest that they have no other income sources that bring them above the MPG level. This means test is enforced by the AFP's or

insurance companies paying the pension, which are required to secure documents from the tax authority and the old pension authority confirming the absence of other income.[3]

The MPG is set in nominal terms but it is reset in a political decision each year. During the 1980's, real wages fell in Chile and then recovered. The MPG also fell and recovered, both with a lag. During the 1990's real wages rose steadily and the MPG again rose more slowly but caught up by the end of the decade. Over the entire 21-year period, 1981-2002, real wages rose by 50% while the MPG for retirees under age 70 rose by 41% and for those over age 70 it rose by 54% (Table 1 and Figure 1). At the beginning of the period the MPG was about 25% of the average wage, by the end it was about 24%, while if it had remained constant in real value it would have fallen to 17% of the average wage and if constant in nominal value, to barely 1%. In this paper we refer to the MPG as roughly wage-indexed, although the relationship is ad hoc and irregular.

When the MPG rises, it rises for the old stock of retires as well as the new flow. Thus it may ultimately apply to annuitants as well as to pensioners on PW. It jumps by about 9% for workers once they reach the age of 70. It is reduced for early retirees, by a formula described below. This reduction, based on age of retirement from the pension system, means that the MPG is very individual-specific—which in the long run may make it difficult to track and enforce. The MPG also applies to survivors' benefits—supposedly at 60% of the full MPG but, because of special adjustments, actually 100%.

**Choice of annuities vs. PW**

Under annuitization workers turn their entire accumulation over to an insurance company that provides the annuity, subject to detailed rules set by the insurance regulator (the Superintendencia de Valores y Seguros—SVS). The retiree foregoes future control over investments and gives up the right to leave bequests (except for that embodied in a joint or guaranteed period annuity), but gets a stable income stream that is guaranteed for life. Regulations require that annuities should be fixed rate rather than variable, price-indexed and joint with 60% to surviving spouse for married men. If the MPG rises above the annuity level, the government tops up the payout. The government also insures 75% of the worker's annuity over the MPG (with a cap of UF 43 or about US$1000 monthly) in case the insurance company becomes insolvent, and to prevent this from happening sets stringent reserve, equity and asset-liability matching requirements (discussed in a

separate paper). So far it has never had to pay this insurance but it is likely to do so for the first time as a result of the recent Inverlink scandal.[4] Subject to meeting regulatory requirements, insurance companies determine annuity payouts and bear the longevity and interest rate risk. They are not permitted to charge explicit fees, but cover their costs and profits out of implicit fees (the spread between the rate of return they earn on investments versus the rate they pay annuitants) that are based on the total assets used to purchase the annuity (See James, Song and Vittas 2003 for a discussion of the role of the spread in annuity pricing in other countries as well).

Under programmed withdrawals (PW) the permissible withdrawal per year from the worker's account depends on a formula that is set by law. Its key arguments are the assumed mortality and interest rates. Workers retain control and bequest rights over the remainder of their accumulation, subject to regulatory constraints. Their investments may lose money and even if they don't the pension is likely to decline dramatically through time, due to the way the formula works (discussed below). If the PW payout hits the MPG, payouts stay at the MPG level until the account is used up, at which point the government pays the entire pension bill. Like annuities, PW pensions must be joint for married men (and for women with dependent children). The same companies (AFPs) that manage investments during the accumulation stage, manage it during the PW stage, subject to rules established by the AFP regulator (the Superintendencia de AFP--SAFP). AFP's have no control over the formula that determines PW payouts nor do they bear the mortality and interest rate risk the formula implies. In contrast to insurance companies, AFP's are required to make all fees explicit and all investment earnings must be passed on to pensioners. Their revenues depend primarily on contribution-based fees during the accumulation stage, secondarily on small fees per account or per payout amount during the withdrawal stage.

One sub-group of retirees does not have a choice between annuities and PW: those whom, upon retirement, do not have an accumulation large enough to purchase an annuity at or above the MPG floor must stay in PW and spend down their savings at the MPG level each month, after which the government pays the full bill. PW pensioners can also become subject to this restriction some years after retirement, hitting the floor as the

PW payout goes down while the MPG goes up. As of 2003, 70% of all PW pensioners (or 24% of all retirees) were in this no-choice situation.

In sum, under annuities pensioners get a fixed payout, pay no fees except that which is implicitly embodied in this payout and insurance companies get the varying residual, while under PW AFP's get a fixed explicit fee and pensioners get the varying residual. Both groups receive ultimate protection from the MPG. Almost two-thirds of all pensioners have annuitized and they constitute about three-quarters of those who had a choice at their date of retirement (Table 2 and Figure 2).

**Choice between normal and early retirement age**

Besides this choice between PW and annuitization, workers must also choose the age at which they will begin to withdraw their money from the system. Normal retirement age is 65 for men, 60 for women. After this age any worker may begin withdrawing funds. But starting in 1987 regulations began to facilitate earlier withdrawals. Early retirement is permitted once workers have an accumulation large enough to finance a pension that is 110% (soon to be 130%) of the MPG and 50% of their own average wage. For workers who qualify, continued saving through the social security system becomes voluntary rather than mandatory. It is important to note that "early retirement from the system" does not mean "retirement from the labor force;" it only means that workers start withdrawing from and may stop contributing to their retirement accounts. In fact, the elimination of the 13% payroll tax may have a positive impact on the labor supply of older workers.[5] But the fact that workers can stop accumulating has a negative impact on their future pensions and the finances of the government. Among current pensioners, 60% retired early, often before the age of 55 (Tables 3 and Figure 3).[6]

**Indexation requirement**

In Chile, both nominal and price-indexed currencies (pesos versus UF's) are in common use, and long-term financial transactions are usually quoted in the latter—a consequence of Chile's long experience with inflation. Regulations require annuities to be issued in UF's. Initial benefits are lower than they would have been otherwise, but later on the nominal value increases with inflation to maintain a constant purchasing power. In nominal terms annuity values are therefore back-loaded while in real terms values are constant over time. A nominal annuity issued in 1993 in Chile would have

fallen to only 63% of its initial real value by 2002, and one issued in 1983 would have fallen to 5% of its initial real value by 2002. Price indexation avoids this problem of falling real values. Price indexation of annuities saves the government considerable money, since nominal annuities are more front-loaded in real value and will quickly fall below a price-indexed MPG. With nominal annuities, the individual would keep an early surplus above the MPG, while the treasury would pay the difference once the pension falls below a constant real MPG. Chile avoids this problem. (However, it faces a similar but smaller problem since the MPG has been rising with wages, while annuities are indexed only to prices. We discuss this further below).

Monthly payouts from PW are also price-indexed in the sense that they are specified in UF's for a 12-month period and most of the investments backing them are price-indexed. However, PW valuations are recalculated every 12 months and, as discussed below, the formula yields a declining real value over the retiree's lifetime. This increases the probability that the MPG will eventually be hit.

**Joint pension requirement**

Benefits are also postponed by the requirement of joint annuities and joint PW. Married men who annuitize must use joint annuities, with the surviving widow receiving at least 60% of the husband's annuity (50% to widow +15% to each child if there are surviving children). The formula for PW, too, includes a provision for the wife to receive 60% of the deceased husband's pension and this provision diminishes the amount that the husband can withdraw.[7] This requirement provides insurance for widows, financed by their husbands, rather than the public treasury. In effect, husbands must put aside some of their retirement savings to cover benefits to their wives, who are likely to be younger and outlive them. (Wives, in contrast, must purchase individual annuities or PW, unless they have disabled husbands or dependent children). If the wife is 5 years younger than the husband and has a life expectancy that is 3 years greater than his—the typical case in Chile--this requirement reduces his monthly payout by about 17% (Table 5; also see James, Edwards and Wong 2003). While many husbands would have chosen the joint annuity option voluntarily, some might have purchased an individual annuity in the absence of this requirement because they place a greater value on their own consumption. The wife is allowed to keep this joint pension in addition to her own pension, if she has

worked. The mandatory joint annuity or PW saves the government money since, together with her own pension, it often brings the income of the surviving wife above the MPG point for working wives or the social assistance point for non-working wives.[8]

## II. Programmed Withdrawals versus Annuitization for Normal Old Age Retirees

A key choice for retirees in Chile is whether to annuitize or take programmed withdrawals. If the individual chooses to annuitize she buys her annuity from an insurance company, which provides longevity and investment insurance. If she takes PW she leaves her money with her AFP, which calculates a stream of monthly withdrawals based on a formula set by the AFP regulator. The MPG is the only longevity and investment insurance she receives. In both cases key ingredients into the determination of payouts are mortality tables assumed and interest rates in the economy at the time the person retires. We analyze how they affect the "money's worth ratio" for annuities, the time stream of payouts under PW, and the choice between them in the context of the MPG.

### Annuities—the high money's worth ratio

Annuities in Chile provide a level real pension for the annuitant's lifetime (plus the lifetime of survivors for joint annuities). When an insurance company sells an annuity, it computes this level pension, taking into account the expected lifetime of the individual (and spouse) and the investment returns it expects to earn with the premium. Do the resulting payouts provide good value to Chilean workers? This will obviously influence their willingness to purchase an annuity. Hence, we start by presenting our calculations on the MWR of annuities in Chile.

Concretely, the MWR for a single life annuity is:

$$MWR = \left\{ \sum_{t=1}^{(T-a)*12} \frac{P_{a,t} \cdot A_a}{(1+i_t)^t} \right\} \Big/ C_a$$

where: T = Maximum attainable age
a = Age (in years) of annuitant at start of contract
t = Number of months beyond annuity starting date

$P_{a,t}$ = Probability of individual being alive t months after age a
$A_a$ = Monthly annuity payment for annuity purchased at age a
$C_a$ = Cost of policy for individual purchasing annuity at age a
$i_t$ = Nominal monthly t-period spot rate

The numerator of this expression is the expected present discounted value of the lifetime income stream from the annuity, while the denominator $C_a$ is the initial capital cost. If the MWR is 100%, this means that consumers can expect to get back what they paid in, in addition to longevity and investment insurance. If the MWR is considerably less than 100% (a high load factor), consumers are getting back a lot less than they put in, and this may not be a good deal for them. If it is much greater than 100%, this raises the prospect that insurance companies are offering too much in order to gain market share in the short run and may not be able to keep their promises in the long run; possibly regulators should be concerned.

*Discount rates.* We surveyed several insurance companies in March 1999 and March 2003, computed the average payout in each year for several annuity products, and calculated the MWR using two different discount rates--the risk-free term structure and a risky term structure. The term structure is used to take account of the fact that annuity payouts flow at different points in time, throughout the annuitant's life. The risk-free rate is based on 0 coupon bonds in 2003 and is derived from PRC paper of differing maturities in 1999 (0 coupon bonds did not exist in 1999). The risky rate is defined as risk-free + 1.4%, which is approximately what insurance companies in Chile have earned, on average per year, over the past decade. The risk-free discount rate is most appropriate for workers who want a secure source of retirement income and consider annuities safe. The risky rate is most appropriate for workers who have a higher subjective time preference or who are willing to accept some investment risk in exchange for a higher expected return.

*Mortality tables.* We employ several mortality tables in our analysis: 1) 1985 mortality tables, RV85, are used by the insurance and AFP regulators. They are period rather than cohort tables; that is, they are based on cross-sectional data and do not take into account expected future longevity improvements. And they are based on old cross-sections (prior to 1985), hence do not even take full account of past longevity

improvements. They likely underestimate life expectancy of workers, especially those in the formal sector who are covered by Chile's social security system. 2) 1998 period tables with lower mortality (RV98) have been developed based on more recent data with pensioners but are not yet used by regulators. 3) we constructed a cohortized version of RV98, using the Canadian mortality improvement factor as a proxy. Life expectancy for males at age 65 is 80.5 in RV85, 82 in RV98 and 83 for the cohortized version of RV98. Our analysis of actual mortality experience for annuitants indicates that RV85 understates longevity for men and women and therefore understates insurance company liabilities. RV98 continues to understate longevity for women, but by a smaller amount, and overstates longevity of men, especially men who retired early, although this overstatement largely disappears by the late 1990's (Table 4). We do not have data that would allow us to assess which table is most accurate for PW pensioners. (See James and Song 2001, James, Song and Vittas 2003 for a more detailed discussion about mortality tables and the role they play in annuity markets).

*Summary of MWR's.* Competition has brought the MWR discounted at the risk-free rate to the neighborhood of 100% in many countries. This appears to be the case in Chile also. According to Table 5, Panel A:

1) For male annuitants who retire at age 65, whose mortality is best represented by RV98, the risk-free MWR is close to 100%. This means that the typical annuitant gets back the present value of his premium over his lifetime, in addition to the insurance value of the annuity.

2) For the average population member, whose expected mortality may be closer to RV85, the MWR is 3-5% lower. If forced to annuitize at current payout rates these individuals are unlikely to recoup their full premiums. This lower MWR helps to explain why some people do not purchase annuities. The PW option allows this group to avoid the negative redistributions that would result under these terms.

3) For workers who retire and annuitize at an earlier age, such as 55, the MWR falls by about 4%--possibly due to the higher risk premium that insurance companies charge for their longer period of exposure and greater reinvestment and longevity risk.

4) The measured MWR is lower for women, probably because they are viewed as posing greater longevity risk. (Table 4 shows that, indeed, they live longer than expected in any of these tables, so actual MWR exceeds measured MWR).

5) Joint annuities, which prevail in Chile, have lower payouts but similar MWR's to individual annuities. They narrow the MWR disparity between retirees with long and short expected lifetimes, because they involve two individuals with non-correlated lifetimes.

Table 5, Panel B compares MWR under various scenarios and shows that:

1) Using the risky discount rate reduces the MWR by about 11%. Individuals for whom the risky rate is appropriate place a lower value on the current limited annuity options, and would be more likely to annuitize if other options, such as variable annuities, were permitted.

2) A higher premium might be expected to reduce the measured MWR because insurance companies believe high premium retirees will have greater expected lifetimes due to the wealth-longevity correlation, and therefore offer lower monthly payouts per dollar of premium. Working in the opposite direction, payouts and MWR might be higher because administrative costs of annuities tend to be fixed per policy, hence a lower percentage of premium for larger accounts (see below for further discussion). Our data indicate that the latter effect dominates and MWR's are slightly higher for larger premiums.

3) Payouts declined more than 10% between 1999 and 2003 but the MWR did not fall—in fact it rose slightly over this period. Apparently payouts have not yet fallen enough to fully compensate for the dramatically falling short term interest rates over this period, perhaps because most investments are made in longer term securities (see below).

The MWR's in Chile are especially high given that they hold for price-indexed annuities. This contrasts with most other countries, where only nominal annuities are offered.[9] Insurance companies are usually reluctant to offer price-indexed annuities because indexed investment instruments with which to hedge this risk are not available or pay a low rate of return. Also, if indexation is voluntary, it is more likely to be chosen by retirees with greater expected longevity--adding to their expected cost. If insurance companies do offer indexed annuities they impose a high price (in the form of a low

money's worth ratio) for these reasons. For example, the MWR that annuitants receive for indexed annuities is 89% in the UK compared with 98% for nominal annuities (see Murthie et al 1999; also see Finkelstein and Poterba, 1999 and 2000). However, we find that the MWR to annuitants for indexed annuities in Chile is 98% (using RV98). Indexed annuities cost less in Chile, possibly because many inflation-indexed investment instruments are available for investment by insurance companies and because indexation is mandated, hence adverse selection is not an issue. (For further discussion of the MWR in other countries see James and Song 2001, James, Song and Vittas 2003).

*Importance of the "spread."* How do insurance companies manage to cover their costs and profits while repaying the full premium and providing longevity and investment insurance to annuitants? Elsewhere we have argued that they can do so because they earn a spread between the risk-free rate that they pay annuitants and the risky rate that they earn on the diversified portfolios in which they invest the premiums (James, Song and Vittas 2003). These portfolios include long-term public and corporate bonds, mortgage-backed securities, and some equities. The risk inherent in these securities is converted into less risky annuities by risk-intermediating measures such as investment diversification, use of derivatives, reinsurance, negative correlations among product lines, keeping reserves that exceed liabilities, using shareholder net worth as buffers, and ultimately, government guarantees. Term intermediation is also used, to a limited extent—investing in long term instruments, whose rates have not fallen nearly as much as short-term rates, while covering short term payouts out of cash inflows. In addition, insurance companies earn a premium owing to their capacity to invest in illiquid instruments. As a result of these measures, in Chile the spread between the rates paid and earned has exceeded 1.4% per year, which is enough to cover their costs (Table 6 and Figure 4) The net result is a MWR of annuities that make them a reasonable option for retirees.

**PW—payouts start high and decline with age**

If a retiree chooses a programmed withdrawal (PW) instead of annuitization, she leaves her money with the AFP and takes a withdrawal each month, based on a specified formula. PWs do not provide longevity and reinvestment insurance. However, they do have five basic advantages: they allow the retiree to:

(1) Be sure that he and his heirs will receive back the full value of his accumulation, regardless of when he dies. This may be valuable to workers who do not want to forego any of the money in their accounts to purchase insurance.

(2) Choose the investment strategy (choice of AFP and, more recently, portfolio). This enables pensioners to invest in a riskier portfolio with a higher return than annuities.

(3) Leave bequests if the worker dies early. Any remaining amount in the account that exceeds the capital needed to finance the joint pension is left to heirs instead of being kept in the annuity pool.

(4) Get her money out of the system quickly. During the first few years of retirement, the PW formula produces payouts that exceed annuity payouts, and then vice versa, due to the required mortality and interest rate assumptions.

(5) Switch to an annuity if desired later on, whereas the choice of an annuity is irreversible.

The disadvantage to the government is that PW pensioners may withdraw more than the MPG level in the early years of retirement and become a cost to the treasury in their later years. Regulations exacerbate these effects.

*PW formula.* The PW formula for an individual pension is

Premium = 12*p*prem + EPV(UF15), where:

Premium = retiree's total accumulation

p = monthly pension, whose value is being ascertained by this formula

prem = EPV of pension that equals 1 UF monthly = $(N_x/D_x - 11/24)$

$N_x$ and $D_x$ are standard actuarial factors that depend on mortality and interest rates

EPV(UF15) = expected present value of UF15, which is the necessary capital for the funeral benefit of Chilean UF15 that must be included in all policies

In the common case of a joint withdrawal, in determining prem enough capital must be set aside to cover 60% of p for the surviving spouse, as well as p for the pensioner, so prem = $(N_x/D_x - 11/24) + .6(N_y/D_y - N_{xy}/D_{xy})$.

This is exactly the same as the formula for an actuarially fair annuity (with MWR=100%). That is, if insurance companies and AFPs use the same term structure of interest rates and mortality tables, annuities and PW will yield the same pension, $P_1$, in

year 1. A level annuity will continue to pay $P_1$ through the lifetime of the retiree and similarly, under PW there should be enough money in the worker's account to pay $P_1$ until her expected age of death, if expected investment returns are realized.

However, the PW payout is recalculated every year. Unless the investment return is much higher than expected, the PW pension in year 2 will decline, because the expected life span increases for pensioners who have survived an additional year; and so on for successive years (Figure 5). Eventually the PW pension falls below the MPG. This point comes sooner if the MPG is wage-indexed rather than price-indexed. At that point the PW formula is discarded and a pension at the MPG level is paid from the account until the accumulation is exhausted, after which the government takes over and pays the entire MPG. This means that the MPG provides longevity insurance for those who live longer than expected and investment insurance for those whose returns are lower than expected.[10] In contrast, an annuity that starts out above the MPG level will never fall below a price-indexed MPG. (The annuity may, however, eventually fall below a wage-indexed MPG, in which case the government tops it up to the incremented floor—a much smaller fiscal obligation than under PW).

