The Payout Stage in Chile: Who Annuitizes and Why?

By Estelle James, Guillermo Martinez and Augusto Iglesias *
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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 when individual accounts replace DB systems, and how detailed regulations shape these reactions.

Retirees in Chile have a choice between early versus normal retirement (before or after age 65M/60W) and between annuitization versus programmed withdrawals; lump sum withdrawals are largely ruled out. Almost two-thirds of all retirees have annuitized—a very high proportion compared with other countries. This paper argues that this high rate of annuitization is the result of guarantees and regulations that constrain payout choices, insure retirees through the minimum pension guarantee, eliminate other DB components, and give a competitive advantage to insurance companies selling annuities. The minimum pension financed by the government provides insurance to workers with small accumulations, who retire at the normal age with programmed withdrawals, while those with large accumulations retire early and must purchase annuities to acquire longevity and investment insurance. Insurance companies further induce annuitization by marketing aggressively, facilitating early retirement for those who annuitize and offering a high money's worth ratio for price-indexed annuities. We find evidence of adverse selection based on asymmetric information about short run health status, but this does not seem to deter the high rate of annuitization.

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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, with annuities as one of the options.

Simple life cycle models predict a high rate of annuitization and policy analysts see annuities as socially desirable because they provide lifelong income. Yet, annuitization rates are very low in many countries—a result that has been attributed to the crowd-out by mandatory defined benefit plans, retirees' demand for liquidity and adverse selection. The Chilean scheme gives us an opportunity to examine how pensioners and pension providers react when individual accounts replace DB systems, and how detailed regulations shape these reactions.[1] Will most retirees choose to buy annuities? Will adverse selection pose a problem? Will the industry grow rapidly enough to accommodate the potential new demand and will it offer attractive terms? Will public guarantees crowd out private insurance? How do policies influence retiree behavior?

In Chile, almost two-thirds of all retirees have annuitized. About 60% of all pensioners have retired early from the system, often before the age of 55. Among early retirees, 85% have annuitized. We argue that this is due to detailed rules of the game that encourage the purchase of annuities by retirees, especially those with large accumulations, and the marketing of annuities by insurance companies, especially for early retirees. Among normal age retirees, only 34% have annuitized. We argue that this is due to the existence of a minimum pension guarantee (MPG) that provides limited longevity insurance and to regulations that rule out annuities to small accounts.

In 1981 the Chilean life insurance industry was an infant industry, and the annuity portion was virtually non-existent. However, the new social security system, which forced people to save for their retirement and greatly constrained their choices during the payout stage, changed this situation dramatically. The industry grew rapidly, and the annuity part grew fastest of all—whether measured by premiums, payouts or reserves. Chile is practically the only example of a large life insurance industry with annuities as its major product. In 1985 total life insurance premiums were only US$145 million, but

by 2000 they reached $2 billion, two-thirds of it for life annuities.[2] In 1985 payouts from annuities were less than half a million dollars, but by 2002 they exceeded $40 million. Life insurance investments were less than half a billion dollars in 1985, but by 2003 they totaled $14 billion, 20% of GDP, with 80% of reserves backing annuities. (Figure 1).

Part I summarizes the rules of the game regarding payouts in Chile. Part II discusses the regulations that create incentives for annuitization. Retirees face a highly constrained choice; basically, they must choose between annuities sold by insurance companies versus programmed withdrawals sold by pension funds (AFPs). In this competition, regulations give insurance companies a competitive advantage. Retirees do not have the option of a public DB, but they do get a government-guarantee on their annuity. Workers also must choose between early versus normal retirement. But regulations have the de facto impact of making it easier to retire early if you annuitize. Part III examines the high money's worth ratio offered by insurance companies for price-indexed annuities. Part IV analyzes who annuitizes. Workers with small retirement accumulations can reap the advantages of programmed withdrawals (bequest motive and investment control) without foregoing longevity and investment insurance, which they get through the MPG, so they have no incentive to annuitize. In contrast, those with large accumulations must annuitize to acquire a meaningful amount of insurance—which they do. They are also more likely to meet the regulatory pre-conditions for early retirement and to be the targets of aggressive insurance company marketing efforts. An analysis of actual/expected death rates in Part V provides evidence of adverse selection due to asymmetric information about short run health status, but this does not deter the high rate of annuitization. The Conclusion presents lessons for other countries.

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 and the AFP regulator. Second, we obtained individual-level data on all annuitants giving gender, size of pensions and dates of birth, retirement and death. (Unfortunately, comparable data on programmed withdrawal pensioners were not available). Third, we held extensive discussions with insurance companies, AFPs and regulators in Santiago, and obtained annuity quotes from several companies for 2003 and 1999, from which we calculated money's worth ratios.

I. The Rules of the Game During the Payout Stage

Payout options

Accumulations in the new Chilean pension system started in 1981 and old age payouts were permitted from 1983 on. The payout rules were fairly stable until August 2004, when they underwent a substantial change that made the system more flexible in some ways, but at the same time tightened the rules against early withdrawals.[3] In this paper we concentrate on the rules and their impact prior to 2004. At relevant points we describe the most important changes that occurred in 2004, but leave it for a future paper, based on future data, to analyze their impact on behavior.

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 120% of the MPG (gradually raised to 150% starting in 2004) and 70% of the worker's average wage over the past ten years. Few workers have met this requirement. Workers cannot access their funds for house purchase, education or medical expenses, as in some other countries. Basically, workers must choose between annuitization versus programmed withdrawals (PW).[4] Additionally, workers must choose their age of retirement, subject to eligibility conditions that are described below.

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.[5] If the worker's own accumulation is not large enough to cover a lifetime pension at the MPG level, because of low wage rates or years of contributions, the government provides a subsidy to bring it to that level. In effect, eligible workers whose own pension is close to the MPG face a 100% tax on incremental retirement accumulations, which simply displace the subsidy. The MPG reduces the worker's longevity and investment risk and the risk of running out of money due to 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. It is partially means-tested.[6]

The MPG is indexed to the consumers' price index, but in reality it has been rising with wages, due to political decisions. 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 4 and Figure 2). At the beginning of the period the MPG was about 25% of the average wage and by the end it was about 24%. In contrast, 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%.

When the MPG rises, this increase applies to the old stock of retirees as well as the new flow. It jumps by about 9% for pensioners once they reach the age of 70. Since 2004 it jumps another 5% when they reach age 75; older pensioners will therefore get 28% of the average wage. 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' and disability benefits—supposedly at 60% of the full MPG for widows but, because of special adjustments, actually 100%.

Joint and indexed pensions

Married men (and other men and women with dependents) 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 dependent children). The formula for PW includes these same provisions for survivors, which diminishes the amount that the husband can withdraw. This requirement provides insurance for widows, financed by their husbands, rather than the public treasury. (Females, 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 2; also see James, Edwards and Wong 2003). The wife is allowed to keep this joint pension in addition to her own pension, if she has worked.

Pensions must also be price-indexed. In Chile, both nominal and price-indexed units of account (pesos versus the Unidad de Fomento--UFs) 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 (although, as noted above, this is about to change). 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. 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, as discussed below, PW valuations are recalculated every 12 months and the formula yields a declining real value over the retiree's lifetime if initial assumptions are met.

How annuities and programmed withdrawals work

Under annuitization workers turn their accumulation over to an insurance company that provides the annuity, subject to detailed rules set by the insurance regulator. 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, which are commonly used), 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. (In 2004 the government passed a law permitting variable annuities and annuities denominated in other currencies, like US dollars, but implementing regulations have not yet been issued). If the MPG rises above the annuity level during the retirement period, the government tops up the payout. The government also insures 75% of the worker's annuity over the MPG (with a cap of 45UF or about US$1200 monthly) in case the insurance company becomes insolvent, and to prevent this from happening sets stringent reserve, equity and asset-liability matching requirements. So far it has never had to pay this insurance.

Subject to meeting regulatory requirements, insurance companies determine annuity payouts and bear the longevity and interest rate risk. The annual annuity payout for a worker who retires at age x = initial premium/annuity factor $a_{x,}$ where a_x is a function of the assumed mortality tables and interest rate. (a_x is calculated such that the annual payout times a_x equals the expected present value of the lifetime annuity stream

and both equal the initial premium). While reserve requirements are calculated according to interest and mortality rate assumptions set by the regulator, insurance companies can choose their own assumptions when setting the a_x that determines their payouts. They also bear the risk that stems from this choice. Later we analyze the expected present value of these lifetime payouts using market rates and alternative mortality rates. The price-indexed annuity requirement implies that the same real payout is guaranteed for life. As of 2002, two-thirds of all retirement pensions, including 85% of all early retirement pensions, were annuities (Figure 3).

Under programmed withdrawals the worker's retirement savings stay in his account in the AFP system but face somewhat more conservative investment restrictions. The retiree retains control over choice of AFP and, since 2002, of portfolio, as well as bequest rights over the accumulation, subject to rules established by the AFP regulator. The maximum permissible monthly withdrawal is recalculated every year, in accordance with a formula that is set by regulations. This formula is the same as that used for annuities, but the AFP regulator rather than the company chooses the interest and mortality rate assumptions that determine a_x. The payout is fixed for only one year, after which another calculation is made for the following year, and so on. The year 1 calculation starts with the initial accumulation and a_x set by the regulator. In year 2 the new pension equals the new accumulation (= initial funds minus actual withdrawals plus actual investment earnings), divided by a_{x+1}.

Programmed withdrawals and annuities have in common a gradual withdrawal profile, but they provide a very different time stream of benefits and risks. In general, the PW formula set by the regulator leads to a pension that is higher than annuities at first, but declines dramatically over the individual's retirement years.

Assume first that the insurance companies and AFPs both use the same interest and mortality rates initially; then, annuities and PW will yield the same pension, P_1, in year 1, at age 65. 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 given survival to age 65, D_1, providing the assumed investment returns are realized. However, the PW payout is recalculated every year, based on the new accumulation and new actuarial factor. At the beginning of year 2

the accumulation has been reduced by one full year of pension withdrawals, but if the pensioner has survived to age 66 this means that her expected remaining number of years will be reduced by less than a full year, due to "survivorship drag." Thus the accumulation in the numerator has gone down by a higher proportion than the actuarial factor in the denominator and (unless the investment return is higher than expected), the PW pension declines in year 2; and so on for successive years (Figure 4). The level annuity compared with the declining PW stems directly from the absence of pooling with those who die early in the latter case plus the absence of a PW formula that offsets this effect.[7]

This decline is accentuated by regulations that, in recent years, have had the effect of overestimating mortality and interest rates, thereby reducing the actuarial factor and enabling higher payouts initially. Because the returns are not realized, this leads to a more rapid decline later on and eventually to very small payouts.[8] If the falling PW payout hits the MPG (which is rising because of wage growth), payouts stay at the MPG level until the account is used up, at which point the government steps in and pays the entire pension. Thus the mortality and interest rate risk is born initially by the individual and ultimately by the government, not by the AFP. The AFP has no incentive to press for realistic interest and mortality assumptions and, indeed, no power to do so.

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. They must stay in PW and spend down their savings at the MPG level each month. When their own money is used up, the government pays the full bill for those who meet the MPG requirements. PW pensioners who start out above the MPG can also eventually fall below, at which point they no longer have a choice. As of 2003, 79% of all normal old age PW pensioners were receiving a pension at the MPG level, although they did not all start out there. Of this total, 67% were still drawing down their own accounts and 12% were already getting the public subsidy. Thus the PW formula does not apply to the majority of PW pensioners, who simply withdraw monthly amounts equal to the MPG.

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, regardless of how much he or she has accumulated. But starting in 1988 regulations began to facilitate earlier withdrawals. Early withdrawal was permitted once workers had an accumulation large enough to finance a pension that was 110% of the MPG and 50% of their own average wage. It is easier for workers with large accumulations to meet this requirement.

In making this calculation, nominal wages from the past 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 for early withdrawal.[9] For workers who meet these conditions, continued saving through the social security system becomes voluntary rather than mandatory. As of 2002, 60% of all pensions and 80% of all newly issued annuities were for early retirement.[10] Table 1 displays the distribution of choices between early retirement versus normal retirement and annuities versus programmed withdrawals that have been made by the stock of retirees in 2002.