The basic reason for the decline in PW relative to annuity payouts and the eventual exhaustion of accumulations under PW (even when mortality and interest rate assumptions are accurate), is that leakage to bequests outside the pool occurs for PW pensioners while all retirement savings are kept within the pool of annuitants. For annuitants the cost of high longevity individuals is covered by assets left in the annuity pool by those who die early, while when a PW pensioner dies his remaining capital goes to his heirs and does not enhance the pool for surviving pensioners.

*Additional front-loading of PW due to mortality and interest rate assumptions.* The allowable PW depends heavily on the mortality table and interest rate structure used in the calculation, and these are specified by the AFP regulator. When these are higher, the initial allowable PW payout is higher—PW becomes more front-loaded. But if these are overstated, the retiree's accumulation is used up faster than it would otherwise. This risk of exaggerated mortality and interest rates is passed on to workers and, eventually, to the public treasury.

Currently the AFP regulator requires that RV85 be used as the mortality tables for PW payouts. We showed earlier that RV85 overstates mortality rates for annuitants. The AFP Supervisor argues that it is more applicable to the PW population, which includes many low earners with low accumulations, who are forced by regulations to take PW. However, mortality data are not available for PW pensioners that would allow us (or the SAFP) to test this hypothesis. [11]

Interest rate assumptions are another key ingredient in the PW formula. Initially a 0 future return was built into the formula, but this was deemed implausible and it produced very low pension payouts. In 1987 the regulator changed this to a positive real interest rate to improve payouts—80% based on the previous year's internal rate of return on new annuities and 20% based on the AFP's average real return over the last ten years (a number that varies by AFP).[12] Since AFP returns were extremely high during the 1980's and early 1990's, while interest rates on annuities (and other investments) have been falling recently, this produces an assumed interest rate for PW that is about .5-1.0 percentage points higher than the current annuity rate. Table 6 compares the internal rate of return on annuities, the annual average rate of return on AFP and insurance company investment portfolios, the rate on the 20-year PRC bond (with a duration of about 8.5 years) and the PW interest rate assumption, between 1988-2001. We see that the twenty-year AFP average return, 1981-2001, was 10.7% and the ten-year average AFP return, 1993-2002, was 7%, while the internal rate of return on old age annuities has mostly ranged between 5 and 5.5%. All these rates have been falling in recent years, with the higher AFP returns in the past pulling up the applicable rate used to determine PW payouts.

The expected return on PW should be higher than the return on a fixed rate annuity, given that the portfolios are more risky, they are invested partially in equities, and pensioners assume some of this risk.[13] Indeed, one reason for choosing PW is its higher expected return, with the pensioner benefiting from any upside gain and protected from downside loss by the MPG. But the risk-adjusted return (to pensioner + treasury) should be the same for PW's and annuities—raising the question of whether expected or risk-adjusted return should be used in the PW formula. Additionally, this backward-looking method of imputing AFP returns may overestimate expected future returns, in a

context when interest rates in the economy are falling. Such an overestimate would increase the PW pension in the early years, but the larger withdrawal as well as the smaller investment return that is actually earned would reduce the retiree's accumulation and pension in later years—until the MPG is reached.[14]

*Incentives for accurate mortality and interest rate assumptions—AFP's vs. insurance companies.* It appears that no one (except for the treasury) has an incentive to test or change these possibly inaccurate assumptions. AFP's have no incentive to collect and analyze mortality data or to press for more forward-looking rate of return assumptions since they do not bear the longevity or investment risk. These assumptions make PW look more attractive to workers, hence keep customers in the AFP industry. Workers have no incentive to question this choice of mortality tables or interest rates since it enables them to get their money out sooner. Moreover, both workers and survivors are protected by the MPG, which cuts their potential losses from overly-optimistic assumptions. Therefore, the mortality and interest assumptions under PW continue in use, without empirical testing or political challenge, although they may eventually impose costs on the government.

The insurance regulator also uses the 1985 mortality tables to determine reserve requirements of companies selling annuities. The use of high mortality tables reduces the insurance companies' reserve requirements and equity costs. This may weaken their solvency in the long run but it increases the rate of return to owners in the short run, so they, too, are reluctant to change. However, insurance companies have the right to set their own payouts and loads and are likely to construct and use more accurate mortality tables for this purpose. Since they bear the longevity risk and will have to come up with the money when annuitants live longer than expected, they are sensitive to the dangers of overestimating mortality. Therefore, they collect their own company data on survival and deaths of annuitants and analyze data for the industry as a whole, made available by the insurance regulator (which is why data on annuitants were available to us but reliable data on PW pensioners were not available). Our discussions with insurance company managers suggest that the tables they have constructed for pricing purposes are similar to the more conservative 1998 tables. As we have seen, the observed payouts yield a money's worth ratio for normal age retirees of around 98% using RV98 period and 101%

using our cohortized version (Table 5). If companies had used the less conservative RV85 and competition kept loads low, this would have yielded higher payouts but companies might have encountered solvency problems down the road.

The fact that insurance companies bear the investment risk also gives them a strong incentive to use forward-looking market rates in setting payouts on their annuity contracts. Our money's worth calculations for 2003 compared with 1999 show that they are very responsive to changes in interest rates, adjusting payouts quickly to hold the MWR's roughly constant. Furthermore, insurance companies largely immunize themselves to unexpected changes in interest rates by matching the duration of assets and liabilities and this is encouraged by regulations;[15] but PW pensioners who must buy into an AFP portfolio designed for workers still in the accumulation stage, cannot do so.

It is quite possible that some insurance company managers will be short-sighted and make high mortality and interest rate assumptions that permit high monthly payouts, in order to maximize their business in the short run. If these companies become insolvent in the long run, many annuitants will be in serious trouble, as will the government given its partial guarantee of the annuity. However, information and regulations are designed to remedy this situation long before that point is reached. When realized investment returns and mortality rates are below the assumed rates, this raises the present value of insurance liabilities and reduces asset values. Regulations then require that additional owner-equity be placed into the reserves. This cost to owners discourages overly optimistic assumptions and encourages medium-term corrections such as the use of more realistic terms on new policies. Thus, insurance companies face incentives and regulations that induce them to improve their assumptions and limit the treasury's contingent obligations, while AFP's have no incentive (or power) to improve these assumptions.

**Which workers choose annuities versus PW at the normal retirement age?**

Among normal age retirees, who chooses to annuitize and who takes PW? We hypothesize that the biggest predictor of choice between annuities and PW is size of accumulation. In part this is due to compulsion. If the accumulation is too small to purchase an annuity at least as great as the MPG upon retirement, such workers are required to take PW with a payout equal to the MPG until they use up their accumulation,

at which point the government steps in to pay the bill. But even among those who have choice, we would expect retirees with smaller accumulations to take PW, because this maximizes their expected lifetime income without adding to their risk in the presence of the MPG, while workers with larger accumulations are relatively more likely to choose annuitization because of its insurance value.

Consider a retiree whose accumulation is just large enough to purchase an annuity at the MPG level (4.46UF). By choosing PW he maximizes his potential bequest to his heirs. In the absence of the MPG he would risk a dramatically fallilng pension for himself. But the MPG avoids this outcome. Indeed, if PW payouts are front-loaded due to higher mortality and interest rate assumptions this also gives him an initial pension (of 5.05UF) > MPG; yet his pension can never fall below MPG. Thus, he enjoys a higher expected lifetime retirement income plus a higher income to his heirs under PW than under annuitization, which gives him a constant payout = MPG (see Figure 6 and simulations in Table 12A).[16]

Ordinarily we would predict that low income workers will get substantial utility from avoiding the longevity and interest rate risk inherent in PW, and this might outweigh its higher expected income. However, the MPG completely protects this worker from the downside of investment and longevity risk—and converts this risk into a benefit. If rates of return should rise he collects the gain, while if interest rates fall the government takes over sooner (he therefore will choose the riskiest investments available). If he dies young, his heirs collect the remainder in his accounts, while if he lives long the government pays the bill. In contrast, as an annuitant he would get no front-loading in the early years, no chance at higher returns, and no bequest to heirs. Thus, he is unambiguously better off choosing PW. Importantly, this holds true regardless of whether he expects his life span to be high or low—that is, asymmetrical information about mortality does not change his choice.

In contrast, consider a pensioner whose initial accumulation is large enough to purchase an annuity that is 200% or more of the MPG. He, too, gets a larger payout in the early years from the front-loaded PW than he would from an annuity (10.09 vs. 8.92UF). And if he dies young his heirs receive the remainder in his account. However, if he lives long his PW pension eventually falls all the way to the MPG level (4.87UF after age 70 if

MPG is price-indexed), which is far less than he would have gotten as an annuitant. PW therefore maximizes his lifetime income if he expects a short life span, but annuitization maximizes it if he expects a long lifetime. And if interest rates plummet, his pension plummets under PW. Thus, this worker pays a price for his higher expected income and bequest rights in the early years—his price is the difference between his declining and volatile PW pension buttressed by the relatively low MPG in the later years versus the constant annuity he could have purchased. A wage-indexed MPG reduces this price because it raises the floor that is financed by the treasury. However, even a wage-indexed MPG that grows at 2% annually will not protect his full annuity value until he is 96 years old. Therefore, workers with large accumulations are more likely to annuitize, unless they expect to be very short-lived or are very anxious to leave bequests (Figure 7 and Table 12A).

Workers whose accumulations are large enough to finance an annuity that is between 100% and 200% of the MPG will fall somewhere in-between these two extremes. In general, a larger accumulation should lead toward annuitization and should make expected mortality rates more relevant to selection, for all the reasons given. Evidence on mortality rates among annuitants is presented in the following section.

This line of reasoning leads us to expect that most PW pensions will be clustered at or very close to the MPG, while most annuities will be well above the MPG. In fact, this is exactly what we find. The average payout among normal retirees in PW has been hovering around the MPG point since the system began (Table 7). Moreover, the vast majority of PW recipients (79% of normal old age pensioners and 77% of widows) are now at the MPG floor (Table 8). (These pensioners might have had the annuity option when they initially retired, but it is no longer available to them as their PW has fallen while the MPG level has risen). Most of these pensioners are currently drawing down their own accumulations, and once their balances are exhausted the government will step in and pay the full pension. This contrasts with annuitants, whose average payout is almost double the MPG (almost treble for the new inflow of annuitants). Three-quarters of normal old age annuitants have pensions above the MPG level (Tables 7 and 9). And among those below the MPG, only a small minority qualify for the top-up, hence are subject to moral hazard (Table 10).[17]

Overall, the majority of normal old age retirees have small accumulations and pensions in the neighborhood of the MPG. Two-thirds—the ones with the smallest payouts--take (or are force to take) PW--while one-third with much larger payouts choose annuitization. This sharp bifurcation suggests that Chilean workers are responding rationally to the incentives created by the MPG and these incentives make size of accumulation a major predictor of choice.

## III. Normal versus Early Retirement

When the Chilean system was first established, retirement age was specified as age 65 for men, 60 for women. Early retirement was also permitted—providing the accumulation met a specified minimum. Early retirement does not mean that the worker had to stop working. It simply means that he or she could stop contributing and start withdrawing. On the one hand, eliminating the mandatory contribution at an early age prevents over-saving and may increase the labor supply of older workers. But on the other hand, it may leave many early retirees with low incomes in very old age. The rising MPG may eventually overtake the pensions of early retirees, thereby imposing a potential cost on the treasury.

Early retirement conditions were stringent at the beginning of the new system, but were loosened during the 1980's. Simultaneously, regulations have given insurance companies selling annuities a competitive edge in selling annuities to early retirees. The net result is that a majority (60%) of pensioners have retired early and an overwhelming proportion of early retirees (85%) have annuitized. This mitigates but does not completely eliminate the dangers of low incomes for the very old and a high contingent public liability.

### Regulations facilitating early retirement

*Eased preconditions.* Initially early retirement was allowed only if the worker could acquire a pension that was 100% of the MPG and 70% of his own average wage over the past 10 years—a condition that was very difficult to meet. However, that situation changed in 1987, when easier conditions for early retirement were specified. By 1987 many workers had sizeable accumulations in their new accounts, due to their 10%

net contributions since 1981, real rates of return that exceeded 12% during the 1980's and recognition bonds that they received for service prior to 1981. Unemployment rates exceeded 10%, many older workers had lost their jobs, and it was difficult to deny them access to their money, especially if they became unemployed.[18] Consequently, in 1987 the replacement rate requirement was reduced to 50% of own wage but the MPG requirement was increased to 110%.[19] In making this calculation nominal wages are indexed up by price growth and months without wages are averaged in as 0's, so unemployment (whether voluntary or involuntary) helps a worker to qualify. Also, starting in 1987 employers who wished to facilitate a worker's early retirement could put extra money into his retirement account.

*Tradable bonos de reconocimiento and complements.* Early retirement, as well as the development of the annuity market more generally, was facilitated by the fact that Chile paid workers recognition bonds (bonos de reconocimiento) in return for their contributions to the old system prior to 1981.[20] Initially the bonos were illiquid until the normal retirement age, but starting in 1987 workers were allowed to sell these bonos to insurance companies as part of the premium for an early retirement annuity. In contrast, AFP's could not buy bonos until 1990, which greatly hampered their ability to compete in the early retirement market.[21] At first insurance companies had to hold the bonos until they matured at the worker's normal retirement age. In 1990 this rule was changed and workers were allowed to sell the bonos to anybody, making them tradable at the securities exchange. This produced a market value for the bonos, reduced their liquidity and political risk and raised their price. Also in 1987 government created "complements" to the bono--additional funds for affiliates who retired in the first ten years of the new pension scheme. The worker's ability to include the bono and the complement as part of the early retirement premium, and the company's ability to trade in the bono, were key regulatory choices that enhanced access to early retirement.

**Regulatory advantages to insurance companies**

*Brokers' commissions.* Besides the initial advantage insurance companies had in purchasing bonos, other regulations gave them an additional competitive edge. These pertained to pricing rules and brokers' commissions. Insurance companies have a large network of independent brokers to whom they pay sales commissions, while AFPs are

not allowed to pay commissions to independent brokers. Hence, workers who visit or are visited by a financial adviser to explore their options (as most do while considering early retirement) are likely to be steered toward insurance companies and annuities. Since brokers' commissions are usually a function of premium size, they will be most interested in marketing to retirees with large accumulations.

*Pricing rules.* Insurance companies in Chile are not permitted to charge explicit fees for annuities. Instead, they can only quote a monthly payout and must cover their costs and profits from the "spread" between rate paid to annuitants and the rate earned on a diversified portfolio of investments. We have estimated that this spread is about 1.4% per year of assets, enough to cover their costs. But this "price" is implicit and hidden, and might not even be recognized as a price by potential customers. These revenues are asset-based and rise with assets, while administrative costs tend to fall with assets, due to transactions costs associated with the MPG. Thus, workers with large accumulations are particularly attractive to insurance companies.

In contrast, regulations require that all AFP fees must be explicit. Regulations also require that the entire investment return must be passed on to the owner of the account by the AFP's. Pensioners have large assets compared with workers, but asset-based fees are ruled out. AFP's are permitted to charge fees based on new contributions during the accumulation stage (this is their major source of income), on payouts during the pension stage, and a flat fee per account. Behavioral economics tells us that labels and framing matter. It is quite possible that workers place a heavier weight on explicit fees that they see than on implicit fees that appear to be zero; they may not even be aware of the latter. In that case, pensioners would choose annuity products sold by insurance companies rather than PW pensions sold by AFP's.

Initially AFP's did not charge any fee for retirees. Since 2002, as the number of pensioners has grown, AFP's began to charge small monthly fees of 1-1.25% of payout amounts. We estimate that the monthly fee per pensioner is about one-third that per worker. Assuming that administrative costs per month are similar for the two groups, retirees are hardly covering their costs while workers are very profitable to AFP's.[22] It is somewhat puzzling that AFP's have failed to price at a more profitable level. The fact that insurance companies charge invisible implicit fees may set a low competitive limit

on the fees that AFP's can charge while staying in the market. Additionally, AFP's may fear that high fees on pensioners will call attention to the substantial profits they are already making on contributing workers, and will stimulate political backlash to control the latter. Pensioners might object to paying the AFP to get their money out, after they already paid to put it in. The outcome of these pricing regulations, political pressures and constraints on brokers commissions seems to be that AFP's have little interest in shifting contributing workers to early retirement pensioners and in marketing PW pensions.

**How do workers learn they are eligible?: marketing by insurance companies**

In contrast, insurance companies eagerly seized the opportunity to sell early retirement annuities to potential clients and lure them away from the AFP's where they were contributing affiliates. Eligibility was complicated to determine, but insurance salesmen figured this out and promptly informed qualifying workers. According to anecdotal evidence, brokers made loans to workers to put into their personal accounts, thereby enabling them to meet the eligibility criteria faster. Insurance companies handled the paperwork, bought the bono early and followed procedures to maximize the size of the allowable lump sum withdrawal. Of course, when they sold early retirement, they also sold annuities. It is widely believed that sales commissions were shared with new annuitants as unofficial rebates. To the degree that this happened, total payouts and the money's worth ratios are higher than the official numbers suggest.[23]

Marketing costs are sometimes disparaged as a pay-off to aggressive salespersons in a zero or negative-sum game. However, in this case marketing provided useful information about the early retirement regulations set by government and pushed retirees in the direction of annuitization, which minimizes risk for government. Although the Chilean life insurance industry barely existed in 1981, it now takes in premiums of more than US$1 billion annually and holds reserves exceeding $10 billion. It is practically the only example of a large life insurance industry with annuities as its major product.

**Lower MPG for early retirees**

Early retirees are not eligible for the MPG until they reach the normal retirement age. However, early retirement creates a much longer period of retirement during which the MPG will rise, thereby increasing the probability that the retiree will end up subsidized. To counter this potential cost to the public treasury, the MPG applicable to

early retirees is reduced. At the point of early retirement an actuarial factor is computed that depends on the retiree's actual age and the interest rate and mortality rate table used in determining pension payouts. The annual pension equals the total accumulation divided by the actuarial factor. At the same time, the actuarial factor is calculated as if the worker were at the normal retirement age, with the same interest rate and mortality table. This actuarial factor is about 13% higher for a male at 60 than at 65, thereby producing smaller payouts for early retirees. The MPG that may be paid some day is reduced by the proportional excess of the early factor over the later factor.[24] Part of the pension floor has been traded off to permit the option to retire early. This trade-off may deter early retirement for workers with small accumulations who expect to receive the MPG. It also adds the administrative and political complexity that a different MPG applies to each early retiree, depending on his or her age of retirement. It remains to be seen whether it is administratively feasible to keep track of this individual-specific MPG over long periods of time, and whether it is politically feasible for different people to have different pension floors, some of which may be quite low.

Thus, an adjustment is made for the denominator in the pension payout equation—the increase in actuarial factor due to the younger age when the worker retires early. But an adjustment is not made for the numerator—the decrease in size of account balance due to loss of interest and contributions that would have accrued if the money had stayed in the account for additional years. With an interest rate of 5%, the accumulation would increase by 28% by age 65 even if no additional contributions are made, and if the worker continued to contribute the increase could be 40%. His annuity or PW payout at age 65 would then be 60% greater than that at age 60. Even for workers who barely qualified for early retirement, this would largely eliminate the government's contingent liability. However, early withdrawals stop the pension growth, so the liability remains. This is discussed further in Part IV.

**Who retires early and who annuitizes?**

For workers who are eligible for early retirement, continued participation in the scheme becomes voluntary. If they choose retirement this indicates that the savings mandate was binding, at least at the margin. Even if workers want to continue saving, it would be rational for them to choose to do so in a form where the investment and payout

options are less constrained. Therefore we would expect that most workers will retire as soon as they learn they are eligible and, given the high rates of return in the 1980's and 1990's, we would expect high rates of early retirement.

These eligibility conditions are much easier for high earners than low earners to meet and for high earners the MPG floor is not binding. The MPG is about 25% of the average male wage in the economy. Workers whose own-average wage is 27.5% of the economy-wide average need a 100% replacement rate of their own-wage in order to meet the MPG requirement. This is difficult to achieve. In contrast, an average-wage male worker with a 50% own-replacement rate gets 200% of the MPG and thereby automatically meets the MPG requirement (Figure 8). We would therefore expect early retirees to have substantially higher pensions than normal retirees (who can retire at age 65 regardless of replacement rate), with pensions well above the MPG, simply because of the eligibility conditions.

In addition, we expect that insurance companies and brokers, whose fees are asset-based, will be more interested in facilitating early retirement for workers with large accumulations. Furthermore, workers with small accumulations have an incentive to postpone retirement to age 65 in order to qualify for the full MPG.[25] For all these reasons we would expect that, on average, pensions would be substantially higher for early than for normal retirees.

We would also expect a higher proportion of early retirees to annuitize: They have larger accumulations, hence receive less insurance from the MPG and, additionally, face a reduced MPG; their longer period of retirement implies greater longevity and investment risk; and they were probably "sold" on early retirement by brokers and insurance companies who simultaneously sell them annuities.

At the same time, workers with the largest accumulations are likely to take early retirement and they may choose PW because they have the greatest capacity to self-insure and may care more about bequests, as a luxury good. As a result of these forces, we would expect to find higher pension size over-all and, especially a higher PW pension size among early retirees as compared with normal retirees.

In sum, regulations around the MPG combined with insurance company marketing references of pensioners lead us to predict that:

1) a high proportion of workers will retire early,
2) this will hold true especially for workers with large accumulations,
3) most early retirees will annuitize and
4) those who don't annuitize will have relatively larger pensions among early retirees than among normal age retirees.

This is exactly what we find.

While only 6% of all retirees were early retirees in 1988, this percentage had risen to 47% in 1993 and 60% in 2002. Since the stock percentage was rising over much of this period, we can infer that the flow percentage was still higher. And 85% of these early retirees have annuitized. Among annuitants, for whom we have individual-level data, 85% of males and 58% of females retired early, 35% retired under the age of 55, and only 5% retired after 65 (Table 11). Consistent with our expectations, the average size of pension is much larger for early retirees than for normal age retirees. And PW payouts are especially larger for early than for normal retirees (Table 7). The fact that most early retirees annuitize reduces (but does not completely eliminate) the contingent risk to the public treasury.

**Does private information about expected longevity influence the annuity choice?**

Until now we have emphasized size of accumulation as a predictor of choice between annuitization and PW, in response to incentives and constraints set by regulations. This is different from the emphasis in the literature on how asymmetric information about state of health and expected longevity leads retirees to select themselves into or out of annuitization. We have already seen that, for workers with small accumulations, PW dominates regardless of expected longevity. We have also seen that early retirees are more likely to annuitize than normal retirees, in part because they have larger accumulations. But all workers with large accumulations do not annutize. Do they have private information about health that influences their choice? We cannot investigate this question directly, since we do not have reliable information on mortality of PW pensioners. However, we do have information about mortality of annuitants, so we can investigate indirect evidence of private information. In Appendix B and Appendix Tables 1 and 2 we present this evidence, which indicates annuitants do have a modest amount of short run private information--their mortality probability shortly after

annuitization is relatively low and those with relatively higher mortality in the short run are more likely to select annuities with a guaranteed payment period. Retirees with higher premiums have lower death rates and also are more likely to annuitize (but this information is not asymmetric). Thus some modest private information seems to exist, and annuitants seem to use it in a rational way.

## IV. Public Liabilities

### Simulations of public liability for alternative scenarios

The rules of the game for pension payouts, combined with marketing activities of insurance companies and brokers, have led workers with small accumulations to stay in the system until the normal retirement age and take PW, while those with larger accumulation withdraw from the system early, with annuities. This behavior, in turn, has implications for the government's contingent liability. To investigate the implications of behavior and rules on public liabilities, we simulate the pension flow for representative male workers purchasing individual pensions under different assumptions concerning payout mode, retirement age, indexation provision for MPG and size of accumulation. In each case we assume that the true mortality and interest rates are RV98 and r=5%, but the PW formula may use RV85 and r=6%. The results are presented in Tables 13A and B and 14A and B. Our main findings:

*Price-indexed vs. wage-indexed MPG.* In all cases, a price-indexed MPG leads to a much later and smaller government liability than a wage-linked MPG. Of course, a price-indexed MPG also means that average pensions (in particular, pensions at the bottom end) fall through time relative to the average wage in the economy. A wage-indexed MPG maintains the relative position of average pension and pension floor to average wage, but at a much higher cost to the government. For example, a worker who retires at age 65 with an annuity = 100% of MPG (4.46UF) receives a pension of 6.82UF at age 82 if the MPG is wage-linked but only 4.46 if it is price-indexed with no age 70 jump-up. The higher pension is financed by the public treasury. Although formally the MPG is not indexed either to wages or prices, in practice the Chilean government has increased the MPG roughly on par with wages.

*Annuitization vs. PW.* The government's contingent liability is much smaller under annuitization than under PW. Indeed, if the MPG is price-indexed (and in the absence of an age-70 jump), the public liability disappears under annuitization. Under wage-indexation the public payment sometimes begins when the retiree is in his 70's or early 80's, but the amounts involved are always small—just enough to finance the top-up due to wage-indexation and age-70 jump, while the insurance company pays the main part of the pension. In contrast, the government takes over the full pension payment for most PW pensioners by their early 80's. For example, a normal age retiree who purchases an annuity of 150% of MPG begins to get a 2% top-up at age 82, while if he chose PW he would deplete his account and be fully financed by the public treasury at age 81. This difference is due to the fact that mortality is pooled under annuitization so retirees who die before the expected age leave money in the pool to cover those who live longer, while PW pensioners who die young leave the money remaining in their accounts to their heirs, so the state must pick up the bill for those who live longer. The older the cohort and the longer its members live, the more individuals exhaust their accounts and the more it costs the government under PW compared with annuitization (Figure 9).

*Impact of overestimated mortality and interest rates for PW.* The individual's accumulation gets used up sooner and the government's liability begins earlier and is larger if interest and mortality assumptions in the PW formula are unrealistically high. The pensioner gets more at first as a result of these assumptions, but the government pays more later. The government also specifies the assumptions for the PW formula. Our simulations indicate a 1-year's difference in liability, in most cases, between RV98, r=5% and RV85, r=6%.

*Early vs. normal retirement.* Allowing workers to retire early also builds a contingent liability that could have been avoided if they had retired at the normal age. Holding the initial accumulation constant, early retirees run out of money 2-3 years sooner. Holding the pension constant—which implies a larger accumulation for early retirees--most of this incremental cost of early retirement disappears, due to the actuarial reduction in MPG that early retirees have accepted. However, the cost to the government would have been still less if workers were required to keep their money in the system until age 65. For example, a worker whose PW pension at 60 is 150% of the MPG, will

use up his account by age 78, while if he kept his money in the system until age 65 the resulting larger accumulation would finance a pension that was 50% greater and would last until age 84. From this perspective, it is fortunate that the rules of the game lead early retirees to annuitize, which counteracts—but does not completely eliminate—this opportunity cost.

*Small vs. large accumulations.* PW pensioners with small accumulations get the public benefit sooner. However, those with large accumulations also get it if they live long enough. For example, early retirees whose initial PW pension is more than 400% of the MPG (more than the average wage in the economy) end up fully financed by the government by age 87, an age that almost 30% will reach (Figure 9). In contrast, annuitants whose initial annuity exceeds 200% of the MPG will practically never qualify for the top-up. From this vantage point, it is fortunate that workers with small accumulations are encouraged to stay in the system until normal retirement age, which reduces their need for subsidy; and that workers with large accumulations face incentives to annuitize, which reduces the perverse redistributions that they would receive under PW.

**Other consequences of front-loaded private pensions and backloaded public benefit**

Level annuity payouts that begin early and PW payouts that decline collide with a pension floor that rises with wages, which means it rises as the cohort ages. This also means that the public benefit is back-loaded in the sense that the proportion of pensioners receiving a public benefit and the public/private share of total pension costs increase with the cohort's age. At age 65 no one receives the public benefit, at 70 some annuitants get a small top-up, at 80 many PW pensioners have run out of their own funds and are fully financed by the government, and by their late 80's the majority of pensioners (practically all PW recipients and many annuitants) who are still alive will receive some public benefit. This includes many whose accumulations were large enough to support a pension above the MPG level throughout their lifetimes—but who used up their money quickly through early retirement or through front-loaded PW pensions.

This rising age profile of public benefits has several important implications:

*Pension convergence as cohorts age.* Pension size will converge to the MGP level as a cohort ages. For most PW pensioners this happens in their 70's, when the MPG

constraint becomes binding on their withdrawals from their own accounts. Small and medium-sized annuitants also converge by their early and mid-80's, as the MPG rises above their constant annuity. The majority of pensioners who survive to their late 80's will be receiving the same size total pension, which equals the MPG, and the public treasury will be paying a growing share of the total cost (Figure 10).

*Redistribution targets.* The MPG was originally intended to subsidize pensions of low earners who could not accumulate enough to purchase a minimal sized pension when they retired. In fact, the subsidy does begin sooner for those with small accumulations. But it eventually reaches those with larger accumulations, especially those on PW. The public benefit ends up going to those who are fortunate enough to live long as well as well as those who are unfortunate enough to have low lifetime earnings. Workers with larger accumulations are more likely to have above-average longevity and to collect the public benefit to a later age, which partially counteracts the original redistributional intent.

*Higher death rate lowers treasury's costs.* The fact that public benefits are back-loaded rather than uniform through the cohort's age means that many retirees die before they become eligible for subsidy. For example, PW pensioners who initially purchased a pension that equaled 170% of the MPG are fully financed by the government by age 81, but only 55% of those who were alive at 65 live to 81--which reduces the expected burden they place on the treasury.

*Short run costs a poor predictor of long run costs in an immature system.* Initially, in a new system, costs of the MPG will appear negligible, because retiring cohorts are "young old" and don't yet qualify to receive the public benefit. But as the system matures and retired cohorts become "very old," total costs will escalate. Since few workers retired under Chile's new system before 1990, the oldest cohorts are now in their mid-70's and unlikely to be collecting the public benefit yet, according to our simulations. Consistent with this, data from the SAFP show that only 12% of primary PW pensioners, 23% of widow PW pensioners and 1.5% of annuitants receive the MPG subsidy today. But another 66% of PW pensioners and 54% of PW widows are in the draw-down stage where the MPG floor has become binding (Table 8). Our simulations tell us that this group will use up its savings within the next few years, after which their

pensions will be financed by the public treasury. More than half of all annuitants receive annuities that are less than 150% of the MPG and, according to our simulations, they will also move into the top-up stage as they pass age 80 over the next decade (Table 9).

The rapid increase in number of very old cohorts that is about to take place in Chile will bring about a sharp and possibly unexpected acceleration in proportion receiving the public benefit. Unfortunately, data do not seem to exist in usable form on the flow of pensioners by age and pension size that would enable a more precise calculation of these forthcoming costs and other consequences.[26] Under stylized assumptions we estimate that the MPG would require (in general revenues) the equivalent of a 2.5-3% payroll tax in a mature system. Most of this is for PW pensioners and survivors.[27] The government may fail to recognize the contingent liability and other effects that it faces down the road, and may establish rules, early access options and guarantees that would not have been offered if these had been taken into account.

It may be efficient to back-load public payouts and front-load private payouts, if the public sector has a comparative advantage in dealing with very long term risk. For example, the government may be better able than individuals to insure against unexpectedly large increases in longevity or prolonged decreases in investment earnings. But this becomes problematic if individuals have the power to make retirement choices that increase risk and shift it to the public treasury. A further danger is that the costs of bearing this risk will be non-transparent in the short term, during which excessive promises are made regarding public benefits. This underscores the importance of simulating the long-term flows from private pensions and public safety net, under different scenarios and designs, in order to enable informed choices about payout policies and trade-offs. Such simulations have not been done in the past but they are likely to become increasingly important in the future.

**How to change the age profile of private and public payouts**

How can private behavior and public benefits be changed if change is desired? How can the age profile of private benefits and the socially acceptable pension floor be brought into closer alignment? Basically, this can be accomplished in two alternative ways--decreasing the upward trajectory of public benefits or reversing the early access to private accounts. The first policy could be accomplished by measures such as:

- switching to a price-indexed MPG or, less extreme, to Swiss indexation (half wages and half prices);
- wage-indexing the initial benefit for newly retiring cohorts but price-indexing for the stock of retirees;
- eliminating the age-70 jump;
- or by a more systematic enforcement of the means test.[28]

This would gradually reduce total old age income relative to worker's income. It would cut tax costs and moral hazard but would also imply greater investment and longevity risk to future cohorts and very old retirees.

The second policy could be accomplished by a variety of means including:

- tightening access to early retirement (requiring a pension that equals 200% of the MPG would practically eliminate liability for early retirees, while keeping more accounts in the system, accumulating, until normal retirement age);[29]
- imposing an escalation formula for PW designed to match the growth in MPG (this would reverse the front-loading of PW payouts by reducing the initial payout while increasing expected future payouts, and may increase the incentive to annuitize);[30]
- requiring that PW pensions be supplemented by a deferred annuity that starts, for example, at age 78 (this is especially important for early retirees);[31]
- using up-dated cohortized mortality tables and more realistic assumptions about future interest rates in the PW formula;
- requiring that annuities contain a floor that matches the expected growth in MPG (e.g. the floor might be set at current MPG + 1% or 2% annual growth);[32]
- requiring that workers who do not have enough money to purchase an annuity at the current MPG level must annuitize in a special annuity pool, instead of taking PW; (this would eliminate the leakage to bequests that occurs now when such retirees take PW and die young).[33]

All these measures would cut tax costs and moral hazard, but would maintain the current relative position of pension floor and wage income. They would cover this floor by shifting the individual's private retirement income from early to later years. Individuals would no longer have the option of consuming above the MPG level in their

early retirement years while expecting government to pay once their pension falls below the MPG in their later years. The ability to retire early and the incentives for PW would be reduced. The treasury's contribution toward the MPG would then be reserved, to a much greater extent, for those whose earnings and contributions were insufficient to finance a lifetime pension above the minimum.

## V. Lessons for the US and Other Countries

We started out by asking: why do so many workers retire early and why do most early retirees annuitize while most normal age retirees take programmed withdrawals (PW)? We have presented evidence suggesting that guarantees plus incentives and constraints imposed by regulations are the major explanation for these observations. This is encouraging because pensioners and pension providers both seem to respond in predictable ways. When policies change, altering incentives, we can also expect behavior to change.

Workers with small accumulations are required to postpone access and retire at the normal age. They choose (or are required to take) PW to maximize their expected lifetime retirement incomes, while protected against downside risk by the MPG. Workers with large accumulations are permitted to retire early and do so—most retire well before the normal age. And since those with large pensions don't get much relevant protection from the MPG, they choose to insure through annuitization. Risk-aversion plays an important role for both groups, but they insure in different ways.

Insurance companies, which base their implicit fee on the spread between the risk-fee rate they pay annuitants and the higher rate they earn on a diversified portfolio, profit from selling annuities to retirees with large premiums and pay commissions to brokers who pursue them as customers. In contrast, AFP's, which provide PW pensions, are at a competitive disadvantage because they are not permitted to pay commissions to independent brokers and must make all their fees explicit. Moreover, AFP's are less interested in competing for these clients--possibly because they fear that charging high explicit fees would create a political backlash that would hurt their profitable business during the accumulation stage. The more aggressive selling by insurance companies

reinforces the demand for insurance among early retirees described above. It is ironical that marketing—the subject of much criticism during the accumulation stage--seems to play a socially useful role—encouraging annuitization—during the payout stage.[34] Two thirds of all retirees have annuitized and annuitization mitigates some of the risks of early retirement faced by pensioners and public treasury.

The good news for other countries is that:

- detailed policies can strongly influence the probability of early versus postponed access and in Chile have gone far toward ensuring lifelong security for workers and their spouses;
- these policies include ruling out lump sum distributions at retirement or any distributions prior to retirement, requiring price-indexed and joint pensions, limiting early retirement but permitting work without contributions after a specified accumulation level has been reached; and
- with appropriate incentives, a high proportion of pensioners will purchase annuities that provide longevity insurance and reduce fiscal liabilities.

But important caveats also emerge:

- in Chile these incentives include aggressive marketing by insurance companies and regulations that give these companies a competitive edge;
- if early withdrawal is permitted, many workers will choose that option, so early withdrawal conditions must be chosen with great care; and
- if these payout conditions are not well coordinated with safety net provisions, this may lead to moral hazard problems and unexpected public liabilities in the future.

**Appendix A—Sources of aggregate time series data on annuities and PW**

We used three aggregate data sets:

1) *the Monthly Bulletin of SVS, which is based on monthly reports submitted to SVS by each insurance company.* This is the most accurate source on annuity flows from 1991-2002 and includes information about number and average size of policies and the interest rate at which they were sold in that month. It does not provide data on PW or data on stocks of pensioners or any data prior to 1991.

2) *the quarterly report provided by insurance companies to SVS (Fecu).* This provides both flow data (number of policies sold in the quarter) and stock data (number of outstanding policies = all policies sold minus deaths) at the end of that quarter, 1985-2002. However, in recent years many insurance companies have stopped supplying Fecu with data on number of new policies sold, so the Fecu flow data are not reliable or consistent with the Monthly Bulletin after 1999. Fecu provides the most reliable stock data on annuities, but it does not provide any data on PW or break down annuities into normal retirement versus early retirement. The Fecu stock aggregates for normal + early retirement are consistent with the sum of flows from the Monthly Bulletin after 1991.

3) *the annual report from SAFP, based on quarterly information from insurance companies on annuities and from AFP's on PW pensions, 1982-2002.* This provides stock information on total number of pensions sold and their average size but it does not subtract deaths. Therefore it may overestimate the number of outstanding policies; but underreporting by companies may lead it to understate outstanding policies (see below). SAFP has the advantage that it is the most complete data set--it includes both annuities and PW (separately), from the inception of the system, and the numbers are broken down between normal old age and early retirement. For these reasons, we use these data to construct our tables on aggregate size of system by type of pension (Tables 2, 3 and 7).

However, we note that SVS reports 30-40% more annuities outstanding than SAFP. Insurance companies probably report more accurately to their own regulator, SVS. Since we have no other data source on PW, we don't know whether this is also understated by SAFP. If PW is reported accurately, this means our tables understate the proportion of annuitization by about 3 percentage points for early retirement and 6 percentage points for normal retirement.

## Appendix B. Does private information about health influence annuitization?

One of the key questions in the annuity literature is whether retiring workers possess private information about their state of health and expected longevity, that leads them to select themselves into or out of annuitization. We have already seen that, for workers with small accumulations, PW is preferable regardless of expected longevity. But what about workers with large accumulations—do they have private information that influences their choice? We cannot investigate this question directly, since we do not have reliable information on mortality of PW pensioners. However, we do have information about mortality of annuitants, so we can investigate indirect evidence of private information.