It is important to note that "early retirement from the system" does not mean "retirement from the labor force"—these two decisions are separated. The former only means that workers start withdrawing from and may stop contributing to their retirement accounts. In fact, preliminary investigations indicate that the elimination of the 12.5% payroll tax has a positive impact on the labor supply of older workers (Edwards and James 2004).[11] But the fact that workers can stop accumulating has a negative impact on their future pensions. It could also have a negative impact on the finances of the government if it means that more retirees eventually become eligible for the MPG. To counteract this possibility, the MPG that applies to early retirees is reduced, by the same proportion that the actuarial factor is increased.[12]

II. Why the High Rate of Annuitization? Regulatory Choices That Shape Pension Choices

A key choice that retirees must make is whether to choose programmed withdrawals or annuities. Policy-makers have an interest in this decision, since annuities

are most likely to provide a steady stream of retirement income, which is a major aim of the social security system. Annuitization also reduces the liability that the government incurs through the minimum pension guarantee. Chile did not mandate annuitization, but two-thirds of all retirees do annuitize. Why this large percentage—which is far greater than in other countries? What lessons can other countries draw from this behavior?

Economic theory would predict that the payout choices of utility-maximizing retirees will depend on their personal characteristics (such as their expected longevity and confidence in their ability to manage investments), their preferences (such as their personal discount rates, bequest motives and degree of risk aversion), and system-wide variables that shape the options, information and time stream of payouts from annuities versus PW. Programmed withdrawals have the advantage that they allow the retiree to: 1) get her money out of the system more quickly than an annuity would, due to the required mortality and interest rate assumptions; 2) choose and vary the AFP and investment portfolio, thereby enabling investment in a riskier portfolio with a higher expected return than annuities;[13] 3) leave a bequest to her heirs if she dies early; and 4) switch to an annuity later on, if desired, whereas the choice of an annuity is irreversible. These advantages might make PW attractive to retiring workers, especially those with high discount rates, bequest motives and investment experience. But PW does not provide investment and longevity insurance. Investment volatility is reflected in the annual payout. Annual income will fall over time and will become very small if the worker lives long enough. To risk-averse workers, this should be a deterrent to choosing PW and an incentive to annuitize. So there are pushes and pulls in both directions.

We argue that the high annuitization rate in Chile is due to system-wide regulations--including the limited range of payout options in the mandatory system; the absence of a public DB except for the MPG, but the existence of a government guarantee of the annuity; rules that give insurance companies an advantage; and eased pre-conditions for early retirement. These regulatory incentives and constraints are reinforced by competition, which forces insurance companies to offer a high money's worth ratio and to market aggressively by helping workers to qualify for early retirement with annuities.

Gradual withdrawal required

Choice of payout mode is severely restricted in Chile. Lump sum withdrawals are subject to tight pre-conditions that few workers have met (in large part because they first meet the easier early retirement requirements and stop accumulating). Basically, retirees must take their money out gradually, either through an annuity or through a formula set by the regulator for "programmed withdrawals" (PW). With the range of payout options so limited, annuitization becomes a more likely choice than it would be in a less constrained environment.

The absence of insurance through DB plans—except for the MPG

When Chile's new individual account system was adopted, it totally replaced a defined benefit plan that provided a pension for life. For workers who switched and for new entrants to the system, the public treasury no longer provides a defined benefit with longevity and investment insurance. Very few employers in Chile provide such plans privately to their employees. Therefore, retirees who wish to ensure that they will not outlive their retirement savings must purchase an annuity. The one exception is the MPG, which provides partial longevity and investment insurance. The MPG is not a separate benefit; rather, it sets a floor on the pension from the mandatory accounts. The floor has been 25% of the average wage in the economy, so it is not very relevant to the average annuitant, whose pension from his own mandatory retirement savings exceeds 50% of the average wage. For this annuitant, however, the government insures the annuity up to the MPG level, plus 75% of the value in excess of the MPG, in case of insurance company insolvency.

This contrasts with other countries where public and/or private DB plans often provide replacement rates of 40-70% and any annuity purchases would come out of voluntary savings and would be uninsured. This absence of a public DB and the back-up of the private annuity in Chile should increase the rate of annuitization for workers with medium and large accumulations (as well as those with fewer than 20 years of contributions)—but it should produce a low annuitization rate for those with small accounts who meet the eligibility criteria for the MPG.

Marketing advantages to insurance companies

Regulations over brokers' commissions give insurance companies selling annuities a competitive edge over AFPs selling PW pensions. Insurance companies are

allowed to pay sales commissions to independent brokers, while AFPs are not allowed to do so. Hence, workers who visit or are visited by a financial adviser to explore their options (as many do) are likely to get information that steers them toward insurance companies and annuities. Since commissions are a function of premium size, brokers will be most interested in marketing to retirees with large accumulations.

Regulations over fees also tilt the scales toward insurance companies. Pensioners have large assets compared with workers, but asset-based fees and fees based on investment returns are ruled out for AFPs, whose fees depend mainly on wage-based contributions.[14] In contrast, insurance companies are not allowed to charge an explicit fee but must cover their costs from the difference between the rate of return they pay annuitants and the rate they earn on the investment portfolios in which they invest their reserves, which come mainly from annuity premiums. Their profits depend on this spread and the size of the premium on which it is earned. These pricing rules make AFPs more motivated to retain workers as clients and less motivated to encourage them to retire with PW pensions, while insurance companies are very interested in marketing retirement annuities to this group, especially those with large accumulations.

Early retirement rules and their link to annuitization

The normal retirement age in Chile is 65 for men, 60 for women, but early retirement is also permitted—providing the accumulation meets a specified minimum. Early retirement does not mean that the worker has to stop working. It simply means that he or she starts withdrawing and may stop contributing. Since 1988 workers have been permitted to stop contributing and start withdrawing once their replacement rate is 50% of own wage and 110% of the MPG (now being raised to 70% and 150%, respectively). The recognition bonds (bonos) that workers received in return for their contributions to the old system could be counted as part of this sum. Given the high rates of return to the retirement accounts during the 1980's and 1990's (exceeding 10% real per year, on average), as well as the possibility of including the bonos, a high proportion of workers met the early retirement pre-conditions once they reached their 50's.

For those who qualified, it was rational to take early retirement, stop contributing, and either consume or save in a more flexible form, as soon as they could. And for most such workers, it was easier to do this through annuitization. Insurance company sales

agents kept track of workers' accumulations, informed them of their eligibility, offered to help process the calculations and paperwork and, of course, sold them annuities at the same time. Although the bono could be applied toward the pension whether the worker annuitized or took PW, insurance company salesmen facilitated this process. Anecdotal evidence indicates that sales agents were a key information source and sometimes made loans to workers to put into their accounts, to help them qualify for early retirement. Access to early retirement thus became the carrot that encouraged workers to annuitize. We would expect them to focus their attention on workers with large accumulations, who were more likely to meet the eligibility conditions and would also yield a higher commission to brokers, larger profits to insurance companies.

Marketing is costly. Over the 1990's average marketing costs varied from 3-6% of premiums across years and in 2001 they ranged from 2.5-4% across companies. Data from the insurance regulator suggest that the highest sales commissions were paid by companies that offered the lowest internal rate of return on annuities (SVS 2002). However, it is widely believed that sales agents shared these high commissions with annuitants, giving them an unofficial lump sum withdrawal as well as an annuity.[15]

III. The High Money's Worth Ratio of Price-Indexed Annuities

Once the type of annuity is specified (fixed rate, joint, indexed for most male retirees in Chile), it is easy for potential consumers to compare annuities that are offered by different companies, simply by looking at the monthly payout they will get from their accumulations. Therefore we would expect insurance companies to compete, also, by offering a high rate of return on premiums. To investigate whether this happened, we calculated the money's worth ratio (MWR)--the present value of the expected lifetime income stream, divided by the initial premium—based on the average payouts offered by insurance companies in surveys we conducted in March 1999 and March 2003.[16] (For earlier discussions of the MWR in the US and other countries see Mitchell et al 1999, Finkelstein and Poterba 1999, Brown et al 2001, James and Vittas 2001, James and Song 2001). We found that in Chile the MWR is close to 100% for price-indexed annuities,

which constitutes better terms than in other countries and may help explain the high rate of annuitization.

Discount and mortality rates used in MWR calculations

We calculated the MWR using two different discount rates--the risk-free term structure and a risky term structure. The risk-free rate is based on 0 coupon bonds in 2003 and is derived from government bonds 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 other countries have earned, per year, over the past decade (James and Song 2001). The relevance of the risk–free versus the risky rate depends on consumer time preferences and perceptions of risk. The latter is influenced by insurance company diversification, tight regulation and the government guarantee of the annuity.[17]

We employ several mortality tables in our analysis: 1) 1985 mortality tables (RV85), which are period tables that were used by the insurance and AFP regulators until 2004; 2) 1998 period tables (RV98) with lower mortality, which are based on more recent data for male pensioners but not for women; and 3) a cohort-based version of RV98 which we constructed, using the Canadian mortality improvement factor as a proxy. Life expectancy for males at 65 is 80.5 in RV85, 82 in RV98 and 83 for cohort-based RV98. Even though the regulator used RV85 during the period of our study for purposes of establishing reserve requirements, insurance companies knew these rates were out-dated and used their own tables for pricing purposes. Our discussions with insurance companies led us to believe their tables were much like RV98 for men but had lower mortality rates for women. Starting in 2004 the regulator started to use an up-dated table--RV2004-- that is virtually the same as RV98 for males but also incorporates lower mortality rates for women. This should change reserve requirements but is unlikely to impact annuity payouts, since insurance companies had already built the lighter mortality expectations into their calculations. (It will, however, reduce PW payouts in the first few years of retirement). The non-availability of true tables for annuitants or for the entire covered population made it impossible for us to measure the difference in MWR between these groups, as an indicator of adverse selection, as in Brown et al. 2001 and Finkelstein and

Poterba 1999. In Part V we present some evidence on expected versus actual death rates for different sub-groups of annuitants, using RV98 and RV85.

Hypotheses about MWR

We would expect competition to bring the MWR discounted at the risk-free rate, using the true annuitant mortality table, close to the neighborhood of 100%. We would also expect insurance companies to classify individuals and product lines according to their differentiated mortality risks and administrative costs, to the degree possible. Then, using RV85 and RV98, we would expect to find the following:

1) For a given premium, payouts would yield a lower measured MWR for early retirees than for normal age retirees, since younger annuitants pose greater risks to insurance companies than older annuitants. They have many years ahead of them during which mortality may improve, and reinvestment risk is high since very long term investment instruments are scarce. Companies would charge early retirees for these risks in the form of lower payouts relative to premium, hence a lower measured MWR. Also, as discussed above, insurance companies and brokers incur costs in helping workers to retire early, and may pass these costs on in the form of lower payouts.

2) The use of gender-specific tables (risk classification by gender) should lead to similar MWR's for men and women. However, insurance companies are aware that both RV85 and RV98 overstated female mortality. Moreover, the normal retirement age for females is younger than that for men, entailing greater risk as discussed above. Thus, we would expect to find lower MWR's for women, when using these out-dated tables as our longevity measure.

3) Since joint annuities include both a husband and a (younger, more risky) wife the net outcome is uncertain, but since the survivor gets only 60% of the primary benefit, most likely in the distant future, the MWR is likely to be closer to that of the individual annuity for men.

4) Higher premiums have two opposing effects on the payout and MWR, so the net effect is uncertain. On the one hand, payout per dollar of premium might be reduced if insurance companies believe that wealthier retirees will live longer. On the other hand, payouts might rise because administrative costs of annuities tend to be fixed per policy,

hence a lower percentage of premiums for larger accounts. The net impact is therefore an empirical question.

Empirical results

In fact, our results are consistent with these predictions. According to Table 2, Panel A:

1) For unmarried men who retire at age 65, using RV98 as the expected mortality table, the risk-free MWR is 98%. The typical annuitant gets back almost his full premium over his lifetime, in addition to the insurance value of the annuity.

2) Using RV85 as an alternative measure of expected mortality, possibly relevant for poorer members of the system, the MWR is 3-5% lower. But cohort-based RV98, which may be appropriate for richer annuitants, produces a MWR that is 3% higher, bringing the total to over 100%

3) For women, and for men who retire at an early age such as 55, the MWR is lower, as expected, to offset the greater investment and longevity risk involved.