First, we hypothesize that, if private information exists, it is most likely to hold for the short run, rather than the long run. That is, individuals know more about their current state of health than their health in the distant future, and are unlikely to annuitize if they are currently ill. Therefore, we predict that 1) if private information exists, annuitants will have relatively low mortality in the first two or three years of retirement, but mortality rates eventually rise again (everyone eventually dies); we investigate how long this reduced mortality effect lasts.

Second, we hypothesize that private information may influence the type of annuity product purchased. Annuitants who think they may have short lifespans are more likely to purchase joint annuities or annuities whose payments are guaranteed for a specified period. While all married men must purchase joint annuities in Chile, the possibility of guaranteed periods is left open to individual discretion. Therefore we predict that 2) if private information exists, annuitants who acquire annuities with guarantees are likely to have higher mortality than those who purchase annuities without guarantees. Again, if private information holds mainly for the short run, this effect should be especially pronounced in the first two or three years of the annuity contract.

Finally, we investigate the relationship between size of premium and mortality among annuitants. Size of premium is likely to be positively correlated with the annuitant's lifetime income, since premiums are a function of wages. (But note that some workers with small accumulations have part of their pension rights in the old system

during this transition phase, so may be quite wealthy en toto). Lifetime income, in turn, has been found to be negatively correlated with mortality rates in other countries. Therefore we predict that 3) higher premiums will imply lower death rates among annuitants, and this is one factor that may lead pensioners with large accumulations to annuitize.

In this analysis we use the ratio of actual to expected deaths (A/E) of various groups. We observe actual deaths and use two standards—RV85 and RV98--to calculate expected deaths. This allows us to control for the differential age composition of various groups. In our discussion we concentrate on the age-specific death rates given in RV98, but we include some results for RV85, which is the regulator's standard. RV85 produces higher expected deaths and lower A/E ratios over-all, but relative positions of different groups is largely the same as for RV98. The A/E ratio for the entire population of male annuitants, 1990-2001, is 118% using RV98, 91% using RV85. The A/E for years 0+1 is 102% for RV98, 77% for RV85. Thus, A/E for the first two years of exposure is only 84-86% of the A/E for total years of exposure of the annuitant population, consistent with our expectation that private information leads to relatively low death rates of annuitants in the short run.

However, the first two years of exposure contain a disproportionate number of workers who retired in 2000 and 2001 and belong to young cohorts, while the entire annuitant population contains many workers who retired in earlier years and belong to older cohorts. If mortality has been falling over time, we could be mistaking a cohort effect for a years-of-exposure effect. To distinguish these two effects, we display the whole array of A/E by year of retirement and years of exposure, and compare the A/E for the first two years of exposure with (a) the A/E for total years of exposure, and (2) the A/E for 5 years of exposure, separately for each year of retirement (Appendix Table 1). This clearly shows the declining mortality rate through time, especially during the latter 1990's, holding years of exposure constant, and the increasing A/E as years of exposure increase, holding year of retirement constant. A/E is especially low during the first two-three years of exposure; it rises thereafter and then seems to stabilize around year 5. The ratio of A/E's for years 0+1 to year 5 or beyond is around .85-.9 for most retirement cohorts, both for RV98 and RV85. This is consistent with our prediction that some

modest amount of private information exists, it is concentrated in the short run, and unfavorable short run information is one factor that may have kept some people out of the annuity market.

We next proceed to compare the death rates for annuitants who chose products with and without guaranteed periods (Appendix Table 2). As expected, we find that A/E is less for those who purchased simple annuities, the effect is modest, and it too is concentrated in the first 2-3 years of exposure.

Finally, we compare the death rates by size of premiums. Our hypothesis is that A/E will be lower the higher the premium (Appendix Table 2). In this case we have no a priori reason to expect the differential to decrease with years of exposure. The effect turns out to be large and uniform across years of exposure. A/E decreases as premium size increases. A/E increases with years of exposure, but at the same rate for each premium size. Annuitants with premiums > 3000UF have an A/E ratio that is only two-thirds that of annuitants with premiums < 1000UF for all years of exposure. If workers had private information anticipating these mortality rates, we would expect that those with large accumulations would be more likely to annuitize, even without the incentives posed by the MPG, due to their greater longevity.

However, insurance companies have full access to information about total size of premium, since Chilean workers are required to make their entire annuity purchase from one company. Insurance companies are also well aware of the wealth-longevity correlation, perhaps even more so than individuals. Thus, the information is not asymmetrical. Then we would expect them to put retirees with large accumulations into a higher risk category with lower payout per dollar of premium, and this risk differentiation would eliminate adverse self-selection based on the wealth-longevity correlation. In fact, however, we observe the opposite—annuity purchasers with large premiums get slightly higher MWR's. This may be due to the fact that administrative costs of annuities are largely fixed (or even inversely related to size of premium, when the pension is in the neighborhood of the MPG). The higher administrative cost per dollar apparently outweighs the greater mortality of annuitants with small premiums, so on balance they get slightly inferior terms. The incentive for retirees with large accumulations to self-select themselves into annuities then remains, as a result of their cost advantage.[35]

**Appendix Table 1: A/E ratios by year of retirement and year of exposure, males, 1990-2001** (expected mortality based on RV98, except for last row)

| | Years of exposure | | | | | | Actual/expected death ratios | |
|---|---|---|---|---|---|---|---|---|
| Year of retirement | 0 | 1 | 2 | 5 | 8 | 11 | Yrs(0+1/total for cal. yr* | Yrs(0+1)/yr5 for cal. yr* |
| 1990 | 84% | 107% | 106% | 121% | 130% | 126% | 0.8. | 0.84 |
| 1991 | 124% | 116% | 133% | 137% | 126% | | 0.95 | 0.86 |
| 1992 | 105% | 111% | 114% | 120% | 124% | | 0.87 | 0.91 |
| 1993 | 89% | 116% | 121% | 119% | 120% | | 0.91 | 0.92 |
| 1994 | 93% | 117% | 124% | 124% | | | 0.88 | 0.89 |
| 1995 | 89% | 110% | 113% | 123% | | | 0.87 | 0.85 |
| 1996 | 94% | 106% | 107% | 115% | | | 0.90 | 0.90 |
| 1997 | 94% | 101% | 101% | | | | 0.93 | |
| 1998 | 98% | 104% | 99% | | | | 1.05 | |
| 1999 | 83% | 94% | 96% | | | | 0.96 | |
| 2000 | 87% | 96% | | | | | 0.97 | |
| 2001 | 66% | | | | | | 1.00 | |
| Total-RV98 | 90% | 106% | 110% | 122% | 124% | 126% | 0.86 | 0.88 |
| Total-RV85 | 68% | 80% | 83% | 93% | 96% | 101% | 0.84 | 0.87 |

* A/E ratios compare A/E for years 0+1 with A/E for year 5 and for total A/E, for each calendar year of retirement. "Total years of exposure" varies by calendar year. Year 5 holds years of exposure constant at 5; this calculation is carried out only for the experience of retirement years 1990-96, which have 5 or more years of exposure.

**Appendix Table 2: A/E ratios by type annuity and size of premium, males, 1990-2001** (expected mortality based on RV98)

| | **Years of exposure** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 5 | 7 | 9 | 10 | **# policies** |
| **By type annuity** | | | | | | | | |
| Simple | 70% | 86% | 93% | 101% | 104% | 106% | 108% | 55,325 |
| Guaranteed | 93% | 102% | 104% | 106% | 109% | 110% | 111% | 118,765 |
| A/E(simple/guarant'd) | 0.75 | 0.84 | 0.9 | 0.95 | 0.95 | 0.96 | 0.97 | 174,090 |
| **By premium size (CH UF)** | | | | | | | | |
| <1000 | 98% | 105% | 109% | 113% | 115% | 117% | 118% | 71,978 |
| 1000 - 3000 | 77% | 97% | 99% | 103% | 106% | 107% | 108% | 80,104 |
| >3000 | 64% | 59% | 65% | 72% | 75% | 78% | 79% | 22,008 |
| A/E(3000/1000) | 0.66 | 0.56 | 0.6 | 0.64 | 0.65 | 0.67 | 0.67 | 174,090 |

**Table 1**
**MPG growth in nominal and real terms, versus real wage growth, 1981-2002***

| Date MPG revised | For pensioners < age70 | | | For pensioners > age 70 | | | Real wage index (1986=100) |
|---|---|---|---|---|---|---|---|
| | Pesos (000) | UF at beginning | UF at end | Pesos (000) | UF at beginning | UF at end | |
| May 81 | 3.7 | 3.17 | 2.84 | 3.7 | 3.17 | 2.84 | 111 |
| Oct. 82 | 4.2 | 3.25 | 2.73 | 4.2 | 3.25 | 2.73 | 105 |
| May 83 | 4.9 | 3.20 | 2.71 | 5.5 | 3.56 | 3.02 | 103 |
| Jan. 84 | 5.7 | 3.12 | 2.81 | 6.0 | 3.29 | 2.96 | 106 |
| Nov. 84 | 6.8 | 3.37 | 2.81 | 7.2 | 3.55 | 2.96 | 97 |
| May 85 | 7.0 | 2.87 | 2.48 | 7.4 | 3.03 | 2.62 | 99 |
| Jan. 86 | 8.0 | 2.84 | 2.60 | 8.4 | 2.99 | 2.74 | 99 |
| July 86 | 8.7 | 2.83 | 2.47 | 9.2 | 2.98 | 2.60 | 100 |
| May 87 | 10.1 | 2.87 | 2.46 | 10.8 | 3.07 | 2.63 | 99 |
| April 88 | 11.7 | 2.85 | 2.62 | 12.5 | 3.05 | 2.80 | 104 |
| Jan. 89 | 12.8 | 2.86 | 2.69 | 13.7 | 3.06 | 2.88 | 107 |
| June 89 | 13.5 | 2.83 | 2.60 | 14.4 | 3.02 | 2.78 | 109 |
| Nov. 89 | 15.8 | 3.04 | 2.61 | 16.8 | 3.25 | 2.79 | 107 |
| July 90 | 20.9 | 3.46 | 2.95 | 22.0 | 3.64 | 3.10 | 112 |
| Feb. 91 | 24.0 | 3.39 | 3.01 | 25.3 | 3.57 | 3.17 | 118 |
| Nov. 91 | 27.8 | 3.48 | 2.99 | 29.3 | 3.67 | 3.15 | 115 |
| Dec. 92 | 32.0 | 3.44 | 3.03 | 33.7 | 3.62 | 3.20 | 123 |
| Dec. 93 | 35.8 | 3.40 | 3.12 | 37.7 | 3.58 | 3.29 | 131 |
| Dec. 94 | 39.0 | 3.40 | 3.23 | 41.1 | 3.58 | 3.40 | 138 |
| Sept 95 | 42.9 | 3.55 | 3.45 | 45.2 | 3.74 | 3.63 | 140 |
| Dec. 95 | 46.4 | 3.73 | 3.51 | 48.9 | 3.93 | 3.79 | 145 |
| Dec. 96 | 49.5 | 3.74 | 3.52 | 54.7 | 4.14 | 3.90 | 149 |
| Dec. 97 | 55.0 | 3.92 | 3.76 | 60.9 | 4.34 | 4.16 | 151 |
| Dec. 98 | 57.4 | 3.92 | 3.91 | 65.5 | 4.34 | 4.32 | 155 |
| Jan. 99 | 65.4 | 4.45 | 4.35 | 71.5 | 4.87 | 4.76 | 156 |
| Dec. 99 | 67.1 | 4.46 | 4.27 | 73.3 | 4.88 | 4.67 | 159 |
| Dec. 00 | 70.2 | 4.47 | 4.32 | 76.8 | 4.89 | 4.72 | 160 |
| Dec. 01 | 72.4 | 4.45 | 4.33 | 79.1 | 4.87 | 4.73 | 164 |
| Dec. 02 | 74.5 | 4.46 | | 81.5 | 4.87 | | 166 |
| Dec.02/May81 | | 141% | | | 154% | | 150% |

Source: MPG from Primamerica, wage index from Instiuto Nacional de Estadisticas .
* The MPG is specified in nominal pesos. It is changed on an ad hoc basis periodically. All changes are shown. The MPG for pensioners over age 70 is about 9% higher than the MPG for pensioners under age 70. Columns for UF show conversion into price-indexed Chilean currency, UF's. UF value is higher at beginning of each period, then declines as price level rises until MPG is revalued. For this reason we show UF value at beginning and end of each period. 1 UF has a constant purchasing power through time. Conversion from UF to US$ has varied from $20.84 = 1 UF in Dec. 1983 to $23.44 = 1 UF in 2002.

**Table 2: Percentage of policies that are annuitized--stock**

| | By # policies | | | By total payouts | | |
|---|---|---|---|---|---|---|
| | **Normal old age** | **Early retirement** | **Total retirement** | **Normal old age** | **Early retirement** | **Total retirement** |
| **1983** | .2% | | .2% | .3% | | .3% |
| **1984** | .5% | | .5% | 1% | | 1% |
| **1985** | 1% | | 1% | 15% | | 15% |
| **1986** | 17% | | 17% | 34% | | 34% |
| **1987** | 27% | | 27% | 50% | | 50% |
| **1988** | 29% | 99% | 33% | 51% | 99% | 57% |
| **1989** | 27% | 99% | 38% | 45% | 97% | 56% |
| **1990** | 29% | 99% | 43% | 49% | 97% | 64% |
| **1991** | 28% | 94% | 51% | 42% | 87% | 63% |
| **1992** | 27% | 90% | 53% | 37% | 78% | 60% |
| **1993** | 27% | 88% | 55% | 37% | 77% | 61% |
| **1994** | 26% | 82% | 54% | 34% | 66% | 55% |
| **1995** | 25% | 77% | 54% | 33% | 61% | 52% |
| **1996** | 27% | 79% | 57% | 37% | 65% | 56% |
| **1997** | 29% | 80% | 59% | 39% | 66% | 57% |
| **1998** | 31% | 85% | 63% | 44% | 77% | 67% |
| **1999** | 34% | 84% | 64% | 46% | 76% | 66% |
| **2000** | 33% | 85% | 63% | 44% | 73% | 64% |
| **2001** | 33% | 85% | 64% | 45% | 75% | 66% |
| **2002** | 34% | 85% | 64% | 46% | 77% | 68% |

Source: calculated by authors from Primamerica data (obtained from SAFP).

**Table 3: Percentage of total retirement policies that are early retirement, 1983-2002**

| | By # of policies | | By payout amounts | |
|---|---|---|---|---|
| | Total number (000) | % early retirement | Total payouts (CH UF 000) | % early retirement |
| **1983** | 0.4 | 0 | 1.2 | 0 |
| **1984** | 1.7 | 0 | 5.6 | 0 |
| **1985** | 2.7 | 0 | 8.2 | 0 |
| **1986** | 4.8 | 0 | 17.5 | 0 |
| **1987** | 8.0 | 0 | 30.4 | 0 |
| **1988** | 12.6 | 6% | 58.2 | 13% |
| **1989** | 19.7 | 14% | 105.3 | 22% |
| **1990** | 29.7 | 20% | 166.1 | 30% |
| **1991** | 45.5 | 34% | 312.8 | 47% |
| **1992** | 62.1 | 42% | 459.7 | 55% |
| **1993** | 80.0 | 47% | 606.2 | 60% |
| **1994** | 104.2 | 51% | 857.0 | 64% |
| **1995** | 125.7 | 56% | 1039.7 | 67% |
| **1996** | 142.2 | 57% | 1182.4 | 69% |
| **1997** | 160.7 | 58% | 1356.3 | 69% |
| **1998** | 177.4 | 60% | 1405.8 | 70% |
| **1999** | 199.0 | 59% | 1665.8 | 69% |
| **2000** | 227.0 | 59% | 1972.7 | 69% |
| **2001** | 252.6 | 59% | 2235.7 | 69% |
| **2002*** | 261.7 | 60% | 2306.2 | 69% |

Source: calculated by authors from Primamerica data (obtained from SAFP).
*includes policies issued as of June 2002.
1 UF has a constant purchasing power through time. Conversion from UF to US$ has varied from $20.84 = 1 UF in December 1983 to $23.44 = 1 UF in 2002. Therefore, retirement payouts in 2002 totalled US$67.7 million.

**Table 4: Actual/expected deaths among annuitants, RV85 vs. RV98, 1990-2001**

| Mortality tables (period) | Men-normal old age | | Women-normal old age | |
|---|---|---|---|---|
| | **1990-2001** | **1997-2001*** | **1990-2001** | **1997-2001*** |
| **RV85** | 87% | 75% | 70% | 64% |
| **RV98** | 105% | 93% | 90% | 85% |
| | **Men-early retirement** | | **Women-early retirement** | |
| **RV85** | 93% | 76% | 73% | 61% |
| **RV98** | 123% | 103% | 99% | 83% |

Source: Calculations by actuary Jorge Lillo and authors based on individual-level data on all annuitants supplied by SVS
Signifies cohorts retiring 1997-2001.

**Table 5: Money's Worth Ratios, Chile**

**A. March, 2003 payouts and term structure for premium = 1,000UF, using risk-free rate; comparing impact of different mortality tables and annuity products**

| Product | Monthly payout | MWR using RV 98, period | MWR using cohortized RV98* | MWR using regulators' period, RV85 |
|---|---|---|---|---|
| **Males** | | | | |
| **Age 65, SPIA** | 7.08 | 98.1 | 101.2 | 93.5 |
| **Age 55, SPIA** | 5.46 | 94.1 | 97.6 | 90.1 |
| **Joint, male 65 & female 60, 60% to survivor** | 5.89 | 97.7 | 100.8 | 94.6 |
| **Joint, male & female 55, 60% to survivor** | 4.82 | 91.6 | 94.6 | 89.1 |
| **Females** | | | | |
| **Age 60, SPIA** | 5.37 | 92.5 | 95.8 | 89.7 |
| **Age 55, SPIA** | 4.81 | 89.9 | 92.9 | 87.4 |

**B. MWR compared under different discount rates, size premiums and time periods, using RV98 cohortized mortality tables**

| Product | 1,000 UF premium, risky rate | 4,000 UF premium, risk-free rate | 1999 payouts for 1,000 UF premium | MWR for 1999 payouts & 1999 risk-free rates |
|---|---|---|---|---|
| **Males** | | | | |
| **Age 65, SPIA** | 90.5 | 101.3 | 8.20 | 100.8 |
| **Age 55, SPIA** | 87.9 | 99.9 | - | - |
| **Joint, male 65 & female 60, 60% to survivor** | 88.3 | 102.5 | 7.31* | 102.9* |
| **Joint, male & female 55, 60% to survivor** | 82.1 | 98.9 | - | - |
| **Females** | | | | |
| **Age 60, SPIA** | 84.5 | 99.2 | 7.23* | 99.3* |
| **Age 55, SPIA** | 81.0 | 97.7 | - | - |

Source: Calculations by authors. For further details see text.

*Notes: Annuity quotes were obtained on March 31, 2003 from 4 companies and average payouts were used. We obtained quotes for two sizes of premiums—100,000 and 400,000. Similar procedure was used in March 1999 in Panel B (see James, Song and Vittas 2001).

Term structure of risk-free rates for March 2003 was based on zero coupon bonds issued by the Central Bank. As these are thinly traded, we used transactions that took place on different days of March 2003, not only March 31. Risk-free term structure for March 1999 was extracted from PRC bonds of different durations, as 0 coupon bonds were not in use at that time. We defined risky rate = risk-free rate+1.4%, which is approximately the rate of return on invesemtnes by insurance companies.

All mortality tables used in Chile are period tables. We "cohortized" the 1998 period table by imputing the improvement factor used by Canadian Society of Actuaries.