4) Joint annuities, which prevail in Chile, have lower payouts but similar MWR's to individual annuities for men. They also narrow the MWR disparity between retirees with long (RV98) and short (RV85) expected lifetimes.

Panel B compares MWR under various scenarios and shows that:

1) When the risky rate (of government + 1.4%) is used, the MWR falls by 10-12 points, making this a poorer option for retirees who impute greater risk.

2) When the premium is raised to 4000UF (instead of 1000 UF), MWR's rise by 2-4%--the lower administrative cost per unit of assets apparently outweighs the greater likely longevity of people who have larger premiums, in insurance company pricing calculations. (This was also observed in the UK by Finkelstein and Poterba 1999 and Murthi et al 1999).

3) Payouts declined 15-20% between 1999 and 2003 but the MWR was roughly unchanged for men. For the most part, falling payouts simply compensated for the dramatically falling interest rates over this period. Of course, the fact that insurance companies have maintained a constant MWR as interest rates fell means that pension size is very sensitive to the interest rate in effect on the date of annuitization. While annuities

protect pensioners from future risks, workers who are approaching retirement are subject to substantial interest rate risk.[18]

These MWR's in Chile are especially high given that they hold for price-indexed annuities. MWR's of 86-94% using the risk-free discount rate and population mortality tables, and 98-100% using annuitant mortality tables, have been found for Canada, Australia, Switzerland and the United States in 1999, but these were for nominal, not real annuities (James and Vittas 2001, James and Song 2001). Lower nominal MWR's were found for the US in previous years (Mitchell et al 1999). In most countries, only nominal annuities are offered and if insurance companies do offer indexed annuities they usually impose a high price (in the form of a low money's worth ratio). For example, in the UK the MWR that annuitants receive for indexed annuities is around 80% using population mortality tables and 90% using annuitant mortality, while the MWR for nominal annuities is 5-8% higher (see Finkelstein and Poterba, 1999; Murthi et al 1999; Brown, Mitchell and Poterba 2001). However, in Chile the MWR for indexed annuities is 98%. This may be due to two factors—first, the availability of many price-indexed financial instruments in which insurance companies can invest to hedge their risk; and second, the indexation requirements, which eliminates adverse selection between nominal and real annuities. Thus, in addition to aggressive marketing, competition force insurance companies to offer a high money's worth ratio on annuities, and this high MWR may help explain Chile's high rate of annuitization.

Internal rate of return on annuities vs. long-term interest rate and PW rate

In Chile data have historically been reported on the internal rate of return on annuities and the long-term government bond interest rate (PRC20), so we can make some useful comparisons between these two rates across time and across annuity products. The internal rate of return on annuities is a cruder measure of value than the MWR since it implicitly discounts all periods at the same rate, in contrast to the term structure, which discounts payouts that accrue at different points in time at different rates. This particularly matters during periods when the yield curve is steep or changing. In general, the MWR is a more accurate measure of value to consumers. Moreover, the reported annuity rate is based on RV85, which overstates mortality and therefore understates the true internal rate of return on annuities. Nevertheless, the availability of

historical data makes this a useful indicator. Specifically, based on the MWR analysis above, we would expect:

(1) the internal rate of return on annuities should be slightly lower than but close to the long-term bond rate.

(2) The annuity rate should be higher for normal old age recipients than for early retirees or survivors, who entail more risk to insurance companies.

(3) The annuity rate should grow closer to the long term bond rate over time as total and average premiums grow (hence administrative costs per unit of assets falls) and as the proportion of survivor annuitants (who are younger and riskier) falls.

(4) However, the total investment return should remain above the internal rate of return on annuities, since insurance companies cover their costs and profits out of this spread.

Indeed, the disaggregated data show that all these expectations are realized. Over the period 1993-2003 the rate of return on the 20-year government bond averaged 5.93% while the internal rate of return on annuities averaged 5.05% and higher for normal old age annuitants. In recent years the annuity rate has actually exceeded the falling government bond rate, but insurance companies have shifted into higher-yielding price-indexed corporate and mortgage bonds which have enabled them to continue earning a positive spread over-all while providing a high MWR and internal rate of return (Figure 5).[19] Compared with the market return on safe fixed income instruments, annuities continue to look attractive—even more attractive—especially if consumers are not aware of the increased risk in insurance company portfolios. But regulators need to think about this risk more than consumers, since the guarantee means that government will eventually pick up the bill if the insurance companies fail. In this connection, it is quite common for insurance companies in other countries to earn a spread by investing in private bonds and mortgages (James and Song 2001). However, some of these companies elsewhere are now in financial difficulty due to unexpectedly low interest rates available on both public and private securities and the reinvestment risk they consequently face (IMF 2004).

IV. Who Retires Early and Who Annuitizes?

Hypotheses: Guarantees and accumulations shape retirement and payout choice

Consider a retiree with low wages or few years of contributions whose small accumulation could buy him an annuity that is just above the MPG level (25% of the average wage). By choosing PW he gets a larger initial payout (due to the formula and its high interest and mortality rate assumptions) while maximizing his potential bequest to his heirs. He also gets the opportunity to choose his investment strategy and possibly benefit from higher returns than an annuity would provide. In the absence of the MPG he would risk a dramatically falling pension for himself if his PW account is depleted due to long life or falling returns. But the MPG floor avoids this declining pension—providing he has the 20 years required for eligibility. The MPG almost completely protects this worker from the downside of investment and longevity risk—while allowing him to receive any upside gain. He is unambiguously better off choosing PW. Normally one might expect the front-loading of PW to attract retirees with low expected longevity, but because of the MPG those with small accumulations are better off with PW whether they expect their life spans to be high or low. This protection is particularly great if the MPG is wage-linked, as it has been, de facto (Figure 6). Such workers are also unlikely to retire early, both because they don't meet the pre-conditions and because they wish to retain access to the full MPG.

Next, consider a higher-earning pensioner with steady contributions whose initial accumulation could purchase an annuity that is 200% of the MPG (50% of the average wage). He, too, would get a larger payout in the early years from the front-loaded PW. And if he dies young his heirs receive the remainder in his account. However, if he lives long or if investment returns plummet, his PW pension eventually falls all the way to the MGP level, which is far less than he would have gotten as an annuitant. Thus, this worker pays a price for his higher expected income and bequest rights in the early years. This price is smaller, but nevertheless substantial, if the MPG is wage-linked. Moreover, he is likely to be the target of intense insurance company marketing efforts to get him to retire early with an annuity. Insurance companies get a larger surplus from the spread and insurance salespersons get a larger commission when they sell annuities with a high premium. Therefore, we expect that retirees with large accumulations are more likely to annuitize than those with small accumulations, unless they are in ill health (Figure 7).

Finally, consider a top-earning retiree whose initial accumulation is very large—enough to purchase an annuity that is 300% of the MPG. He may have a stronger bequest motive (if bequests are a superior good) and confidence in his own ability to manage investments. He may also wish to keep his withdrawal below the maximum allowed (which he can do with PW), in order to avoid the tax on withdrawals. Like his high-income counterpart he faces a trade-off between maximizing versus insuring his retirement income, but he may have greater capacity to self-insure. These forces may push him to choose PW, while retiring early. If this is the case, we would find an inverted U-shaped relationship between pension wealth and probability of annuitizing.

In sum, we would expect that, as a result of incentives created by the MPG:

1) workers with large accumulations are likely to retire early with annuities;

2) PW is likely to be concentrated among normal age retirees who have small accumulations and pensions clustered around the MPG;

3) but early retirees with the greatest accumulations may choose PW because they are willing to self-insure while gaining its other advantages.

This is exactly what we find.

Empirical evidence

We do not have individual-level data on PW pensioners that would allow us to identify who chooses PW versus annuities. However, we do have aggregate-level data, which we use to throw light on this question.

Almost two-thirds of all retirees in Chile are annuitants and 60% of retirees are early retirees. Among the stock of early retirees, 85% have annuitized and 80% of the flow of new annuitants are early retirees. In contrast, two-thirds of all normal age retirees are PW pensioners and three-quarters of all PW pensioners are normal retirees (Figure 3). These numbers underscore the close linkage between early retirement and annuitization. The probability of annuitization for early retirees is 250% that of normal age retirees.

Consistent with our expectations, the average annuity is almost double that of the average PW pension among normal age retirees. But retirees with the largest payouts are also on PW—they are wealthy enough to retire early and to self-insure (Table 3).

Among normal old age PW pensioners the average payout has been hovering close to the MPG since the system began. Some of these did not have a choice initially,

but even those who did typically no longer do--79% of normal old age PW pensioners, including 12% whose pensions are fully paid by the government, are now at the MPG floor (Table 4). This differs sharply from annuitants, whose average payout is almost double the MPG. Only 2% of annuitants receive the MPG top-up (Table 5).

This disparity between PW pensioners and annuitants underscores the moral hazard problem and the crowd-out effect on private insurance that stems from publicly provided insurance. The absence of mortality pooling implied by bequests means that some retirees who choose PW will eventually exhaust their accounts and become a charge on the public treasury, even though they initially had enough money to buy an immediate or deferred annuity that would have kept them above the MPG level for life.

Comparison with other empirical studies on annuitization choice

These high annuitization rates for Chile, especially among retirees with medium and large accumulations, may be contrasted with those of empirical studies of pension withdrawal decisions in other contexts. For example, studies of the choice between cash-outs and other forms of withdrawal in occupational pension plans in the US, based on individual-level data, have found high rates of cash-outs when workers leave their jobs (Hurd, Lillard and Panis 1998, Warner and Pleeter 2001). However, these choices were made in a context where lump sum cash-outs were a feasible option, the mandatory social security system provided a defined benefit, insurance companies did not receive competitive advantages, and the small size of the potential market did not make aggressive marketing efforts worthwhile. In other words, the very conditions to which we attribute the high rate of annuitization in Chile were absent in these situations. Consistent with our results, cash-out rates were lower for workers with larger retirement savings and higher incomes.

Closest to our study is one by Butler and Teppa (2004) on distributions from mandatory retirement accounts in Switzerland. Here, lump sum withdrawals are permitted, which should reduce the annuitization rate—but annuitization is presented as the "standard" or default option—which should have a positive effect. The public benefit is a DB—which should reduce annuitization--but it is relatively small for high earners—which should reduce its negative impact on annuitization. Insurance companies usually play an important role in these pension plans but their payout terms are set by law and

imply a generous money's worth ratio exceeding 100% for nominal annuities—higher than those provided in Chile but without inflation insurance. Butler and Teppa found a high annuitization rate of 67%--practically the same as our rate in Chile. They also found a U-shaped relationship with total retirement accumulation, as did we.

V. Adverse Selection—Does Private Information Influence the Annuity Choice?

It is often claimed that asymmetric information about health and expected longevity could lead to a breakdown of the annuity market through the well-known process of adverse selection. If insurance companies expect that annuities will be purchased disproportionately by people with good health they will set their payouts accordingly and this will imply bad terms for people with poor health, who consequently will not purchase annuities. This is sometimes used as a rationale for a public DB plan or for compulsory annuitization under a private DC plan. What light do the data from Chile throw on this question? As noted above, retirees with small accumulations are unlikely to annuitize regardless of expected longevity, but health expectations could enter into the decisions of those with large accumulations.

Before turning to our data analysis, it is clear that the market has not broken down given the high rate of annuitization in Chile. Since the majority of retirees purchase annuities, this insurance product does not appeal only to a small group of very healthy people. We argue that this is due in large part to the regulations described above, which attract a broad base of consumers into the market. The joint annuity requirement further reduces potential adverse selection because it means that both spouses, whose expected longevity is not strongly correlated, will be involved in most annuity contracts. Gender-specific mortality tables are permitted for risk differentiation, thereby avoiding adverse selection based on gender.[20]

Hypotheses

To throw light on the degree to which asymmetric information distorts the annuity market, we would like to compare the mortality rates of retirees who choose PW versus annuities. Unfortunately, we cannot use this direct test since we do not have information on mortality of PW pensioners. However, we do have individual-level information about

mortality rates of annuitants, so we can investigate indirect evidence of private information, via the disparity between actual and expected deaths (A/E ratios) among different sub-groups of annuitants. Expected deaths are the number of deaths we would expect to have in a sub-group based on its age distribution and age-specific mortality rates from a specified table. Actual deaths are the observed deaths for that sub-group, again a function of its age distribution. That is:

$$A/E = \Sigma w_x q^a_x / \Sigma w_x q^e_x$$

where q^a and q^e are actual and expected age-specific death rates and w_x gives the relative weights for each age x.