**Table 6: Rate of return on PW, annuities, insurance company and AFP investments, 1993-2002 (in %)**

| | Average annuity rate | Insurance company investment return* | Rates of return on 20 year PRC | Average AFP returns | Average PW rate | PW rate minus annuity rate | Investment return minus annuity rate |
|---|---|---|---|---|---|---|---|
| **1993** | 5.16 | 7.48 | 6.81 | 16.7 | 6.7 | 1.5 | 2.33 |
| **1994** | 4.76 | 9.63 | 5.88 | 17.8 | 7.1 | 2.3 | 4.88 |
| **1995** | 4.83 | 6.13 | 6.11 | -2.5 | 7.4 | 2.6 | 1.30 |
| **1996** | 5.09 | 4.84 | 6.11 | 3.3 | 6.4 | 1.3 | -0.26 |
| **1997** | 5.01 | 5.88 | 6.31 | 4.8 | 6.3 | 1.3 | 0.87 |
| **1998** | 5.57 | 4.74 | 7.18 | -1.6 | 6.1 | .5 | -0.83 |
| **1999** | 5.31 | 8.25 | 6.45 | 16.6 | 6.3 | 1.0 | 2.94 |
| **2000** | 5.37 | 5.76 | 6.4 | 4.6 | 6.4 | 1.0 | 0.39 |
| **2001** | 5.26 | 6.89 | 5.52 | 7.2 | 6.2 | .9 | 1.63 |
| **2002*** | 5.25 | 6.56 | 4.84 | 2.5 | 5.6 | .3 | 1.31 |
| **Av.** | 5.16 | 6.62 | 6.16 | 7.0 | 6.5 | 1.3 | 1.46 |

Source: Primamerica data base
Notes: 20 yr AFP average real returns, 1981-2001 = 10.7%;
2003 annuity rate was 5.2% and PW rate was 5.6%
Investment returns includes realized capital gains but not unrealized capital gains.

**Table 7: Average monthly payout per pensioner from annuities and programmed withdrawals, in Chile, 1983-2002** (in Chilean UFs)*

| | Normal old age | | | | Early retirement | | |
|---|---|---|---|---|---|---|---|
| **Year** | **Annuities-flow** | **Annuities-stock** | **PW -stock** | **PW-MPG (>age 70)** | **Annuities-flow** | **Annuities-stock** | **PW-stock** |
| 1983 | | 3.7 | 2.9 | -.66 | | | |
| 1984 | | 8.5 | 3.2 | -.09 | | | |
| 1985 | | 8.4 | 2.8 | -.23 | | | |
| 1986 | | 7.3 | 2.9 | -.09 | | | |
| 1987 | | 7.0 | 2.6 | -.47 | | | |
| 1988 | | 7.7 | 3.0 | -.05 | | 9.4 | 12.9 |
| 1989 | | 7.9 | 3.7 | .64 | | 8.2 | 20.5 |
| 1990 | | 8.2 | 3.4 | -.24 | | 8.4 | 17.9 |
| 1991 | | 8.3 | 4.3 | .83 | | 8.6 | 15.8 |
| 1992 | | 8.0 | 4.6 | .78 | | 8.4 | 15.6 |
| 1993 | 8.1 | 7.7 | 4.5 | .92 | 8.6 | 8.4 | 13.5 |
| 1994 | 7.7 | 7.8 | 5.0 | 1.42 | 8.3 | 8.3 | 14.8 |
| 1995 | 7.3 | 7.9 | 5.2 | 1.46 | 7.9 | 8.1 | 14.5 |
| 1996 | 9.3 | 8.3 | 4.9 | .76 | 9.2 | 8.2 | 13.3 |
| 1997 | 9.1 | 8.3 | 5.0 | .66 | 9.2 | 8.2 | 13.6 |
| 1998 | 10.9 | 8.6 | 4.6 | 1.26 | 10.9 | 8.4 | 10.7 |
| 1999 | 11.6 | 8.7 | 4.9 | .03 | 11.4 | 8.7 | 11.3 |
| 2000 | 11.0 | 8.8 | 5.2 | .31 | 10.9 | 8.9 | 14.1 |
| 2001 | 12.4 | 9.1 | 5.2 | .33 | 10.8 | 9.1 | 13.7 |
| 2002* | 12.4 | 9.3 | 5.2 | .33 | 11.6 | 9.3 | 12.4 |

Source: Calculated by authors from SVS data for flows and SAFP data for stocks.
*UF is the price-indexed Chilean currency. 1 UF has a constant purchasing power through time. Conversion from UF to US$ has varied from US$20.84 = 1 UF in 1983 to US$23.44 = 1U in 2002. Therefore, average monthly payout for new annuities in 2002 was US$291.

**Table 8: Actual PW payouts compared with MPG, May 31, 2003 (in 000)**

| | **Receiving MPG from govt.** | | **Increasing PW to MPG floor** | | **Following PW formula** | | **Voluntary reduction** | | **Total** | | **% at MPG (1+2)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. (000) | Av. UF | No. (000) | Av. UF. | No. (000) | Av. UF | No. (000) | Av. UF | No. (000) | Av. UF | |
| Normal old age | 9.1 | 4.72 | 49.0 | 4.38 | 15.0 | 7.26 | 0.8 | 6.74 | 73.9 | 5.04 | 79% |
| Early retirement | 0 | 0 | 3.2 | 4.38 | 13.0 | 14.85 | 1.2 | 14.38 | 13.8 | 12.9 | 18% |
| widows | 7.6 | 4.18 | 18.3 | 3.48 | 6.7 | 6.16 | 0.8 | 7.86 | 33.4 | 4.29 | 77% |
| orphans | 4.3 | 0.66 | 13.5 | 0.68 | 8.5 | 2.93 | 1.4 | 2.7 | 27.7 | 1.47 | 64% |

Source: data provided by SAFP and calculations by authors

This table shows number of pensioners and their survivors who already receive the full MPG from the government (col. 1); those who are still drawing down their own accumulations but at an accelerated rate in order to stay above the MPG floor (col. 2); those who are following the PW formula above the MPG level (col. 3); and those who have voluntary reduced their payouts, perhaps for tax reasons, while remaining above the MPG (col. 4). % whose current pensions are at MPG level is given in final column. This table applies only to PW pensioners.

**Table 9: Distribution of annuities by pension size**

| Monthly payout (UF) | Men-normal | Men-ER | Women-normal | Women-ER | Total |
|---|---|---|---|---|---|
| < 4 | 4,102 | 12,418 | 1,839 | 2,063 | 20422 |
| 4 - 4.5 | 3,363 | 14,722 | 1,497 | 2,569 | 22151 |
| 4.5 - 5 | 3,041 | 14,674 | 1,576 | 2,450 | 21741 |
| *Sum of <5* | *10,506* | *41,814* | *4,912* | *7,082* | 64314 |
| 5 - 7.5 | 6,969 | 39,544 | 4,476 | 6,966 | 57955 |
| 7.5 - 10 | 2,906 | 19,051 | 2,505 | 3,699 | 28161 |
| 10 - 15 | 2,589 | 20,661 | 3,070 | 3,589 | 29909 |
| 15 & more | 4,559 | 25,491 | 2,644 | 2,975 | 35669 |
| **Total** | 27,529 | 146,561 | 17,607 | 24,311 | 216008 |

| Monthly payout (UF) | Men-normal | Men-ER | Women-normal | Women-ER | Total |
|---|---|---|---|---|---|
| < 4 | 15% | 8% | 10% | 8% | 9% |
| 4 - 4.5 | 12% | 10% | 9% | 11% | 10% |
| 4.5 - 5 | 11% | 10% | 9% | 10% | 10% |
| *Sum of <5* | *38%* | *29%* | *28%* | *29%* | *30%* |
| 5 - 7.5 | 25% | 27% | 25% | 29% | 27% |
| 7.5 - 10 | 11% | 13% | 14% | 15% | 13% |
| 10 - 15 | 9% | 14% | 17% | 15% | 14% |
| 15 & more | 17% | 17% | 15% | 12% | 17% |
| **Total** | 100% | 100% | 100% | 100% | 1 |

Source: calculated by authors from data on all annuitants provided by SVS
Note: Current MPG=4.46UF, or 4.87UF for pensioners > age70. This table does not include PW pensioners.

**Table 10: Number of old age annuitants who receive MPG top-up**
(December of each year)

| Year | Annuitants receiving MPG |
|---|---|
| 1990 | 0 |
| 1991 | 10 |
| 1992 | 20 |
| 1993 | 46 |
| 1994 | 50 |
| 1995 | 50 |
| 1996 | 218 |
| 1997 | 557 |
| 1998 | 940 |
| 1999 | 2642 |
| 2000 | 3155 |
| 2001 | 3724 |
| 2002 | 3825 |

**Source: SAFP**

**Table 11: Age at which current stock of annuitants retired from the system***

| | Men | | Women | |
|---|---|---|---|---|
| | **# (000)** | **%** | **# (000)** | **%** |
| **<50** | 15.4 | 9% | 4.2 | 10% |
| **50<55** | 46.0 | 26% | 10.1 | 24% |
| **55<60** | 53.3 | 31% | 9.9 | 24% |
| **60** | 9.0 | 5% | 10.1 | 24% |
| **>60<65** | 22.9 | 13% | 5.7 | 14% |
| **65** | 18.2 | 10% | .5 | 1% |
| **>65<70** | 7.3 | 4% | 1.1 | 3% |
| **70+** | 2.1 | 1% | .4 | 1% |
| **Total** | 174.1 | 100% | 41.9 | 100% |
| **% early retirem't** | | 85% | | 58% |
| **% 60 or below** | | 71% | | 82% |
| **% above age 65** | | 5% | | 4% |

Source: calculated by Jorge Lillo from SVS data

* This does not mean that they retire from the labor force; only that they stop contributing and start withdrawing.

**Table 12A: Simulations: Annuity payouts compared with PW payouts under different scenarios, normal retirement at age 65**
(RV98 is assumed to give actual mortality rates and real interest rate earned = 5%).

| Accumulation at 65 (CH UF) | Annuity at 65 in CH UF* (%MPG) | PW payout at 65 (CH UF) | Lowest PW payout (CH UF) | Ages PW>annuity | Ages annuity>PW |
|---|---|---|---|---|---|
| **No MPG, payouts based on RV98, r=5%** | | | | | |
| 597 | 4.46 (100%MPG) | 4.46 | =>0 | never | 66 on |
| **Price-indexed MPG, payouts based on RV98, r=5%** | | | | | |
| 597 | 4.46 (100%MPG) | 4.46 | 4.46 | never | never |
| **Price-indexed MPG, PW payouts based on RV85, r=6%** | | | | | |
| 597 | 4.46 (100%MPG) | 5.05 | 4.46 | 65-68 | never |
| 895 | 6.69 (150%MPG) | 7.57 | 4.87 | 65-68 | 69 on |
| 1193 | 8.92 (200%MPG) | 10.0F | 4.87 | 65-68 | 69 on |
| **Wage-linked MPG, PW payouts based on RV85, r=6%** | | | | | |
| 597UF | 4.46 (100%MPG) | 5.05 | 4.73 | 65-68 | never |
| 895UF | 6.69 (150%MPG) | 7.57 | 5.71 | 65-68 | 69-81 |
| 1193UF | 8.92 (200%MPG) | 10.09 | 6.18 | 65-68 | 69-95 |

Source: calculations by authors

* Annuity is constant except that under wage-linked MPG annuity is topped up to rising MPG beginning at ages 66, 82 and 96, respectively, for different initial accumulations. We define wage-linked as a 2% annual growth rate in MPG. Public benefit jumps 9% at age 70 in either case.

**Table 12B: Simulations: Annuities payouts compared with PW payouts under different scenarios, early retirement at age 60**
(RV98 is assumed to give actual mortality rates and real interest rate earned = 5%).

| Accumulation at 60 (CH UF) | Annuity payout at 60 in CH UF* (%MPG) | PW Payout at 60 (CH UF) | Lowest PW payout (CH UF) | Ages PW>annuity | Ages annuity>PW |
|---|---|---|---|---|---|
| **Price-indexed, payouts based on RV98, r=5%** | | | | | |
| 742 | 4.91 (110%MPG) | 4.91 | 4.24 | never | 61 on |
| **Price-indexed MPG, payouts based on RV85, r=6%** | | | | | |
| 742 | 4.91 (110%MPG) | 5.6 | 4.24 | 60-66 | 67 on |
| 1013 | 6.69 (150%MPG) | 7.64 | 4.24 | 60-66 | 67 on |
| 1350 | 8.92 (200%MPG) | 10.19 | 4.24 | 60-66 | 67 on |
| **Wage-linked MPG, payouts based on RV85, r=6%** | | | | | |
| 742 | 4.91 (110%MPG) | 5.6 | 4.94 | 60-75 | never |
| 1013 | 6.69 (150%MPG) | 7.64 | 5.94 | 60-65 | 66-83 |
| 1350 | 8.92 (200%MPG) | 10.19 | 6.18 | 60-65 | 66-97 |

Source: calculations by authors

* Annuity is constant except that under wage-linked MPG, annuity is topped up to rising MPG at ages 70, 84 and 98, respectively. We define wage-linked as a 2% annual growth rate in MPG. Public benefit jumps 9% at age 70 in either case.

**Table 13A: Simulations of private and public benefits for annuitants under normal retirement at age 65** (interest rate = 5%, mortality assumptions based on RV98)

| **Accumulation at age 65 in CH UF** | **Pension at 65 in CH UF (%MPG$_{65}$)** | **Age MPG> annuity (public top-up begins)** | **Prob. of surviving to collect pub. ben. (exp. yrs. collecting)** | **Public benefit/ total pension at age 82** | **Total pension at age 82 in CH UF (%MPG$_{82}$)** |
|---|---|---|---|---|---|
| **Price-indexed MPG** | | | | | |
| 597 | 4.46 (100% MPG) | 70 | 90% (13) | 8% | 4.87 (100%MPG) |
| 895 | 6.69 (150% MPG) | never | 0 | 0 | 6.69 (137%MPG) |
| 1193 | 8.92 (200% MPG) | never | 0 | 0 | 8.92 (183%MPG) |
| **Wage-linked MPG** | | | | | |
| 597 | 4.46 (100% MPG) | 66 | 98% (16) | 35% | 6.82 (100%MPG) |
| 895 | 6.69 (150% MPG) | 82 | 51% (6) | 2% | 6.82 (100%MPG) |
| 1193 | 8.92 (200% MPG) | 96 | 5% (2) | 0 | 8.92 (131%MPG) |

Source: simulations by authors

This table shows how pension under annuity varies depending on whether price or wage indexation of MPG is assumed. In the past MPG has risen roughly on par with wages. We define "wage-indexation" as a projected growth in real MPG of 2% annually. MPG jumps 9% at age 70 in either case. Col. 1 shows accumulation when worker retires at age 65 and col. 2 shows real annuity this purchases. Three different accumulations are shown that finance annuities = 100%, 150% and 200% of MPG at age 65. Col. 3 shows age when MPG rises above fixed annuity (due to age 70 jump-up and wage indexation) so public top-up begins. Col. 4 shows probability at age 65 that pensioner will survive to age when he begins collecting MPG top-up (and number of years he expects to live after that point, contingent on surviving to that point). Col. 5 shows percentage of total pension paid by government at age 82, which is the expected lifetime of male at age 65 under RV98. Col. 6 shows total pension at age 82 (when wage-linked MPG=6.82UF) and total pension as percentage of MPG at age 82. Calculations are for individual annuity for single male.

**Table 13B: Simulations of private and public benefits for PW under normal retirement at age 65**
(RV 98 assumed to give true mortality rates and real interest rate earned=5%)

| Accumulation at 65 in CH UF | PW/annuity pension at 65 (%MPG) | Age MPG becomes binding | Age acct. bal=0, public benefit begins | Prob. surviving to collect public ben. (exp. yrs. collecting) | Public benefit/ total pension at age 82 | Total PW pension at 82/pension at 65 in CH UF | PW/ annuity at age 82 (%$MPG_{82}$) |
|---|---|---|---|---|---|---|---|
| **No MPG, PW formula based on RV98, r=5%** | | | | | | | |
| 597 | 4.46/4.46UF | NA | never | 0 | 0 | 2.32/4.46 | 2.33/4.46UF |
| **Price-indexed MPG, PW formula based on RV98, r=5%** | | | | | | | |
| 597 | 100/100% | 65 | 79 | 63% (8) | 100% | 4.87/4.46 | 100/100% |
| **Price-indexed MPG, PW formula based on RV85, r=6%** | | | | | | | |
| 597 | 113/100% | 69 | 78 | 67% (8) | 100% | 4.87/5.05 | 100/100% |
| 895 | 170/150% | 76 | 83 | 47% (6) | 0 | 4.87/7.57 | 100/137% |
| 1193 | 226/200% | 80 | 86 | 34% (5) | 0 | 4.87/10.09 | 100/183% |
| 2386 | 456/400% | 87 | 91 | 17% (3) | 0 | 7.94/20.19 | 163/366% |
| Wage-linked **MPG, PW formula based on RV85, r=6%** | | | | | | | |
| 597 | 113/100% | 68 | 77 | 70% (9) | 100% | 6.82/5.05 | 100/100% |
| 895 | 170/150% | 73 | 81 | 55% (7) | 100 | 6.82/7.57 | 100/100% |
| 1193 | 226/200% | 77 | 84 | 43% (5) | 0 | 6.82/10.09 | 100/131% |
| 2386 | 456/400% | 84 | 88 | 27% (4) | 0 | 7.94/20.19 | 116/262 |

Col. 1 shows accumulation when worker retires at age 65. Four different accumulations are shown, that are large enough to finance annuities = 100%, 150%, 200% and 400% of initial MPG. Col. 2 shows initial PW/annuity payout as % of MPG at age 65. Col. 3 shows age when MPG constraint becomes binding, although pension is still paid by drawing down individual's account. Col 4shows age at which account balance=0 under PW, so public benefit begins. Col. 5 shows probability of survival at age 65 to the age at which public benefit begins. Number in parentheses gives expected years of future lifetime after that point, contingent on surviving to that point. Col.6 shows percentage of total pension paid by government at age 82, which is expected lifetime of male at age 65 under RV98. Col. 7 shows total pension at age 82 (when wage-linked MPG=6.82UF)/initial pension. Col 8 shows PW/annuity payout as % of MPG at age 82. Calculations are for individual PW for single male. Price and wage indexation scenarios are given; in the past MPG has risen roughly on par with wages. We define "wage-indexation" as a projected growth in real MPG of 2% annually. MPG jumps 9% at age 70 in either case.