If the true population mortality table is used to calculate expected deaths and there is no selection, this ratio would converge to 100%. In the presence of selection among annuitants, we would predict that $q^a<q^e$ and A/E may be used as a measure of adverse selection. In this analysis we use two mortality tables—RV85 and RV98—to calculate expected deaths as a function of age and gender for members of each sub-group. RV85 is the out-dated table that was used by the insurance and AFP regulators during the period covered by this study while, for men, RV98 is virtually identical to the newer mortality table that was adopted in 2004. As discussed above, neither table is a "true" population table. For men, RV98 (=RV2004) is apparently considered the best approximation to a true pensioner mortality table for men, but it is a period rather than a cohort table. Given this uncertainty about true tables, we do not expect A/E ratios to converge to 100% in the absence of selection and we do not use A/E ratios as a measure of absolute selection from the population. Instead, our hypotheses focus on how these ratios vary across sub-groups of annuitants, as a possible measure of relative selection among these sub-groups. We also discuss some biases that might be introduced into these relative ratios if the age pattern of mortality in RV98 deviates from true mortality rates. (For more generic development of the A/E metric and its application to life insurance purchases in the US, UK and Japan, see McCarthy and Mitchell 2003. For evidence on population and annuitant mortality tables in the US, displaying adverse selection, see Brown et al 2001 and for the UK see Finkelstein and Poterba 1999). We hypothesize that:

(1) If private information exists it is likely to be concentrated in the short 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. The concentration of selection effects in the short run is a common phenomenon in the insurance literature (see the distinction between select and ultimate mortality tables in McCarthy and Mitchell 2003). Therefore, we predict that annuitants will have lower A/E ratios in the first few years of exposure than they will later on. Given that we have only ten years of exposure in our data, we may never reach "ultimate" values.

(2) Private information may influence the type of annuity product purchased. Annuitants who expect to have short life-spans are more likely to purchase annuities with a guaranteed payment period, in which their heirs continue collecting benefits even if they die—a partial bequest. Such products are likely to have higher A/E ratios than simple annuities, and we expect this effect to be stronger in the short run for the reason given above.

(3) Finally, we investigate the relationship between size of premium or pension, and mortality among annuitants. Size of premium and payouts are likely to be positively correlated with the annuitant's lifetime income, since premiums and pensions are a function of contributions that are based on wages. Lifetime income, in turn, is known to be negatively correlated with mortality rates in other countries. Therefore we expect that annuitants with higher premiums and pensions will have lower A/E ratios than those with smaller premiums and pensions. This effect is not due to selection and asymmetric information—it simply stems from correlations and public information--and it may continue in the long as well as the short run.

We concentrate this analysis on men, who constitute the majority of annuitants, since some cell sizes are rather small for women and the annuitization choice for women may depend to a greater extent on variables (such as marital status) that are not included in our data set.

Findings

A/E ratios by years of exposure. Our evidence, summarized in Table 6, is consistent with the prediction that asymmetric information will be concentrated in the short run. We show both marginal and cumulative ratios for each sub-group, the former essentially considering each year of exposure, $y_{i,}$ as a separate risk category and the latter summing over the mortality experience of all years of exposure from y_1 to y_i for each i.

When the cumulative A/E's are rising, this implies the marginal values are higher than the cumulative, and vice versa. Using RV85 as the "expected" table, A/E ratios for men start at 64%, rise sharply to 86% (marginal) and 79% (cumulative) after 5 years of exposure, and rise much more gradually thereafter, barely approaching 100% in the end. Using RV98 as the "expected" table, A/E ratios for men start at 85%, rise sharply to 112% (marginal) and 104% (cumulative) by year 5, and rise more slowly thereafter. (This is consistent with the fact that RV85 has much higher mortality than RV98; but it is somewhat surprising that the ratios for RV98 eventually exceed 100%). Ratios for women lie considerably below those for men and are more irregular, but exhibit the same characteristic of starting low and rising for subsequent years of exposure (Figure 8).

It is possible that the expected mortality tables overstate true mortality in the age range 50-60, which is the age when many workers retire. This could produce relatively low A/E ratios in the early years of exposure even if there were no asymmetric information. To test this possibility we separated out early and normal age retirees. Using RV85 we found the two groups were very similar and the cumulative A/E was below 100% for both groups. Using RV98, the ratios are much lower for normal than for early retirees and exceed 100% for the latter, suggesting that, in fact, RV98 may understate mortality in the age range 50-60. Most important for us: for all sub-groups, the pattern with respect to years of exposure is similar: A/E ratios are low initially, increase sharply in the short run and more slowly thereafter.

The first few years of exposure contain many workers who retired in more recent years and belong to young cohorts, while the later years of exposure contain mainly workers who retired in earlier years and belong to older cohorts. If mortality has been falling over time, we could be mistaking a mortality-improvement factor for a years-of-exposure effect. To distinguish these two effects, we disaggregated A/E ratios by year of retirement. While these ratios have indeed been slightly lower in more recent years, holding year of retirement constant we found a similar pattern in each case.

The rest of our analysis compares sub-groups of men (those purchasing simple versus guaranteed annuity products, those with large versus small accumulations and pensions), using RV98 as the standard of measurement.

A/*E ratios by type of annuity product.* Next we break down A/E ratios by type of annuity purchased—simple versus one with a guaranteed period. As expected, A/E ratios are higher for retirees who purchase annuities with a guaranteed payout period. While the ratios rise with years of exposure in both cases, the rise is steeper for purchasers of simple annuities. Thus, the differential between the two sub-groups is stronger in the first few years of exposure, as expected (Figure 9). For purchasers of simple versus guaranteed products, their relative cumulative A/E ratios rise from 75% in year 1 to 95% in year 5. This is consistent with our hypothesis that workers do not purchase simple annuities if they know they are currently in ill health, but they may purchase guaranteed period annuities that will continue payments to their heirs; and they do not have enough private information to make an intelligent selection for the long run. (Selection by type of product was also found by Finkelstein and Poterba 1999 in their study of the UK).

Selection by product is mitigated by the fact that some healthy retirees may also purchase annuities with guaranteed periods, to avoid the effect of new negative information about their health status shortly after annuitizing, which would cost their heirs a large potential estate. Importantly, two-thirds of all annuities sold in Chile are guaranteed for a 10-15 year periods. This is obviously a crucial strategy for overcoming adverse selection in the broader annuity market and accommodating the bequest motive--thereby fostering the growth of annuitization.

A/E ratios by size of premium and pension. Next we compare A/E by size of premiums and pensions. Our hypothesis is that A/E is inversely related to size of premium and pension. We attribute this to the well-known observation that people with greater income and wealth live longer, rather than to active selection. Thus we expect to observe higher relative A/E rates among those with smaller premiums and pensions, in all years of exposures.

Indeed, this turns out to be the case. A/E is much lower for those with larger premiums and pensions. As before, A/E ratios increase with years of exposure. But this effect is very similar for all premium and pension groups. In other words, selection based on short run private information takes place within each group, but not to a markedly different extent across groups. A/E for those with premiums exceeding 3000 UF (about US$72,000 in 2002) is only 60-65% as high as A/E for those with premiums below 1000

UF (about US$24,000 in 2002)--for all years of exposure. A/E for pensioners with payouts exceeding 10 UF per month are only 70-75% as high as those for pensioners with less than 5UF per month--for all years of exposure (Figure 10). While we do not have data on mortality rates of PW pensioners, these data suggest that they may have shorter longevity too, given their smaller accumulations.

Information about their accumulations and higher expected lifetimes is public, not private, so insurance companies could vary their terms according to these differential probabilities. But our analysis of the MWR showed that retirees with larger accumulations are not charged more; on the contrary, they get slightly better terms than average, probably because of the fixed administrative costs per account. This means that, given their higher expected lifetime, our measurement may understate their true MWR and overstate that of lower income groups. This may be a contributing factor leading to the higher annuitization rate observed for those with large accumulations.

Summary. In sum, this evidence suggests that some limited selection based on expected longevity is taking place despite the high proportion of retirees who annuitize. The relatively low A/E ratios in the first years of exposure suggests that retirees who know they are in bad health and likely to die soon are less likely to purchase annuities. But they are less able to make good predictions about their health status in the long run—which reduces the pricing and distortionary impact of adverse selection. Workers appear to use this information in a rational way. Retirees who want the insurance that annuities provide but fear they may die young choose a product (such as annuities with guaranteed payment periods) that does not penalize those with short lifetimes. Retirees with small accumulations are likely to have shorter lifetimes and, as we know from the preceding discussion, they are less likely to annuitize--but this information is not private and the MPG deserves much of the credit for this behavior. While some short run asymmetric information appears to exist, apparently it has not been a major source of adverse selection among annuitants and has not prevented the growth of a flourishing annuity industry in Chile.

VI. Conclusion: Lessons for the US and Other Countries

We started out by asking: what explains the high rate of annuitization in Chile and who annuitizes? Our evidence suggests that incentives and constraints imposed by guarantees and regulations, as well as competition in the insurance market, are the major explanations. Workers with small accumulations retire at the normal age and take PW pensions, receiving insurance through the public MPG. But the majority of workers retire early, assisted by insurance company salesmen, and 85% of them purchase annuities—the only source of meaningful investment and longevity insurance available to them, in the absence of any other DB in the system. As a result, a new multi-billion dollar industry—the life insurance industry, specializing in annuities--has developed, practically from scratch.

Insurance companies offer a high money's worth ratio for price-indexed annuities, which makes annuitization attractive to retirees, while covering their costs out of the spread between the risk-free rate that they pay annuitants and the higher return they earn on a diversified investment portfolio. They pay generous sales commissions to brokers, who actively pursue workers with large accumulations as potential clients, at the earliest point of eligibility. In contrast, AFPs, which provide PW pensions, are at a competitive disadvantage because they are not permitted to pay commissions to independent brokers. Moreover, AFPs have no incentive to convince their worker-clients to retire and become pensioner-clients, while insurance companies do not face this opportunity cost.

Almost two-thirds of all retirees have annuitized and annuitization mitigates some of the longevity and investment risks faced by pensioners and public treasury. Nevertheless, the fiscal cost faced by the government may be substantial, as a result of its provision of longevity and investment insurance. Careful long-term projections have not yet been carried out. However it appears likely that many PW pensioners who live past the expected age of death will be fully financed by the government. Some of these pensioners had accumulations that were large enough to finance annuities that would have kept them above the MPG level for their lifetimes. These costs to the treasury could have been reduced if PW were required to be buttressed by a deferred annuity or if bequests were limited and the government recaptured part of the remaining accumulation, upon death of the pensioner, in exchange for its MPG insurance.

Additionally, if the MPG continues to move with wages, many annuitants will become eligible for a top-up at some point in their 80's, because the rising MPG will have passed their annuity payout. While these potential fiscal costs have been reduced by recent tightening of the early retirement pre-conditions, further tightening may be desirable. Beyond that, if the intent is to have an escalating MPG, perhaps annuities and PW should also be based on an escalating formula, to prevent payouts that exceed the MPG initially but fall below later on.

Although we found some evidence of short-term asymmetric information, its effect is mitigated by the joint annuity requirement and the ability of those with shorter expected lifetimes to purchase annuities with guaranteed payment periods. Thus, adverse selection has not stopped the rapid growth of the annuity market in Chile.

The good news for other countries is that:

1) even though life insurance companies hardly existed before the pension reform, they quickly developed in response to the demand for annuities, further stimulated this demand, and provide a high MWR for price-indexed annuities;
2) under these conditions, adverse selection due to asymmetric information does not seem to pose a major problem;
3) with appropriate incentives and constraints, a high proportion of pensioners will purchase annuities that provide longevity insurance and reduce fiscal liabilities.

But important caveats also emerge:

1) in Chile the incentives for annuitization include the absence of a public or private DB (except for the MPG), government guarantees of annuities and regulations that give insurance companies a competitive edge over AFPs selling PW pensions;
2) if early pensioning is permitted many workers will choose that option; and
3) if payout rules and early retirement pre-conditions are not well coordinated with minimum pension guarantees and other safety net provisions, this may lead to moral hazard problems and increases in public obligations as the system matures.

This analysis was limited by the absence of mortality data on PW and our lack of knowledge about the accumulations available upon retirement, therefore the choice set that individuals actually faced at that point. We also don't have information about worker

characteristics, such as marital status and other sources of income, which might influence annuitization choice. A new individual-level data set on AFP affiliates, giving work, contribution and retirement histories has just become available and that should enable further explorations of these issues.

Table 1: Percentage distribution: Early versus normal retirement, annuities vs. PW, stock of pensioners in 2002

	Normal retirement	**Early retirement**	**Total**
PW	26%	9%	35%
Annuitization	14%	51%	65%
Total	40%	60%	100%

Source: calculations by authors based on data from Superintendencia de Valores y Seguros (SVS) and Superintendencia de AFP (SAFP)

Table 2: Money's Worth Ratios, Chile, 1999 and 2003*

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

Annuity product	2003 monthly payout (UF)	MWR using RV 98, period	MWR using cohort-based RV98*	MWR using regulators' period, RV85
Males				
Age 65, individual annuity	7.08UF	98.1%	101.2%	93.5%
Age 55, individual annuity	5.46UF	94.1%	97.6%	90.1%
Joint, male 65 & female 60, 60% to survivor	5.89UF	97.7%	100.8%	94.6%
Joint, male & female 55, 60% to survivor	4.82UF	91.6%	94.6%	89.1%
Females				
Age 60, individual annuity	5.37UF	92.5%	95.8%	89.7%
Age 55, individual annuity	4.81UF	89.9%	92.9%	87.4%

B. MWR under different discount rates, premiums and years, using RV98 period

Annuity product	2003- 1,000 UF premium, risky rate	2003- 4,000 UF premium, risk-free rate	1999 payouts for 1,000 UF premium	MWR for 1999 payouts & 1999 risk-free rate
Males				
Age 65, individual annuity	88.1UF	98.2%	8.20UF	97.9%
Age 55, individual annuity	82.2UF	96.3%	-	-
Joint, male 65 & female 60, 60% to survivor	86.0UF	99.3%	7.31UF	100.0%
Joint, male & female 55, 60% to survivor	78.9UF	95.8%	-	-
Females				
Age 60, individual annuity	81.0UF	95.6%	7.23UF	96.3%
Age 55, individual annuity	77.6UF	94.7%	-	-

Source: Calculations by authors. For mortality tables and other details see text.

Notes: MWR = expected present value of lifetime annuity payments/initial premium. UF is Unidad de Fomento—the price indexed unit of account. In 2003 1000UF=about $25,000.

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 and Vittas 2001). Term structure of risk-free rates for March 2003 was based on zero coupon bonds issued by the Central Bank. 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 investments by insurance companies. All mortality tables in Chile are period tables. The 1985 table was used by the regulator until 2004. The 1998 table is similar to the new table that was adopted in 2004 for men but overstates mortality for women. We transformed the 1998 period table into a "cohort-based" table by imputing the improvement factor used in Canada. Actual MWR's may be higher for two reasons: 1) We do not include the required funeral benefit of 15UF; and 2) We do not include the rebate that, according to anecdotal evidence, is sometimes paid to annuitants by brokers.

Table 3: Average monthly payout per pensioner from annuities and programmed withdrawals, in Chile, selected years, 1983-2002 (in Chilean UFs)*

	Normal old age pensions				Early retirement		
Year	**New annuities (flow)**	**Stock of annuities**	**Stock of PW pensions**	**PW minus MPG**	**Annuities-flow**	**Annuities-stock**	**PW-stock**
1983		3.7	2.9	-.66			
1985		8.4	2.8	-.23			
1988		7.7	3.0	-.05		9.4	12.9
1990		8.2	3.4	-.24		8.4	17.9
1993	8.1	7.7	4.5	.92	8.6	8.4	13.5
1995	7.3	7.9	5.2	1.46	7.9	8.1	14.5
1998	10.9	8.6	4.6	1.26	10.9	8.4	10.7
2000	11.0	8.8	5.2	.31	10.9	8.9	14.1
2002	12.4	9.3	5.2	.33	11.6	9.3	12.4

Source: Calculated by authors from Superintendencia de Valores y Seguros (SVS) data for flows and Superintendencia de AFP (SAFP) data for stocks.

UF is Unidad de Fomento, 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 12.4*23.44 = US$291.

PW minus MPG is given for retirees over age 70, who get higher MPG than those under age 70.

Table 4: Actual PW payouts compared with MPG, May 31, 2003—number of pensioners (in 000) and average pensions in UF*

	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%

Source: data provided by Superintendencia de AFP (SAFP) and calculations by authors.
*UF is Unidad de Fomento, the price-indexed Chilean currency.
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 5: Number of 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
2002--% of total annuitants	2%

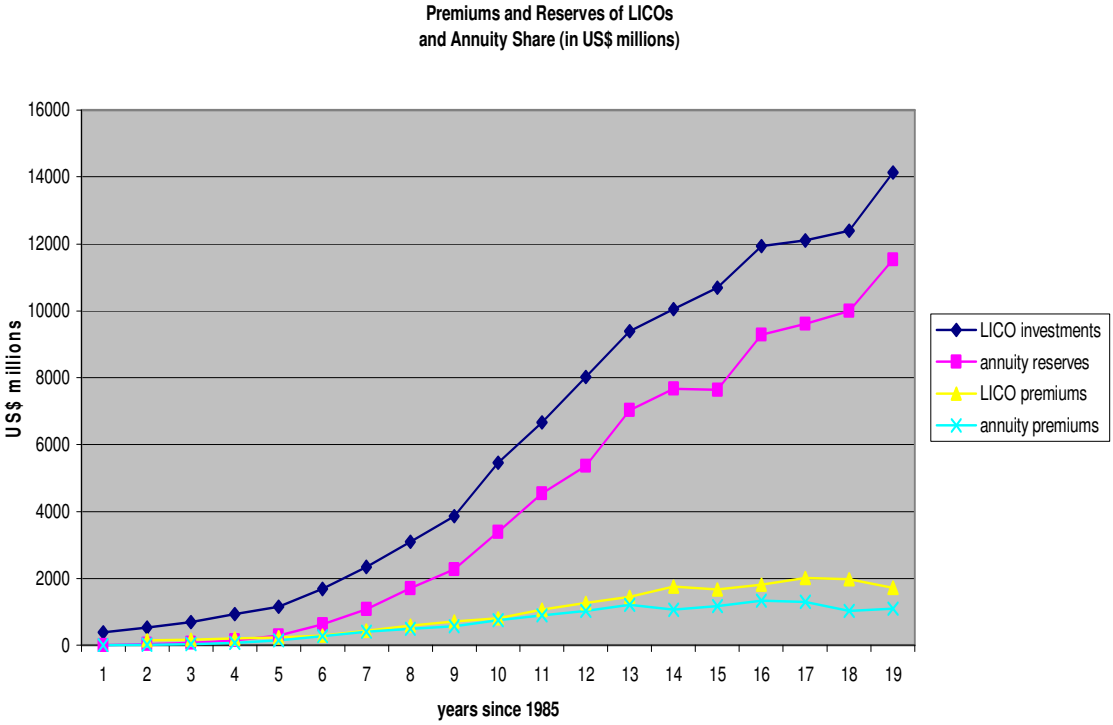
Source: Superintendencia de AFP (SAFP)

Table 6: A/E ratios by type annuity and size of premium, men, 1990-2001*

Years of exposure	1	2	3	5	7	9	10	# policies
CUMULATIVE DEATHS								
Observed death-cum.	660	2,085	3,490	6,241	8,670	10,497	11,196	
A/E ratios by mortality table, years of exposure and normal vs. early retirement								
A/E-RV98	85%	96%	100%	104%	107%	109%	110%	174,090
RV98 normal age ret.	81%	87%	89%	93%	97%	99%	100%	27,529
RV98 early retirement	87%	101%	105%	110%	112%	114%	115%	146,561
A/E-RV85	64%	72%	75%	79%	82%	84%	85%	174,090
By type annuity								
Simple	70%	86%	93%	101%	104%	106%	108%	55,325
Guaranteed	93%	102%	104%	106%	109%	110%	111%	118,765
A/Esimple/A/Eguarant'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)/A/E(<1000)	0.66	0.56	0.6	0.64	0.65	0.67	0.67	
By pension size (CH UF monthly)								
<5	99%	108%	114%	118%	120%	121%	122%	52,320
5-10	86%	101%	103%	106%	109%	110%	111%	68,470
>10	70%	77%	80%	85%	88%	91%	91%	53,300
A/E(>10)/A/E(<5)	.71	.72	.68	.75	.85	.82	.73	
MARGINAL DEATHS								
Observed deaths-marginal	660	1424	1406	1364	1125	846	699	
A/E ratios by mortality table, years of exposure and normal vs. early retirement								
A/E-RV98	85%	102%	108%	112%	114%	119%	125%	174,090
RV98 normal age ret.	81%	90%	93%	103%	112%	101%	116%	27,529
RV98 early retirement	87%	109%	112%	117%	115%	129%	130%	146,561
A/E-RV85	.64	.77	.80	.86	.89	.96	1.02	174,090
By type annuity								
Simple	93%	107%	107%	112%	115%	122%	127%	55,325
Guaranteed	70%	95%	104%	113%	113%	117%	122%	118,765
A/Esimple/A/Eguarant'd)	.75	.89	.98	1.02	.99	.96	.81	174,090
By premium size (CH UF)								
<1000	98%	109%	115%	122%	114%	121%	131%	71,978
1000 - 3000	77%	109%	103%	105%	121%	120%	122%	80,104
>3000	64%	56%	76%	92%	83%	107%	106%	22,008
A/E(3000/1000)	.66	.52	.66	.75	.73	.89	.81	
By pension size (CH UF monthly)								
<5	99%	113%	124%	125%	118%	125%	142%	52,320
5-10	86%	109%	106%	112%	120%	126%	126%	68,470
>10	70%	81%	84%	94%	101%	103%	103%	53,300
A/E(>10)/A/E(<5)	.71	.72	.68	.75	.85	.82	.73	