**Table 14A: Simulations of private and public benefits for annuitants under early retirement at 60** (interest rate = 5%, mortality assumptions based on RV98)

| **Accumulation at age 60 (CH UF)** | **Pension at 60 in CH UF (%$MPG_{60}$)** | **Age MPG > annuity (public benefit begins)** | **Prob. at 60 of collecting pub. ben. (exp. yrs. collecting)** | **Public benefit/ total pension at age 82** | **Total pension at 82 in CH UF (% full $MPG_{82}$)** |
|---|---|---|---|---|---|
| **Price-indexed MPG** | | | | | |
| 742 | 4.91 (110% MPG) | never | 0 | 0 | 4.91 (101% MPG) |
| 878 | 5.8 (130%MPG) | never | 0 | 0 | 5.88 (119% MPG) |
| **Wage-linked MPG** | | | | | |
| 742 | 4.91 (110% MPG) | 70 | 85% (13) | 25% | 6.55 (87% MPG) |
| 878 | 5.8 (130%MPG) | 76 | 69% (9) | 11% | 6.55 (87% MPG) |
| 1013 | 6.69 (150% MPG) | 84 | 40% (5) | 0 | 6.69 (89% MPG) |
| 1350 | 8.92 (200% MPG) | 98 | 3% (2) | 0 | 8.92 (118% MPG) |

Source: simulations by authors

This table shows how pension under early retirement annuity varies depending on whether price or wage indexation of MPG is assumed. In the past MPG has risen roughly on par with wages. We define "wage-indexation" as a projected growth in real MPG of 2% annually. MPG jumps 9% at age 70 in either case. Relevant MPG for early retirement at age 60 is 87% of full MPG. Col. 1 shows accumulation when worker retires at age 65 and col. 2 shows real annuity this purchases. Four different accumulations are shown that finance annuities = 110% (which is the minimum for early retirement), 130% (which will become the new minimum), 150% and 200% MPG. Col. 3 shows age when MPG rises above fixed annuity (due to age 70 jump-up and wage indexation) so public top-up bewgins. Col. 4 shows probability at age 60 that pensioner will survive to age when he begins collecting MPG top-up (and number of years he expects to live after that point, contingent on surviving to that point). Col. 5 shows percentage of total pension paid by government at age 82, which is expected lifetime of male at age 65 under RV98. Col. 6 shows total pension at age 82 (when full wage-linked MPG = 6.82 and reduced MPG for early retiree =6.55UF). Calculations are for individual annuity for single male.

**Table 14B: Simulations of private and public benefits for PW under early retirement at age 60**
(RV 98 assumed to give true mortality rates and real interest rate earned=5%)

| Accumu-lation at 65 in CH UF | PW/annuity pension at age 60 (%MPG) | Age MPG becomes binding | Age acct bal= 0, public benefit begins | Prob. surviving to collect public ben. (exp. yrs. collecting) | Public benefit/ total pension at age 82 | Total PW pension at 82/ pension at 60 in CH UF | PW pension/ annuity at age 82 (%MPG) |
|---|---|---|---|---|---|---|---|
| **No MPG, PW formula based on RV98, r=5%** | | | | | | | |
| 742 | 4.91/4.46UF | NA | never | 0 | 0 | 2.33/4.91 | 2.33/4.91 |
| **Price-indexed MPG, PW formula based on RV98, r=5%** | | | | | | | |
| 742 | 110/110% | 69 | 80 | 55% (7) | 100% | 4.24/4.91 | 87/101% |
| **Price-indexed MPG, PW formula based on RV85, r=6%** | | | | | | | |
| 742 | 126/110% | 69 | 79 | 59% (8) | 100% | 4.24/5.6 | 87/101% |
| 878 | 148/130% | 71 | 81 | 52% (7) | 100% | 4.24/6.62 | 87/119% |
| 1013 | 171/150% | 74 | 82 | 48% (6) | 100% | 4.24/7.64 | 87/137% |
| 1350 | 228/200% | 78 | 85 | 36% (5) | 0 | 4.87/10.19 | 100/183% |
| 2700 | 456/400% | 82 | 87 | 29% (4) | 0 | 7.07/20.37 | 145/366% |
| Wage-linked **MPG, PW formula based on RV85, r=6%** | | | | | | | |
| 742 | 126/110% | 66 | 76 | 69% (9) | 100% | 6.55/5.6 | 87/87% |
| 878 | 148/130% | 69 | 78 | 63% (8) | 100% | 6.55/6/62 | 87/87% |
| 1013 | 171/150% | 70 | 79 | 59% (8) | 100% | 6.55/7.64 | 87/89% |
| 1350 | 228/200% | 74 | 82 | 48% (6) | 100% | 6.55/10.19 | 87/118% |
| 2700 | 456/400% | 82 | 87 | 29% (4) | 0 | 7.07/20.37 | 94/237% |

Source: simulations by authors
Columns and rows are same as Table 12B except that retirement age is 60, smallest accumulation yields annuity = 110% of MPG (minimum needed for early retirement) and MPG is reduced 13% because of early retirement adjustment (proportional to reduction in actuarial factor). Therefore benefit at age 82 is less than full MPG and less than normal age retiree gets. Early retirees draw down their accounts at the full MPG level until their balances are 0, at which point the government begins paying at the reduced MPG level.

**Figure 1: MPG growth tracks real wage growth** (all indices = 111 in 1981)

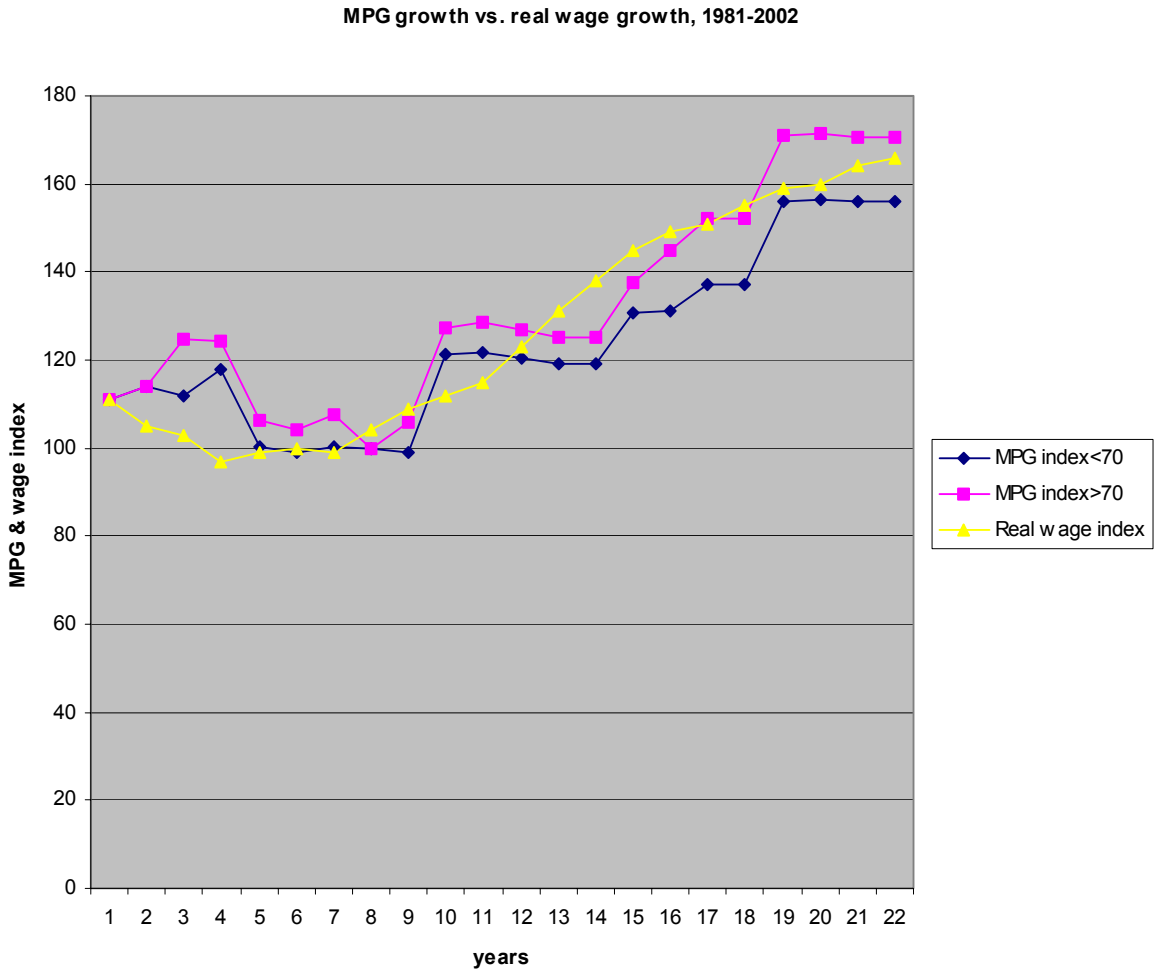


**Figure 2: Proportion of policies that are annuitized is much higher for early than for normal retirees, 1988-2002**

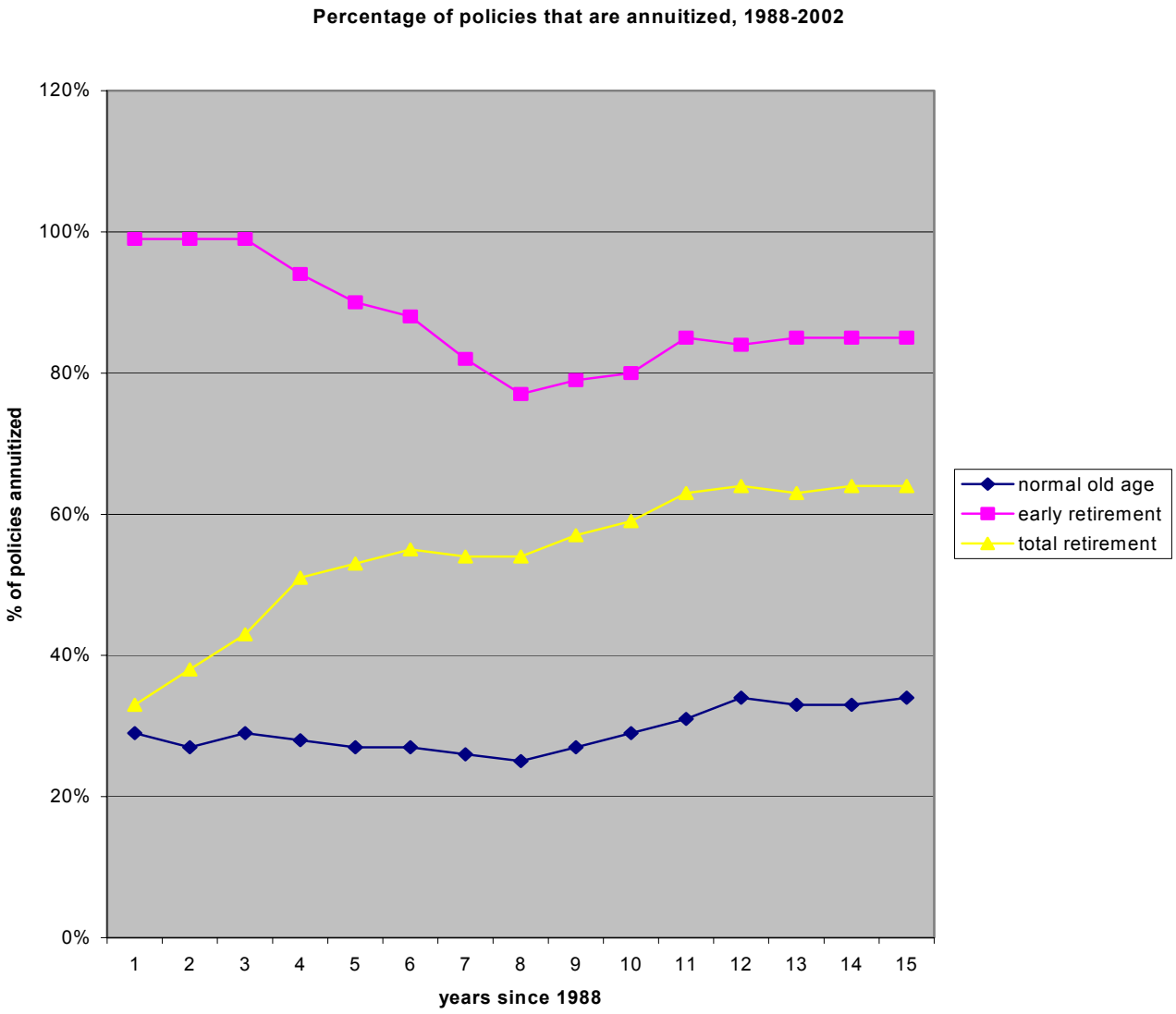


**Figure 3: Proportion of pensioners who retired early, 1988-2002**

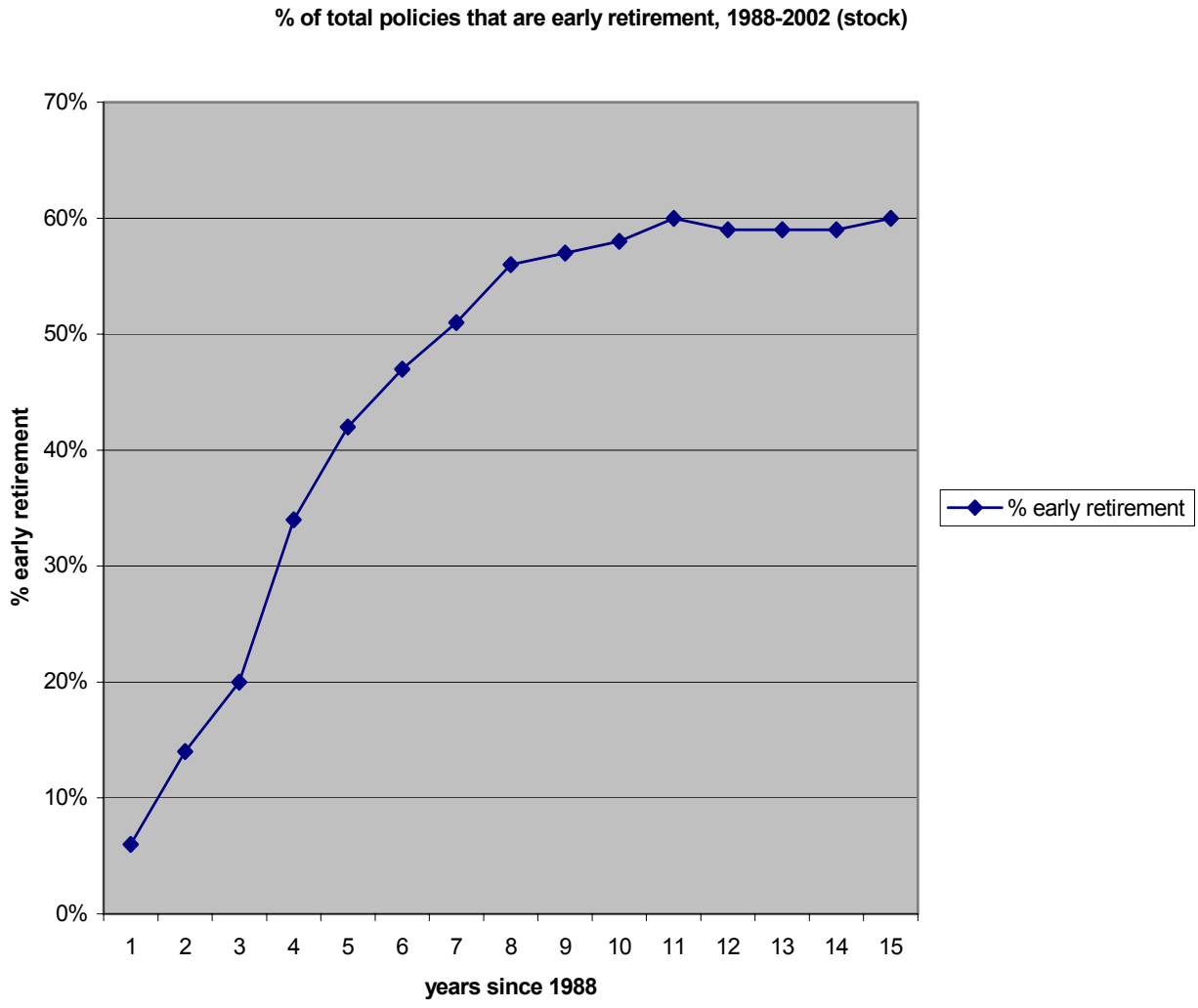
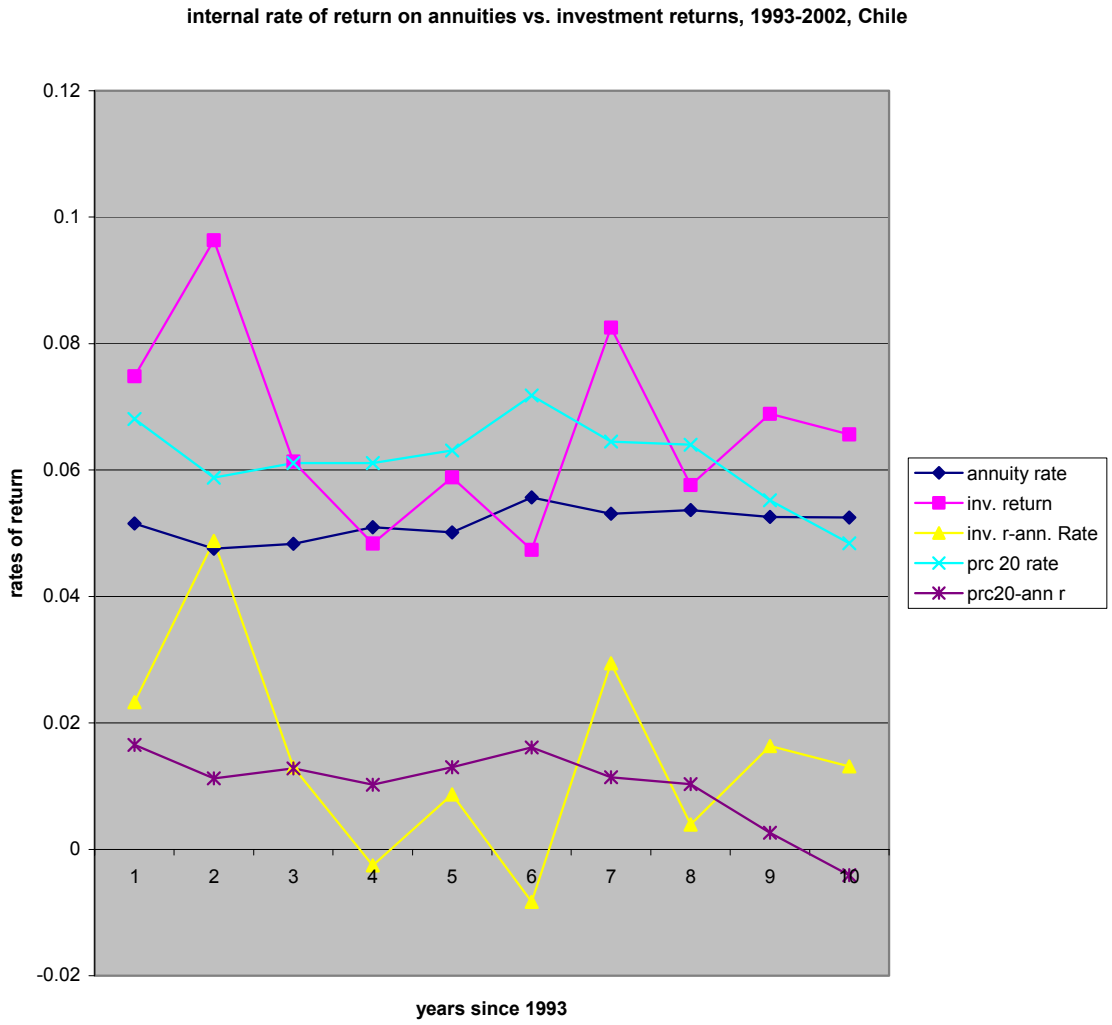
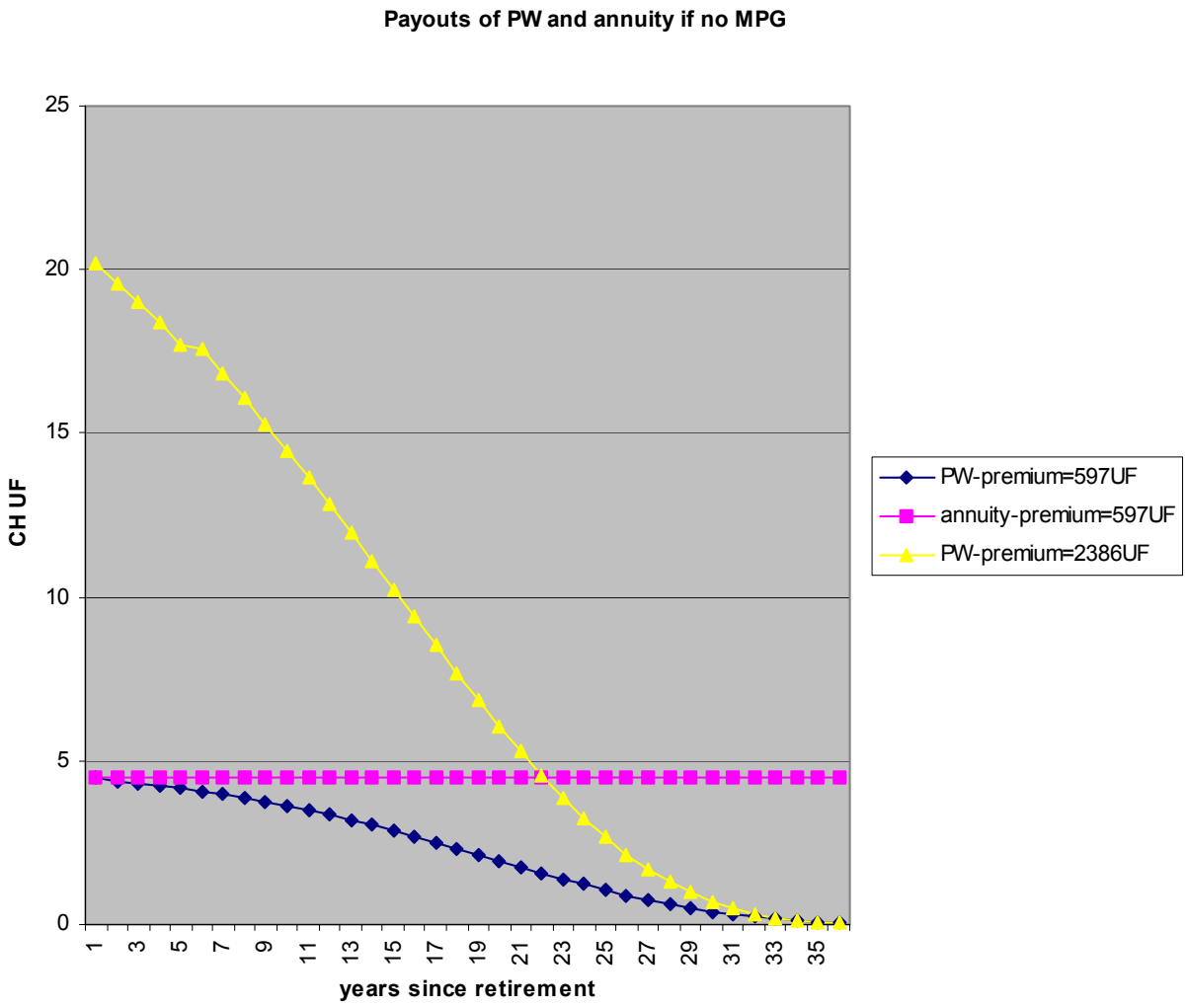