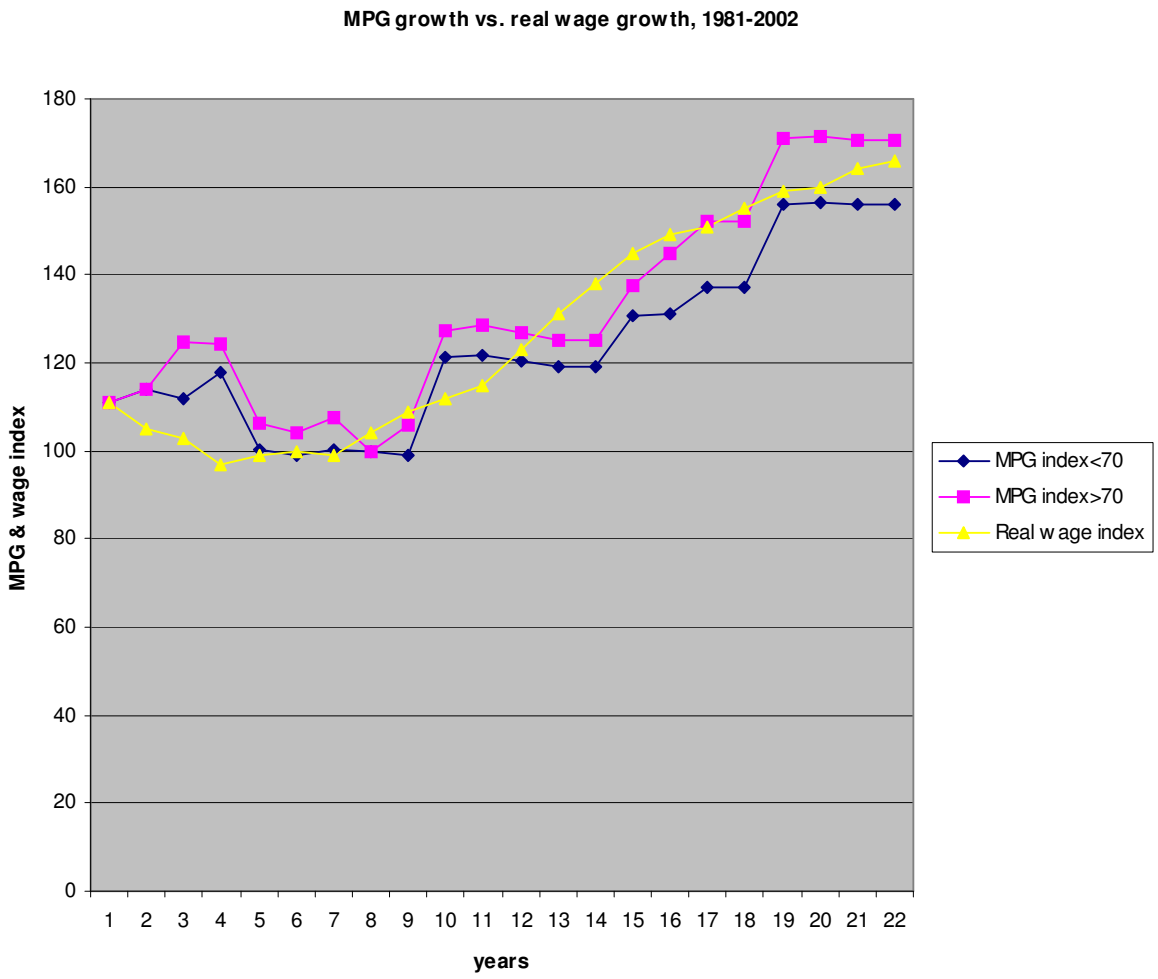
* A/E ratio=actual/expected mortality based on RV98, except for rows giving A/E-RV85. Calculations by authors based on individual-level data on annuitants supplied by Superintendencia de Valores y Seguros (SVS).

Figure 1: Premiums and Reserves of Life Insurance Companies (LICOs) and Annuity Share (in US$ millions)



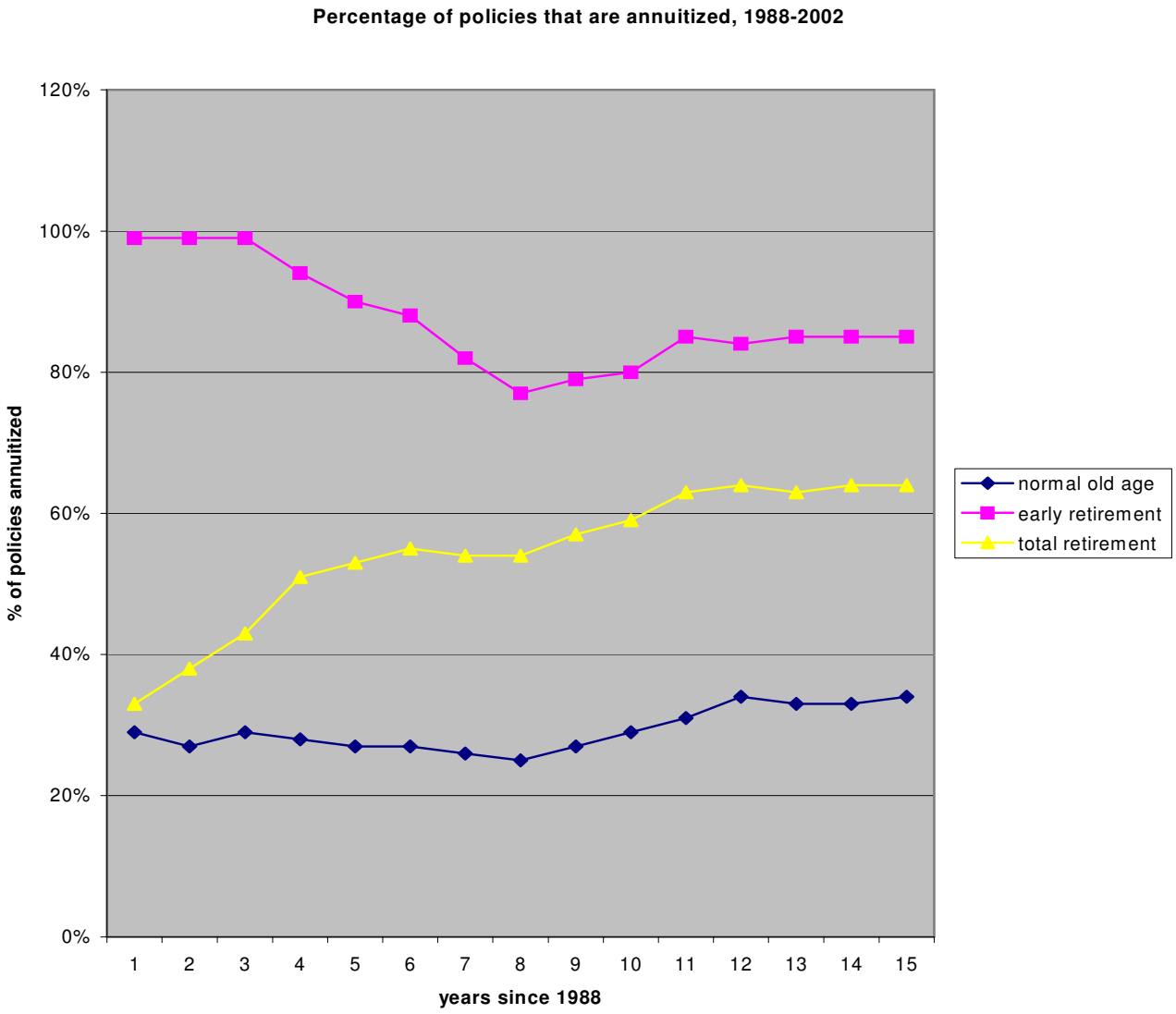
Source: Calculated by authors based on data from Superintendencia de Valores y Seguros (SVS).

Figure 2: MPG growth tracks real wage growth (all indices = 111 in 1981)



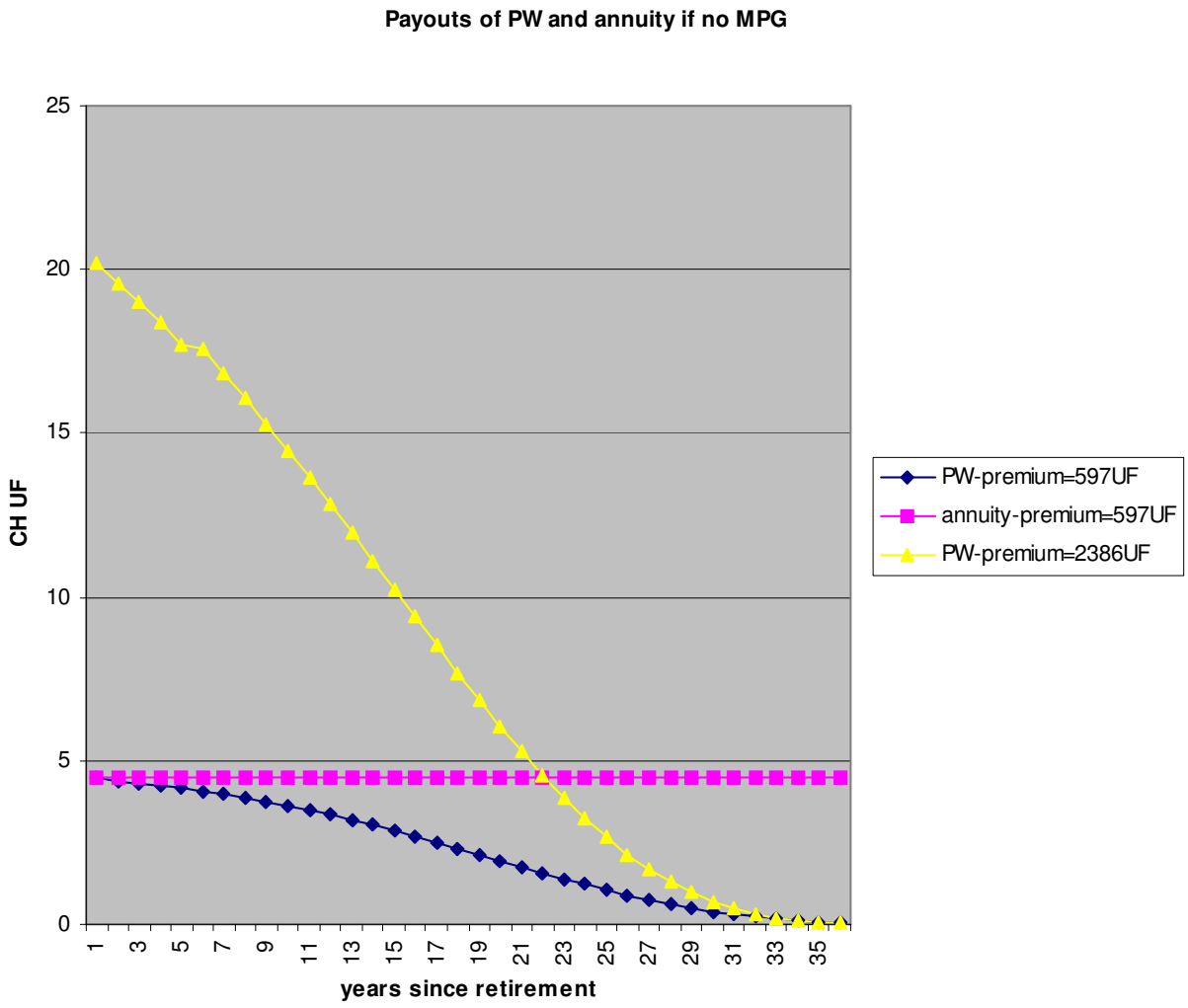
Source: MPG from Primamerica data base, wage index from Instituto Nacional de Estadisticas .

Figure 3: Proportion of policies that are annuitized, 1988-2002



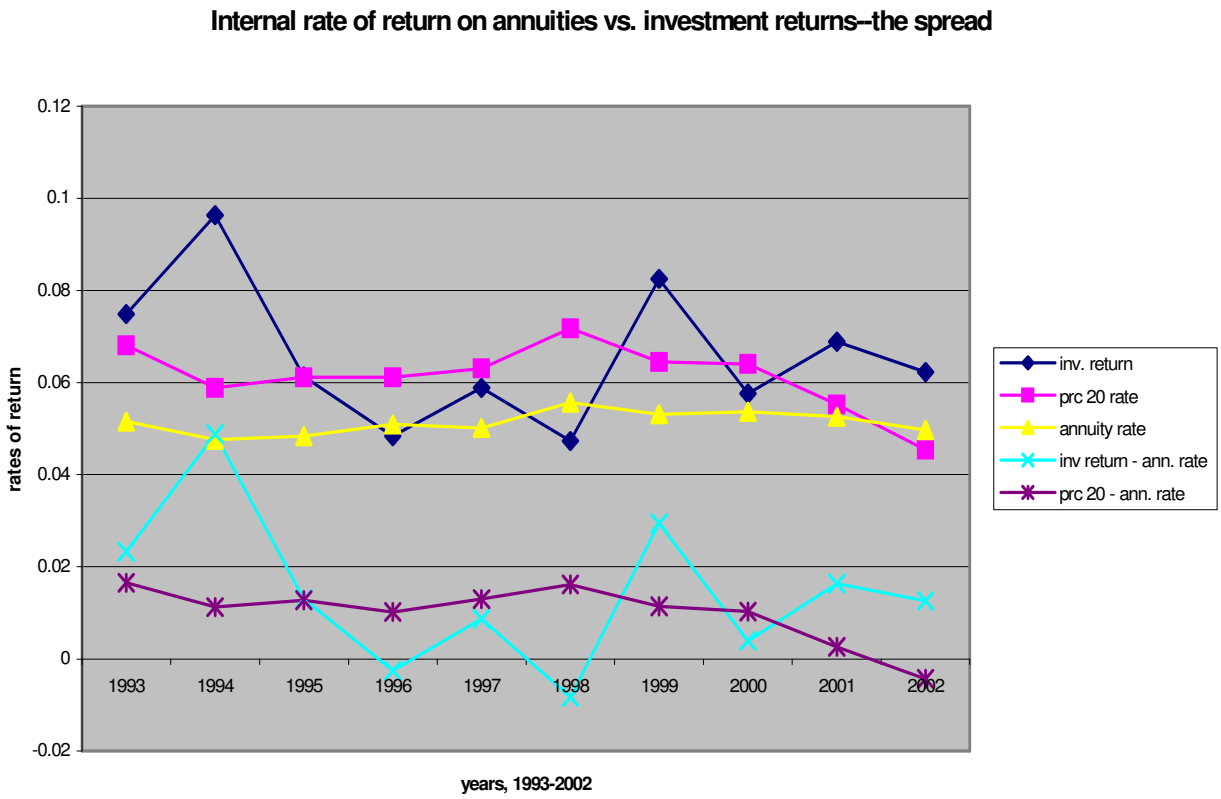
Source: Calculations by authors from data in Superintendencia de AFP (SAFP). 2003. The Chilean Pension System. Santiago, Chile.