**Figure 4: Investment returns to insurance companies exceeds internal rate of return to annuitants 1993-2002**



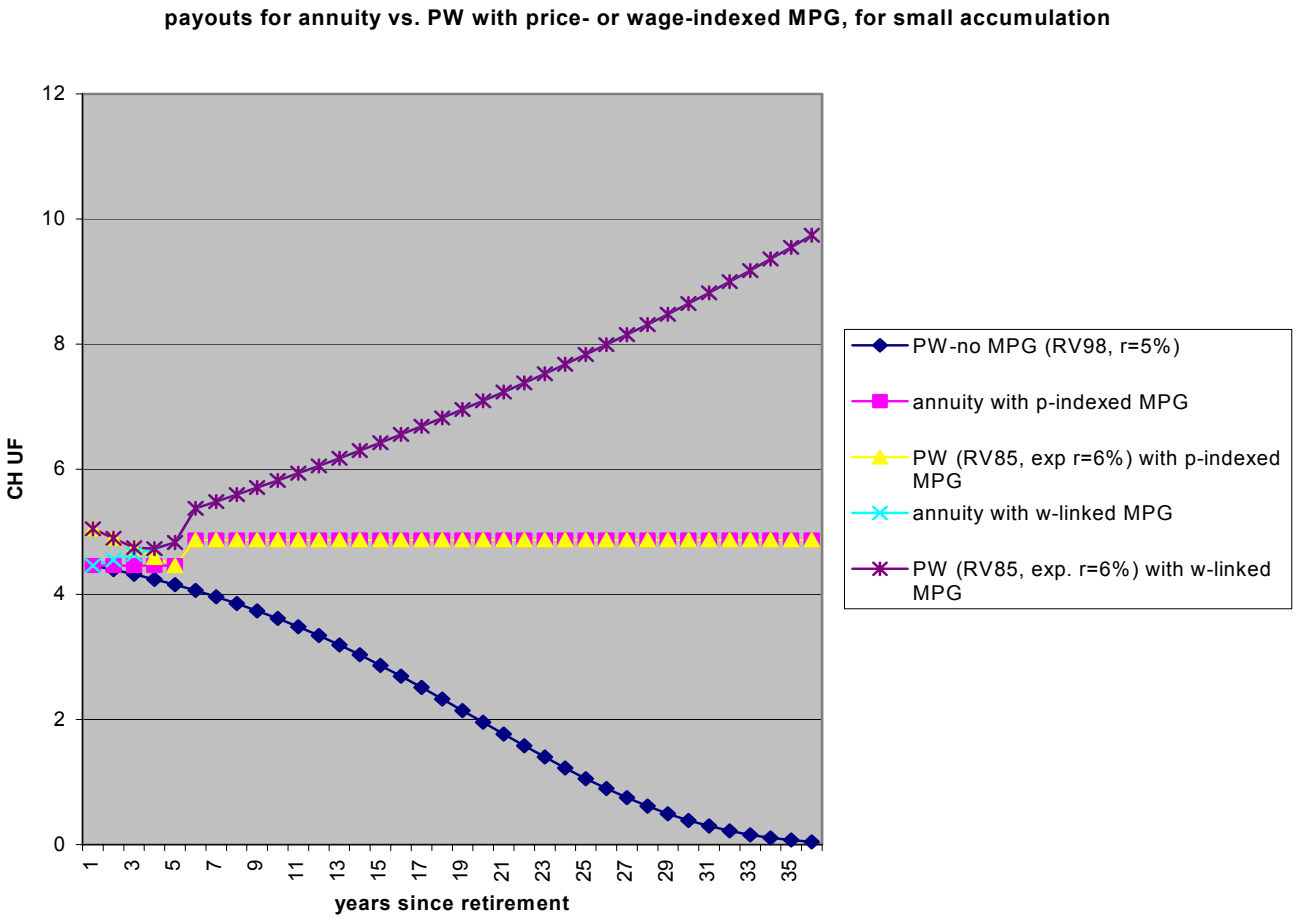

Note: Investment returns include realized capital gains and losses but do not include unrealized gains and losses.

**Figure 5: Level annuity compared with declining PW if no MPG**




Note: 597 UF purchases annuity = 100% MPG
2386UF purchases annuity = 400% MPG

**Figure 6: PW dominates choice between annuity vs. PW for small accumulation, with MPG**




Note: Premium = 597 UF, enough to purchase annuity = 100% of MPG in year 1. Annuity follows MPG line thereafter. PW for no MPG is shown under same assumptions as annuity. PW with MPG is shown for higher expected mortality and interest rate yielding larger payout initially. In all cases MPG jumps up 9% at age 70.

**Figure 7: Choice between annuity vs. PW for large accumulation**

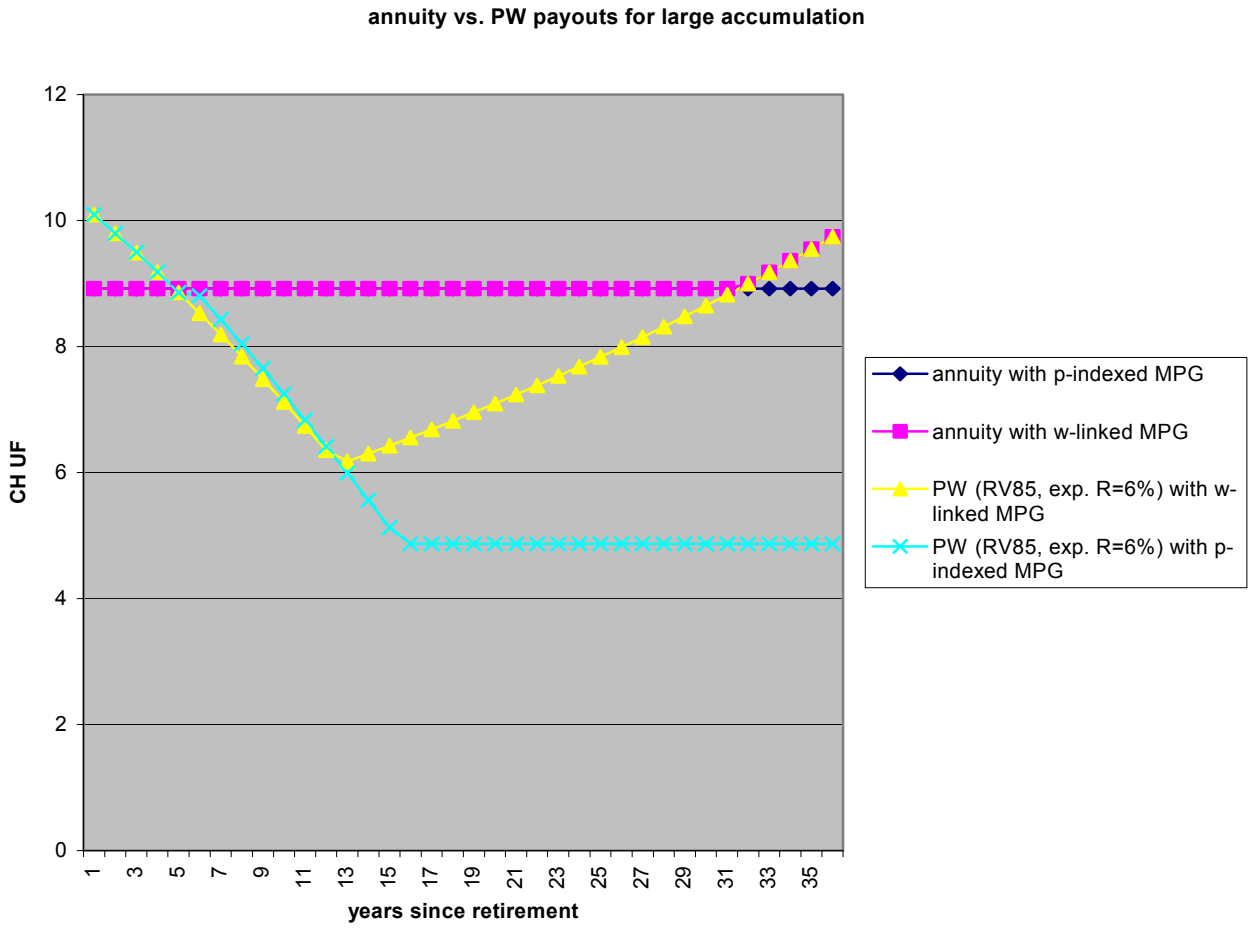
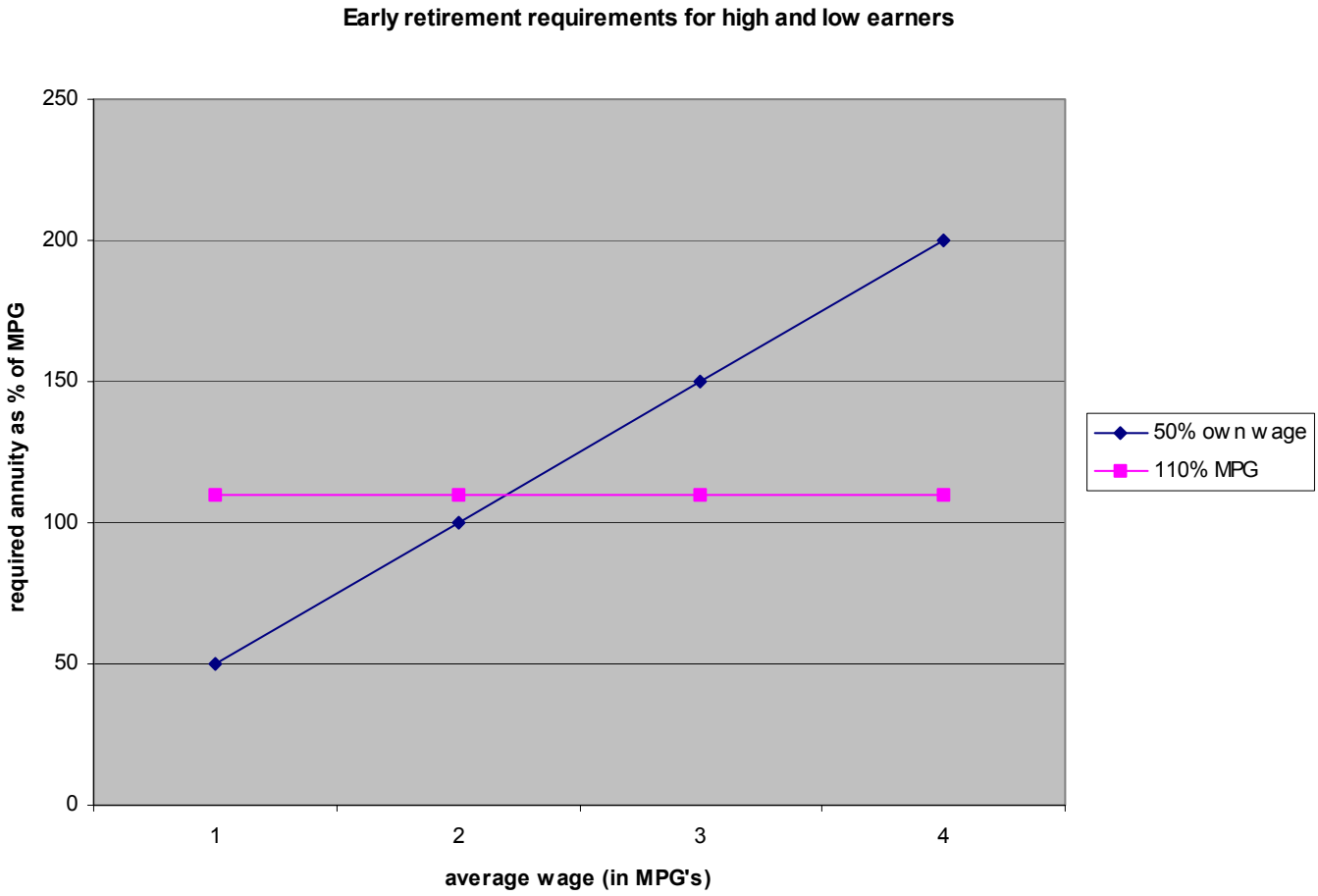
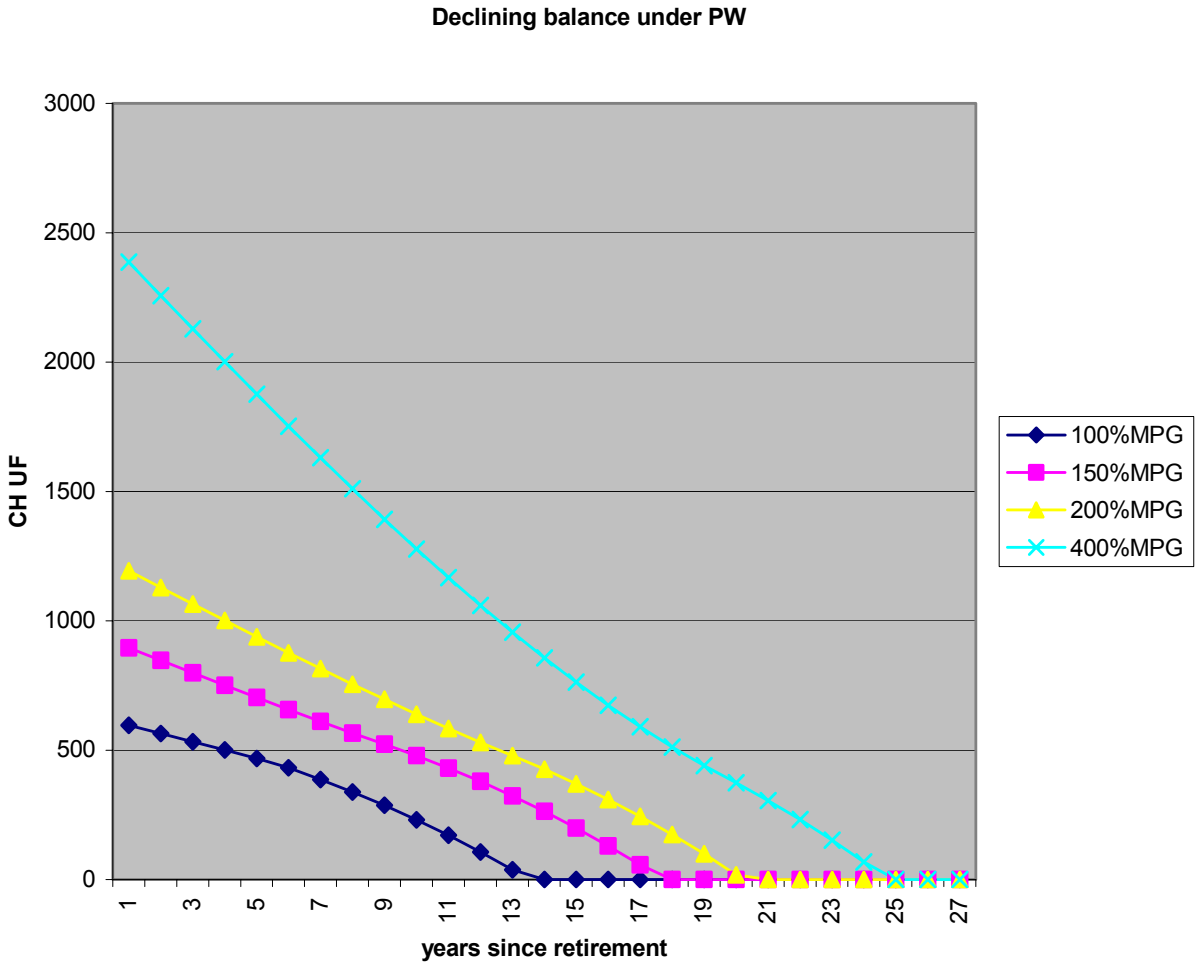