Figure 4: Level annuity compared with declining PW if no MPG



Source: calculations by authors
Note: Accumulation of 597 UF purchases annuity = 100% MPG at age 65
2386UF purchases annuity = 400% MPG
Annuity and PW pension are based on mortality table RV98, r=5%.

Figure 5: Investment returns to insurance companies exceeds internal rate of return to annuitants 1993-2002—the spread



Source: Calculations by authors based on data from Superintendencia de Valores y Seguros (SVS), Superintendencia de AFP (SAFP) and Central Bank of Chile.
Note: PRC 20 is 20-year government bond rate. Investment returns include realized capital gains and losses but do not include unrealized gains and losses. Annuity rate is internal rate of return for new annuities (flow) while investment returns include returns on entire stock of investments.

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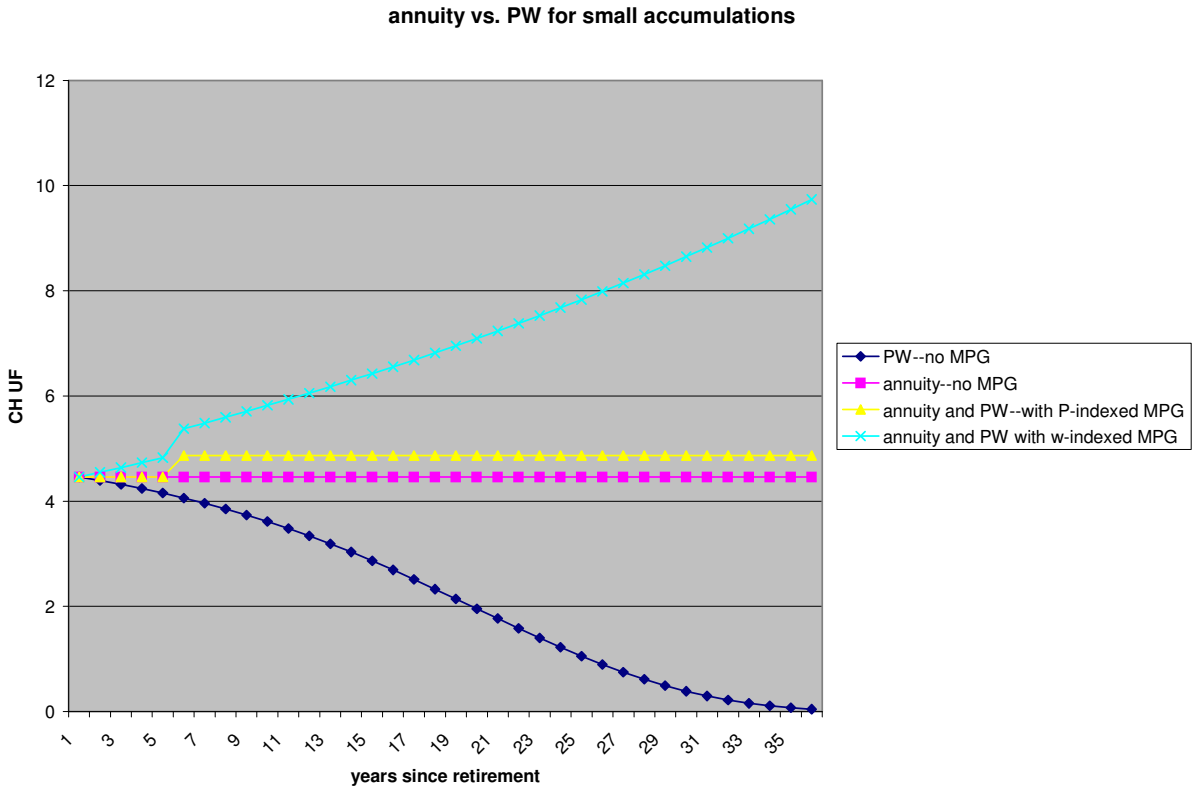
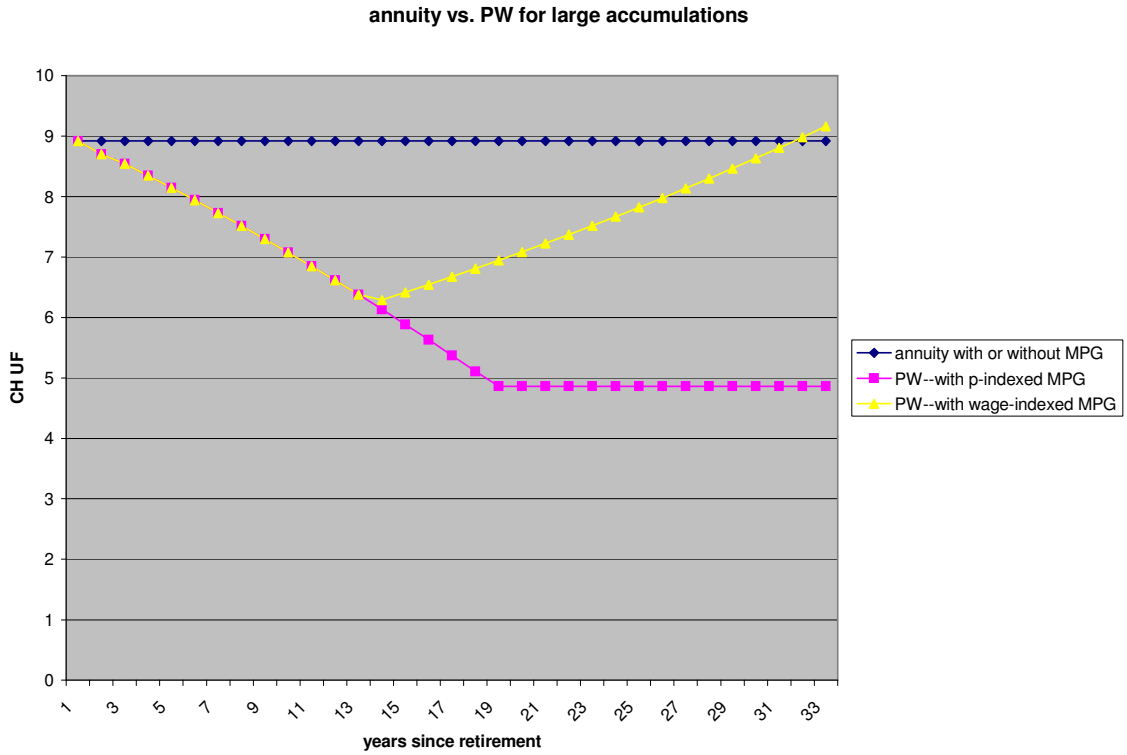
Figure 6: Monthly payouts for PW vs. annuity for small accumulation, with MPG



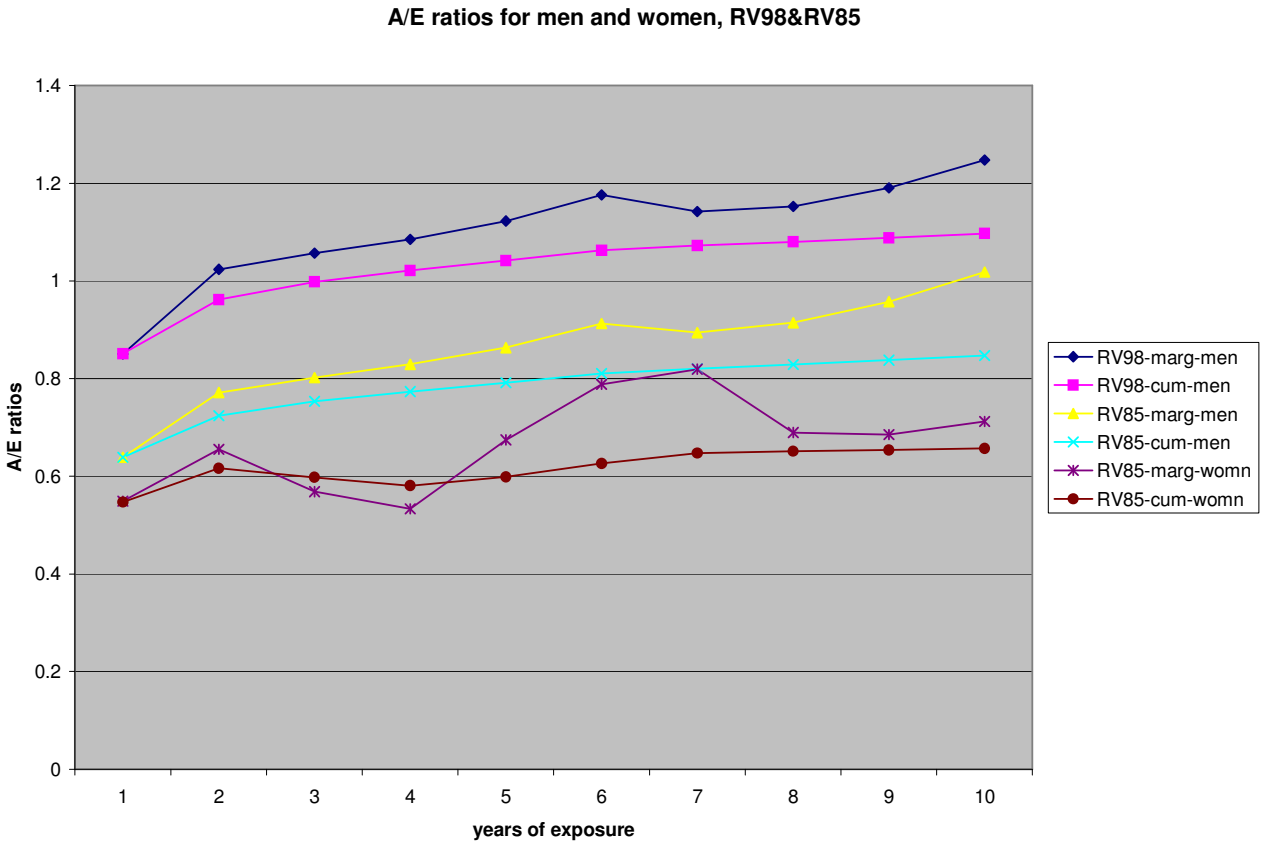
Source: calculations by authors based on mortality table RV98, r=5%, wage growth=2%. Initial balance is assumed to be just enough to purchase monthly annuity=MPG=4.46UF (about US$112). PW payout could go higher if interest rate rises, but will not go lower if interest rate falls. Annuity remains constant if interest rate changes. UF is Unidad de Fomento—the Chilean price indexed unit of account.

Figure 7: Monthly payouts from annuity vs. PW for large accumulation



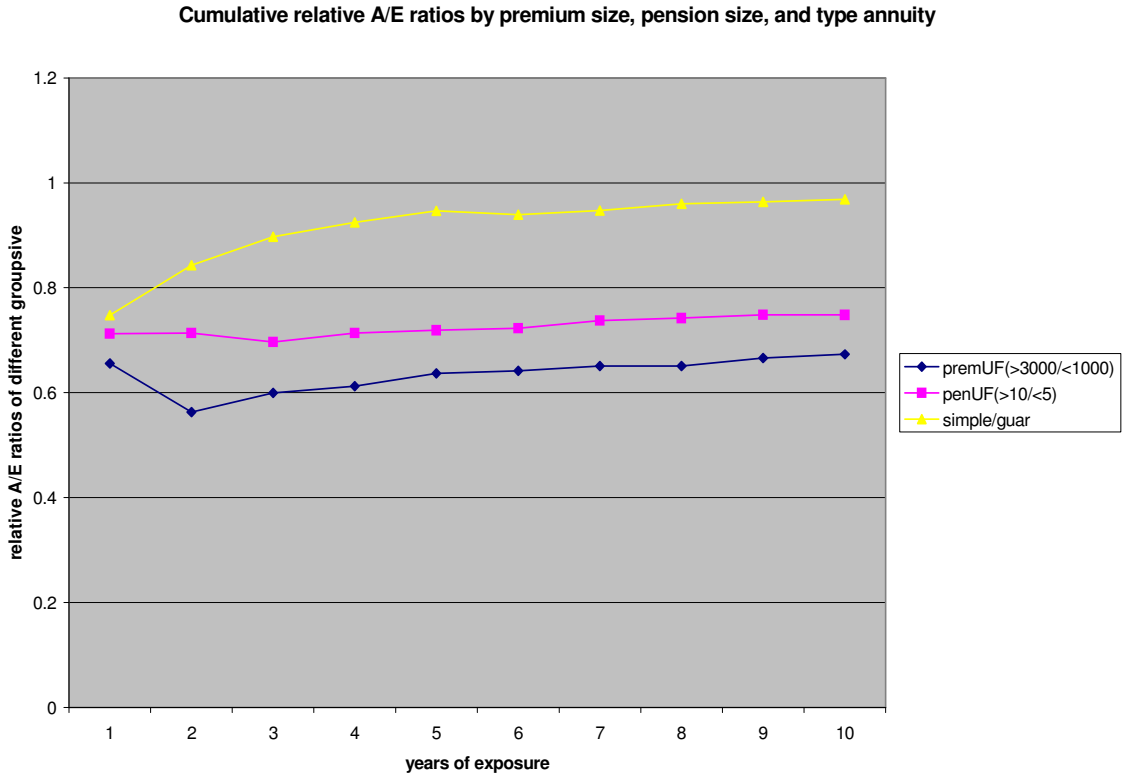
Source: calculations by authors based on mortality table RV98, r=5%, wage growth=2%. Initial balance is assumed to be just enough to purchase monthly annuity=200% MPG = 8.92UF (about US$224). UF is Unidad de Fomento—the Chilean price-indexed unit of account.

Figure 8: Cumulative and marginal A/E ratios for men and women



Source: Calculations by authors based on individual-level data on annuitants supplied by Superintendencia de Valores y Seguros (SVS). A/E ratio=actual/expected mortality, where expected mortality is based on mortality tables RV98 or RV85.
See Table 6 and discussion in text.

Figure 9: Relative cumulative A/E ratios for small vs. large premium size and pension size, and for simple vs. guaranteed period annuity products



Source: Calculations by authors based on individual-level data on annuitants supplied by Superintendencia de Valores y Seguros (SVS). A/E ratio=actual/expected mortality, where expected mortality is based on mortality tables RV98 or RV85.
See Table 6 and discussion in text.
PremUF (>3000/<1000) is A/E ratio for premiums larger than 3000UF, divided by ratio for premiums smaller than 100UF.
PenUF(>10/<5) is A/E ratio for monthly pension larger than 10UF, divided by ratio for pensions smaller than 5UF
Simple/guarantee is A/E ratio for simple annuities divided by A/E ratio for annuities with a guaranteed payout period of 10 years or longer.

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Endnotes

[1] See Walker 2003 and Valdes 1998 for previous analyses of selected payout issues.

[2] In contrast, in the US less than 2% of total life insurance premiums in recent years were for immediate individual payout annuities and most of these were for fixed payout periods resulting from structure settlements, not for life annuities (American Council of Life Insurers. 2000. pp. 30, 31, 84).

[3] For example, variable annuities and annuities denominated in foreign currencies will be permitted as soon as implementing regulations are developed, a pension that combines annuity plus programmed withdrawals will be allowed in the future, and banks will be authorized to sell annuities. At the same time, the requirement for early retirement is being gradually raised (to 70% of own-wage and 150% of MPG), the definition of average wage used in this requirement has been tightened, a limit has been set on sales commissions to brokers selling annuities and an electronic quotation system is now required for annuity sales. The greater flexibility might make annuities more attractive and thereby increase demand but the tightening of early retirement pre-conditions and restrictions on commissions (by cutting rebates) might reduce demand. These changes are being phased in between 2004 and 2010.

[4] The start of the annuity payout can be postponed through a program called "temporal withdrawals" in which workers purchase a deferred annuity upon retirement and take a monthly withdrawal during the interim period. However, participation in this program has been small and the data do not allow us to distinguish annuitants who started out on temporal withdrawal versus those who purchased immediate annuities at retirement.

[5] Many Chilean workers will not accumulate the 20 years of contributions needed to be eligible for the MPG, because of their low density of contributions. Measured as contributors/employment, the density of contributions has been about 64%; as contributors/labor force it is 58%; as contributors/ affiliates, it is 54%. Thus, the average person with an account, who contributes for about 54% of his potential working life, exceeds the 20 years required for eligibility. However, 40% of affiliates have contributed less than 42% of the time, and therefore would miss the eligibility criterion. These are disproportionately women. (Arenas et al 2004; Berstein et al 2005). Most of these women are covered indirectly, through the joint pension that is purchased by their husbands, to which the MPG applies.

The low density of contributions is due mainly to affiliates who drop out of the labor force (such as women) and those who work in the informal sector or as self-employed, who are not required to contribute. As the work force ages, these average densities may increase, since older workers are much more likely to contribute. We would expect that, as they approach retirement age, workers near 20 years of contributions will change their behavior and increase their density, if they foresee having a pension that is less than the MPG. However, the available data do not allow us to test this hypothesis. We would also expect that workers who are not eligible for the MPG are more likely to annuitize, to get investment and longevity insurance. This might explain why some retirees with relatively

small accumulations have nonetheless purchased annuities. Workers who are not eligible for the MPG might qualify for the means-tested benefit for non-contributors (PASIS).

[6] The means test is implemented by requiring the AFPs and insurance companies that are paying the pensions to secure documents from the tax authority and the old pension authority confirming the absence of other income, as part of the application process for the MPG. This makes retirees with low pensions expensive to such companies 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.

[7] An escalating formula, for example, could offset this decline, by starting with a smaller payout that rises over time. For a discussion of the properties of other possible gradual withdrawal rules, in the German context, see Dus, Maurer and Mitchell 2004.

[8] Regulators require that the interest rate assumption is based 80% on the previous year's internal rate of return on new annuities and 20% on the AFP's average real return over the last ten years. Since AFP returns were extremely high during the 1980's and early 1990's, this produced an assumed interest rate for PW that was higher than the forward-looking interest rate built into annuity prices. However, actual interest rates have been falling since the late 1990's, so these returns were not realized, which led to a decline in PW payouts in subsequent retirement years.
Also, until 2004 the regulator required that a mortality table known as RV85 should be used for PW payouts. Our analysis of actual mortality experience for annuitants indicates that RV85 is based on obsolete data and understates longevity (see discussion in text). It therefore produces a higher PW pension at first, but the average individual eventually outlives his savings. In contrast, insurance companies were able to choose their own mortality tables for pricing purposes and, since they bear the mortality risk, they had an incentive to use a more conservative table that produced a lower level payout. In 2004 regulators introduced a new mortality life with much greater life expectancy for the PW formula. This will reduce initial PW payouts in the future.

[9] Starting in August 2004, this formula was changed and tightened. Early retirement requirements will be increased gradually to 70% of own-wage and 150% of MPG. Average monthly own-wage will be calculated by summing the last 120 months of wages, adjusted by the CPI, and dividing by 120 months minus the number of non-contributing months in excess of 16. That is, a limit of 16 was placed on the number of non-contributing months that would be included in the denominator. This will raise the average own-wage and therefore reduce the number of workers who qualify for early retirement. The new formula will be phased in gradually over 4 years.

[10] Some selection biases may be influencing these propensities to retire early, especially in the 1980's and 1990's, due to the incentives for older workers to stay in the old system when the new system was implemented in 1882; switching was voluntary. However, the fact that the percentage of early retirees among all pensioners has remained constant over the last 5 years as most new retirees have come from the new system suggests that these biases are not consequential at present. It is also worth noting that early retirees likely

have lower mortality rates than normal retirees, because they are younger and richer. If this is the case, the stock percentage will overstate the flow percentage of early retirees, even in the long run.

[11] The 12.5% figure is based on a 10% net contribution + approximately 2.5% for administrative expenses and disability and survivors insurance. The increase in liquidity of retirement savings and in monthly income flows may lead some credit-constrained workers to retire from the labor market when they retire from the system. But the elimination of the 12.5% payroll tax may have a positive substitution effect on continued labor supply, since their net current pay increases. The liquid wealth and substitution effects therefore work in opposite directions in influencing the labor supply of older workers. In either case, workers can no longer increase the net present value of their lifetime pensions by retiring early from the labor force, as they could in the old DB system. Preliminary investigations suggest that the labor force participation rate of older male workers has gone up significantly, especially among pensioners, over the past 20 years (Edwards and James. 2005).

[12] At the point of early retirement an actuarial factor is computed that depends on the retiree's actual age and the interest and mortality rates used in determining pension payouts. At the same time, the actuarial factor is calculated as if the worker were at the normal retirement age, with the same interest and mortality rate tables. 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. Part of the pension floor is traded off to permit the option to retire early. This trade-off may deter early retirement for workers with small accumulations who expect to qualify for the MPG in the near future.

[13] The annual rate of return on PW has been 1-1.5% higher than the internal rate of return on annuities but it has been falling. Until 2002 PW pensioners had no portfolio choice. 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 portfolio choice and are permitted to invest up to 40% in equities.

[14] AFPs charge 1.5% of wages and 1.25% of PW pension payouts per month. Fees are not allowed for pensioners on the MPG. Since the average pension is 50% of the average wage, the average monthly fee per pensioner is about 40% that per worker, although the administrative costs they incur seem to be very similar. Political pressures may keep fees low for pensioners.

[15] The new 2004 law limited the sales commission to 2.5% of the premium, which should reduce the feasible cash rebate and possibly the sales of annuities.

[16] Concretely, the MWR for a single life annuity is:

$$MWR = \left\{ \sum_{t=1}^{(T-a)*12} \frac{P_{a,t} \cdot A_a}{(1+i_t)^t} \right\} \Big/ C_a \quad + EPV(UF15)/C_a$$

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
EPV(UF15) = expected present value of UF 15, which is the required funeral benefit when the annuitant dies

[17] Insurance companies in Chile have earned slightly larger risky returns. The risk-free discount rate is most appropriate in evaluating the expected present value of annuities for workers who want a steady source of retirement income and consider annuities safer than the companies' investment portfolios would suggest. The risky rate is most appropriate for workers who have a higher subjective time preference or consider insurance company promises unreliable. For evidence that many workers have a high time preference, see Hurd, Lillard and Panis 1998; Warner and Pletter 2001. The government guarantee (MPG + 75% of annuity value exceeding the MPG) substantially reduces the risk faced by annuitants, tilting the scales toward the risk-free rate for discounting.

[18] This risk could be reduced if Chile allowed annuities to be purchased in a series of purchases that occur at different points in time, or if workers approaching retirement were permitted to gradually purchase a portfolio of long term bonds whose value would rise if interest rates should fall.

[19] The reader is reminded that all these numbers must be viewed with caution since the rates earned are measured on the total stock of portfolio but do not include unrealized capital gains, while the rates paid are measured on the flow of new annuities issued in the current period and do not include the rates paid on the entire stock of old annuities. Moreover, RV85 understates expected returns to annuities.

[20] For other insurance products, companies customarily reduce adverse selection by putting customers into different risk categories. Family background, DNA and health examinations could be used for this purpose in the annuities market, although this would be controversial. This does not happen in Chile now, but it is not prohibited under current law.