**Figure 8: Early requirement conditions are easier for high earners to meet***



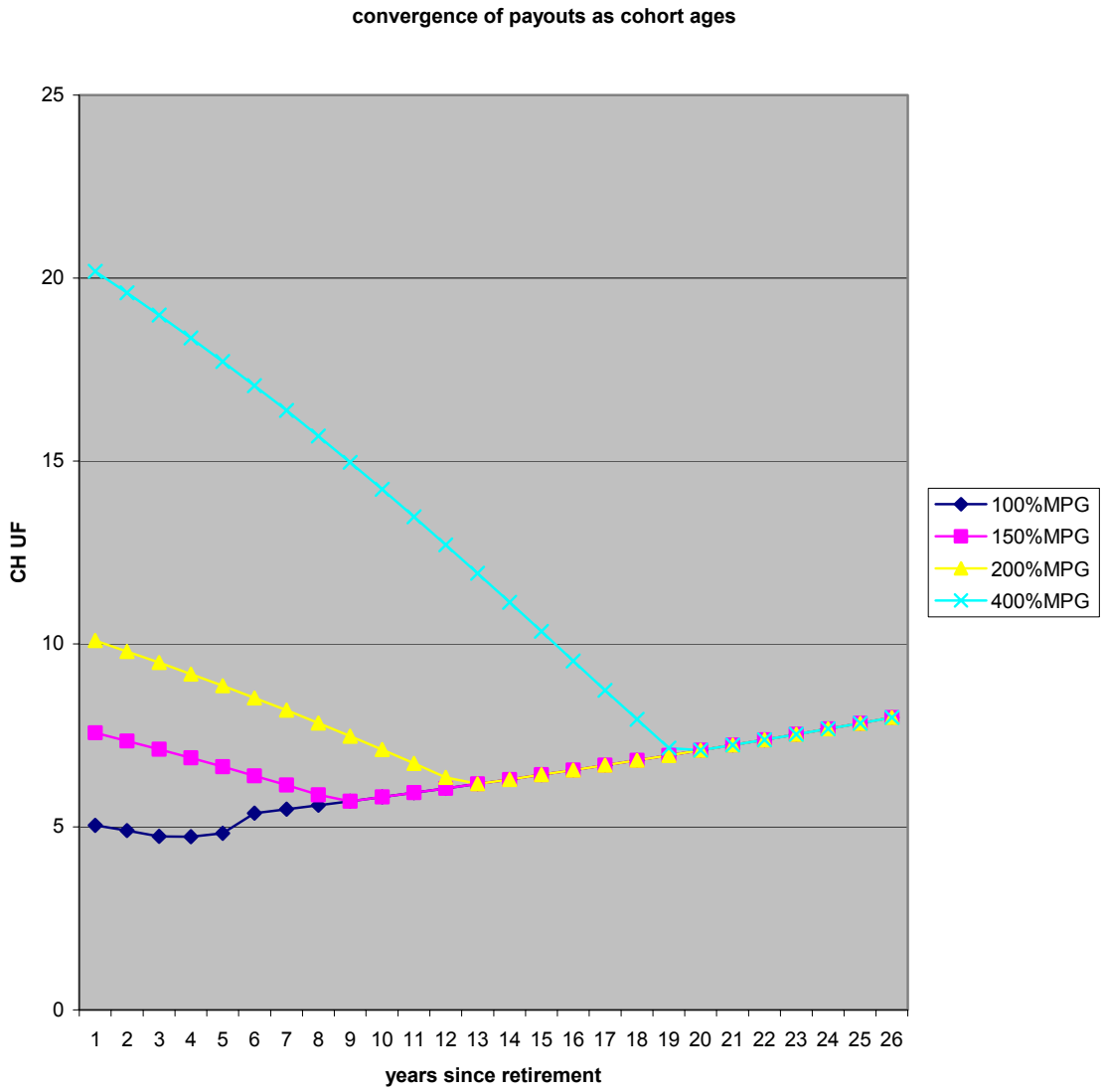

*** For workers whose own-average wage<220% MPG (<55% economy-wide average wage), the binding constraint is 110% MPG. When this is satisfied, the own-wage requirement is over-satisfied. For workers whose average wage>220% MPG, the binding constraint is 50% own-wage. When this is satisfied, the MPG requirement is over-satisfied.**

Figure 9: Declining balance under PW, with wage-indexed MPG, for different accumulations (and implications for public/private shares)




Note: Initial premium is large enough to purchase annuity = 100%, 150%, 200% and 400% MPG, respectively. Private share of pension is 100% when account is positive. When account is exhausted private share is 0 and public share becomes 100%.

**Figure 10: Converging payouts under PW, with wage-indexed MPG, for different accumulations**




Note: Initial premium is large enough to purchase annuity = 100%, 150%, 200% and 400% MPG, respectively. Convergence of payouts occurs when account is still positive, when rising MPG line is reached.

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**Endnotes**

[1] This contrast with Singapore, for example, where withdrawals are permitted for housing. These withdrawals have led to a heavy investment in housing by workers and very low cash balances upon retirement.

[2] The choice of annuitization is irrevocable. In contrast, retirees who start with PW can choose to annuitize later on. It is also possible for retirees to take a temporary withdrawal (TW) for one to three years and purchase a deferred annuity that applies afterwards. In this case, the initial PW can be 1-2 times as great as the monthly future annuity will be. One might expect this to become very popular as it allows for large early payouts while also providing longevity insurance. However, the data do not allow us to distinguish between immediate annuitants and those who become annuitants after some years on temporal withdrawal or PW. Most available data are on stocks of pensioners, and these show a very small proportion of temporal withdrawals. This is to be expected, as retirees quickly move out of the temporal withdrawal category. Even if everyone started out in TW, only 10-15% of all retirees would still be in TW after 20 years of equal-sized cohorts. For purposes of this paper, we treat workers who choose temporal withdrawal as annuitants, which they become very soon.

[3] One advantage of a minimum pension is that it is relatively easy to implement administratively—simply by checking the individual's own annuity or PW pension. The transactions costs are much lower than for means-testing based on more general income and assets. However, this also means that some individuals with small pensions but large non-pension wealth or income get a public subsidy—which many would regard as a poor use of public funds. Chile attempts to avoid this possibility by making eligibility for the MPG top-up contingent on the absence of other sources of income. But this reintroduces a means-test and the transactions costs it implies. Chile passes these enforcement costs on to the AFP's and insurance companies. This makes retirees with low pensions expensive to such companies, and undesirable if these costs can't be recouped. While required to enforce, these companies have little incentive to do so carefully. We are unable to assess how effectively the broader income test is implemented.

[4] The Inverlink scandal started with the discovery by the President of the Chilean Central Bank that confidential information in his personal computer was being sent by his secretary to a friend of hers who was an active participant in the capital market (partner and manager of a stock broker company, Inverlink). When this news was released to the market, clients of the Inverlink Group started to withdraw their money from Inverlink accounts. Inverlink faced a huge liquidity problem.

To overcome the financial crisis, Inverlink asked for cash from its related financial institutions, the pension fund AFP Magíster, the life insurance company Le Mans Desarrollo and the health insurance organization Isapre Vida Plena. AFP Magíster refused to do have any financial transaction with Inverlink, but Le Mans and Isapre Vida Plena agreed to transfer cash in exchange for financial instruments. Inverlink took this money but failed to deliver the financial papers. This meant that Le Mans Desarrollo lost Ch $10,000 million (approximately US $ 15 million).

Today, the group has been taken over by the supervising authorities, the insurance company has a negative equity (approximately the same Ch $ 10,000 million) and it will probably be declared bankrupt or liquidated. Le Mans has several outstanding annuity policies (3,082 annuity policies, 3,203 pensioners and CH $ 91,500 millions in technical reserves as of March 31, 2003) and also some other life insurance policies. It is likely that the Chilean Government guarantee for annuity pensioners of a bankrupt insurance company will be used for the first time.

[5] The 13% figure is based on a 10% net contribution + 3% for administrative expenses and disability and survivors insurance. The increase in liquidity of retirement savings and in monthly income flows may lead some workers to withdraw from the labor market. This would hold for workers who have been forced to save more than they would have chosen for their retirement, and who prefer to spend some of that saving on leisure instead of material consumption. But the elimination of the 13% payroll tax may have a positive effect on continued labor supply. The liquid wealth and the substitution effects therefore work in opposite directions in influencing the labor supply of older workers. In either case, workers can no longer increase the present value of their pension by withdrawing from the labor force, as they could in the old DB system. This reduces the incentive that existed in the old system to stop working early. This is the topic of a future inquiry that we plan to undertake.

[6] It is likely that early retirees have lower mortality rates than normal retirees, because they are younger, on average, and richer (hence may have lower age-specific mortality rates). If this is the case, the flow of new retirees into early versus normal retirement, would be closer to 50% of the total rather than 60%. However, we do not have flow data for PW pensioners, so cannot derive total flow ratios.

[7] Joint PW affords less certainty to the widow than joint annuities, as both the primary and secondary benefits are recalculated and fall every year. If her husband dies young she gets a joint pension that is higher than the annuity she would have gotten, but if he dies late in life, she gets a smaller pension. Since the wife of a long-lived husband is likely to be younger than he and must live on the smaller joint pension for several years, she (and eventually the public treasury) bears much of the longevity risk.

[8] Simulations show that the expected widow's benefit exceeds both the own-pension of the average working woman and the MPG (James, Edwards and Wong 2003). Chile also has a means-tested social assistance program for the elderly who are destitute. Widows who receive the joint annuity are less likely to qualify for social assistance. The requirement that most wives purchase individual pensions also saves money for the government, since it yields a higher monthly payout for a group that tends to contain many low earners and greater life expectancy. This means that fewer women annuitants will qualify for the MPG than would be the case if they purchased joint annuities.

[9] In the mandatory part of the UK system annuities must be indexed up to a ceiling of 5 % inflation. Other countries with new multi-pillar systems are considering requiring indexed

annuities, but this may be difficult to implement given the absence of indexed financial instruments.

[10] It also provides pension insurance for those whose accumulation is not large enough to purchase an annuity that equals the MPG, which was its original objective.

[11] Ironically, the 1985 tables replaced 1981 tables that had lower mortality assumptions. This change enabled higher PW pensions to be paid in the short run, although it means that pensioners will run out of money sooner.

[12] Until 1997 the AFP's real return was averaged over five years.

[13] Until 2002 PW pensioners had no portfolio choice and simply had to accept whatever the AFP offered. AFP portfolios were heavily invested in fixed income securities, especially mortgage-backed securities that paid somewhat more than government bonds, but a growing portion was invested in equities. Starting in 2002 pensioners have been allowed some control over their portfolios and are permitted to invest up to a maximum of 40% in equities.

[14] For a proposal to use forward-looking rate of return assumptions for PW, based on the term structure, see PrimAmerica Consultores 2002.

[15] The "calce rule" penalizes mismatching of liabilities and assets by requiring higher reserves. If long-term rates are much higher than short-term rates, companies sometimes engage in a limited amount of mismatch, as part of their investment strategy.

[16] Workers with small accumulations, which signal smaller earnings and wealth, are likely to have a high subjective discount rate and therefore an even higher relative present value of lifetime income under PW, whose payouts are more front-loaded than those of annuities.

[17] Most of the remainder have other income sources (such as a pension from the old system) that make them ineligible for the MPG. Annuitants with low payouts may not get the MPG top-up for other reasons as well. Insurance companies may make up small differentials themselves, because of the high transactions costs of applying for the public subsidy. Early retirees with low annuities don't get a top-up until they reach normal retirement age, and even then they are subject to a lower MPG.

[18] The link between early retirement and unemployment has been noted in many countries and it does not seem to be fully broken in Chile.

[19] Note that in 2001 a typical worker who had earned the average AFP return of 10.7% during 1981-2001 would have achieved a 50% replacement rate with a pension that exceeded 110% of the MPG by age 45.

[20] For older workers, the bonos would have been equivalent to several years of contributions and could be applied toward the purchase of a pension. This contrasts with Argentina, which paid a compensatory pension for prior service and Mexico, which did not pay anything but granted workers the right to opt back to the old system upon retirement.

[21] This proscription may have been due to the regulator's fear that such purchases would set up a conflict of interest between worker and AFP, to the detriment of the pension system. Once the market for bonos was well established, its price exogenously determined, AFP's were allowed to buy them and compete for early retirees.

[22] Workers (who are required to place their mandatory saving with AFP's) are charged 15% of contributions (1.5% of wages), Then, since the average pension is 50% of the average wage, the monthly fee for the average pensioner is about one-third that paid by the average worker. The average cost per worker is estimated to be 8% of contributions, so affiliates are very profitable during the accumulation stage. We do not have data on relative costs of worker-contributors and pensioners. Workers may be more expensive because they can transfer between AFP's, hence impose liquidity, marketing and switching transactions costs. However, PW pensioners also impose costs on AFP's. Besides sending a monthly check, every year AFP's must calculate the new PW payout. If the payout approaches the MPG level they must handle the paper work for MPG eligibility, and verify with other pension funds and tax authorities that there are no other income sources for the means test. They pay the full MPG and later get reimbursed by the government. Thus, at least for small accounts, administrative costs are likely to be at least as great for PW pensioners as for worker contributors.

[23] Sales commissions (and probably the accompanying rebates) have declined in recent years, making this effect smaller.

[24] For example, if the interest rate is 5% and the regulator's mortality table RV85 is used, the actuarial factor would be 12.03 at age 60, 10.62 at age 65. The MPG for the worker who retires at 60 is then reduced by (12.03/10.62)-1=13.3%.

[25] Once they attain the 20 years needed for MPG eligibility, they may simply take a job in the informal sector or as a self-employed worker (where contributions are not required) until age 65, since any further private benefits would simply crowd out future public benefits.

[26] For attempts to simulate future public expenditures see Arenas. 1999, Wagner. 1990 and Ortuzar . 1998. However, none of these studies builds these simulations on a cohort analysis of past and expected future pensions and estimates of future MPG, as should be done. In particular, data on PW pensions by cohort, as well as mortality experience of PW pensioners, are not available.

[27] We make this rough estimate for a mature system, i.e. one that has been in existence for at least 40 years, and we calculate the wage tax that would cover the cost even though

the MPG is, in fact, financed by a broader tax base. We do not know the distribution of pension size by age. Hence we make stylized assumptions, based on the data in Tables 13 and 14. We assume that the "representative" normal age PW retiree has an initial pension that is 125% of the MPG. He or she will run out of funds by age 78 and after that the government will pay the full MPG—but only to 36% of all PW pensioners since the others are still under age 78. The post-age-70 MPG is 27% of the average wage. Then, if it is financed by a payroll tax and if the ratio of contributing workers to retired workers (the support ratio) is 2/1, it would cost 27/2*36%=4.9% of payroll to finance this benefit--if all pensioners were on PW. But since only 26% of all pensioners are normal age PW retirees, the cost for this group would be 1.3% of payroll.

For annuitants the estimation is more difficult since the dispersion of pension size is greater and most annuitants retire early, but we do not have data on dispersion by cohort. If the data in Table 9 were relevant for each new cohort, this would suggest that about 30% of all annuitants start out with an annuity < 110% of MPG and become eligible for the MPG top-up by age 70. Another 30% would never qualify for the public benefit because their own benefit exceeds 200% of the MPG (Tables 13A and 14A).

To simplify, we deal with a "representative" annuitant who retires at age 60 or 65 and starts receiving a top-up at age 82. The top-up is only 1% of the MPG at age 82 but by age 100 (for the few who are still alive) it is 30% of the MPG. Thus his average expected payment per year is only about 10% of that for the representative PW pensioner described above. But 64% of all pensioners are annuitants, compared with 26% who are normal age PW pensioners, and 22% of these are age 82 or over. Thus the tax cost over all annuitants would be 10%*64/26*22/36 that of PW pensioners, or .2% of wages. The total cost for normal age PW pensioners plus all annuitants would be 1.5% of payroll. (Based on Table 7, we assume that the 9% of retirees who are PW early retirees start out with a much larger pension and are unlikely to get any public benefit).

However, this number is likely to underestimate costs by a large amount, for the following reasons: 1) Many PW recipients are women. Their own-accumulations are lower than those of men, their normal retirement age is 60 rather than 65--hence they deplete their own accounts before the age of 78--and they live much longer than men. Therefore, the proportion of women PW pensioners who receive the government subsidy in steady state is likely to be much larger than that of men. For example, in a constant cohort world half of all women age 60+ will be age 74 or older, at which point they are likely to receive the government subsidy. 2) Some PW normal retirees could not have purchased a pension = 125% of the MPG initially, and the government payment for this group would have begun much earlier than age 78. This applies especially to women. 3) RV98 understates life expectancy for women and will do so increasingly for men as well as mortality declines. Then, the support ratio will decline and the proportion of pensioners who are very old (and hence eligible for the MPG subsidy) will increase. In Chile, the government bears a disproportionate amount of this longevity risk. 4) These calculations are based on individual pensions rather than on joint pensions. They do not include survivors' benefits for widows. While the husband must allow for a survivor's benefit that is 60% of his own benefit, the government actually guarantees 100%. Moreover, women get this benefit for longer, because of their greater longevity. Currently the number of widows on PW is 38% the number of primary beneficiaries, a

much higher proportion of these are already receiving the full MPG from the government, and many more wives are likely to become widows soon. (Working wives are entitled to the full widow's benefit in addition to their own benefit). 5) Moreover, other survivors such as orphans are also excluded in these calculations, but these constitute a much smaller amount that do widows. 6) We have assumed constant size cohorts but in reality the baby boom generation will be followed by a smaller generation, so the support ratio will be lower and the necessary wage tax would be higher. These factors could increase the long run cost of the MPG to the equivalent of 2.5-3% of payroll. A full actuarial model with more detailed data are needed for a more accurate estimate.

[28] Changing indexation provisions is a common reform provision. The UK has kept fiscal costs under control by price-indexing its basic benefit, which consequently has been falling through time relative to wages so it is now only 16% of the average wage. The President's Commission to Strengthen Social Security in the US recently made two alternative proposals regarding indexation of the DB in the US: one proposal would index to prices and the other would index to wages adjusted by longevity, which is approximately Swiss indexation.

[29] The Chilean government is now planning to require a pension that is at least 130% of the MPG and 70% of own-wage (but even this may not be enough) and to eliminate periods of unemployment from the calculation of the average own-wage.

[30] The escalation might match the 2% historical average annual growth in the MPG or might escalate at a more modest 1% per year. A 2% escalation might result in too much postponement of consumption, given uncertainty about whether wages and MPG will really rise at 2% indefinitely. For these reasons, a 1% escalation might be preferable. If PW becomes back-loaded while annuities remain level, this will increase the incentive to annuitize.

[31] This would provide longevity insurance at relatively low cost, if mortality pooling began immediately (that is, if the premium is not refundableturned to the estates of retirees who die before age 78).

[32] The floor would be binding on retirees who start out with annuities less than 180% of the MPG. It would reduce the initial pension for this group and thereby discourage their early retirement while keeping the long run annuity payment above the MPG.

[33] The special pool would ensure that the money goes to these low-wealth annuitants (and indirectly to the public treasury) rather than being used to subsidize high-income high-longevity annuitants. It would encourage the use of special income-related mortality tables and a higher money's worth ratio for this group than would otherwise transpire if broader pooling were used. These low-income annuitants would have little or no incentive to choose a low-cost provider, since the government has insured their minimum pension at the MPG level and their own accumulation is not large enough to go above this amount. Therefore, the government would have to play an important role in organizing this market, perhaps auctioning it off to the best bidding insurance company

each year. Part of the pension would be paid by the company and the remainder, up to the MPG level, by the treasury.

[34] Insurance company marketing also encourages early retirement, which may be less socially useful, by spreading information about eligibility. However, since these eligibility rules were set by government and could be changed by government, it would seem that government deserves the credit or blame for early retirement.

[35] This was also observed in the UK by Murthi et al 1999. Part of this effect in our data may be due to the fact that premiums were smaller in the early years of the system, and mortality was higher in those years.