International Contributions to Labour Studies (1995) **5**, 27–43

Individual capitalisation pension plans and old-age pension benefits for low-paid workers in Chile

Armando Barrientos and Luis Firinguetti*

1. Introduction

In 1981, the Chilean Government implemented a radical reform of pension provision by introducing a compulsory individual capitalisation pension scheme. Under this new scheme, workers contribute 10% of their monthly earnings to a capitalisation account with a private pension fund. The pension funds invest the workers' contributions in a range of permitted instruments. At retirement, the worker can use the accumulated fund to purchase a Life Annuity, or agree to a Scheduled Withdrawal Programme, or to a Scheduled Withdrawal Programme with a Life Annuity at a later age.

The reform of pensions in Chile has attracted a great deal of interest (Vittas, 1993A; Vittas and Iglesias, 1992; Gillion and Bonilla, 1992; Diamond, 1993; Barrientos, 1993; Marcel and Arenas, 1992). A number of countries in Latin America and Eastern Europe have introduced, or are considering introducing, individual capitalisation pension schemes similar to that of Chile (*International Labour Review*, 1994). Also, the Chilean pension reform comes at a time when the economic challenges posed by pension provision for ageing populations are becoming the subject of extensive scrutiny (Hagemann and Nicoletti, 1989; Johnson, 1992; Mitchell, 1993; Blanchet and Kessler, 1992; World Bank, 1994).

This paper examines whether the Chilean individual capitalisation pension scheme can ensure adequate old-age pensions for workers who experience low pay or irregular employment.[1] Such workers constitute an important portion of the labour force in developing countries, and the question of whether or not individual capitalisation pension plans are appropriate as their only option has not been investigated in the literature and raises important issues relating to the need for safety net provision, future government pension liabilities, and labour market incentives.

2. The Chilean pension scheme

Pension reform in 1981 was part of a general overhaul of the Social Insurance System in which Social Insurance Funds ('Cajas de Previsión') provided a range of

*University of Hertfordshire, Hertford, UK, and University of Santiago, Chile, respectively.

[1] Our study focuses on old-age pension only. The Chilean pension scheme also includes provision for disability and dependant survival pensions.

1052-9187/95/010027+17 $12.00/0

benefits for specific groups of workers. The first of these Insurance Funds, covering manual workers, was set up in 1924. By 1973 there were 35 Insurance Funds covering 76% of the labour force and their dependants. The range of contingencies covered varied from one Insurance Fund to another but typically included old age, disability, sickness, costs of preventive and basic medicine, unemployment, and industrial injury.

Over time, government funding commitments to the Social Insurance Funds, and concern over the variation in the scope and level of benefits provided, increased. But the overhaul of the social insurance system was driven by the macroeconomic stabilisation and structural reform programme implemented by the military government then in power. From this perspective, the reform of social insurance could help reduce government expenditure and employers' labour costs, and provide significant opportunities for the private sector. The government first consolidated the different Social Insurance Funds into a single body, and then, in 1980, separated out and reformed pension insurance and health insurance. Since normal political processes were suspended at the time, the government had a largely free hand in fashioning the reforms. Under the new health insurance scheme, active and retired workers contribute 7% of their earnings either to the public health insurance programme or to private health insurance programmes. Under the new pension insurance scheme, the government introduced compulsory individual capitalisation pension plans.

The individual capitalisation pension scheme introduced in Chile is of a defined contribution type. In such schemes, benefits depend solely on the size of the fund accumulated at retirement in an individual's capitalisation account.[1] Therefore, pension benefits depend on earning levels, the rate of contributions paid, and the rate of return applying to their capitalisation. With the contribution rate at c, wages W at time t, and assuming the pension fund is translated into an annuity by a factor h, pension benefit $PBDC$ at retirement R is

$$PBDC(R) = \left[\sum_{t=1}^{R} cW_t(\exp^{r(R-t)}) \right] \cdot h \tag{1}$$

The Chilean scheme has several distinctive features (Iglesias and Acuña, 1991). Employees contribute 10% of their monthly earnings to their pension accounts, and an additional contribution of 3% covers charges and a disability and dependant-benefit insurance. Employers do not make contributions to the pension funds. The accounts are kept with private 'Administradoras de Fondos de Pensiones' or AFPs. The pension contributions and the pension fund returns are tax-free.

The performance of the AFPs is buttressed by competition and regulation. AFPs compete for accounts, which can be transferred with relative ease, by offering higher returns, lower charges, or stronger marketing. Between 1981 and 1991, the number

[1] Defined contribution pension schemes are an alternative to defined benefit pension schemes, in which pension benefits depend on a formula relating years of service to final salary. On the properties of defined contribution and defined benefit pension plans, see Dorsey (1987); Gustman and Steinmeier (1989); Bodie, Marcus and Merton (1988). In the last decade and a half, a shift to defined contribution pension plans can be observed in a number of countries. See Turner and Beller (1992) for the US, Disney and Whitehouse (1992) for the UK, and St John and Ashton (1993) for New Zealand.

of AFPs oscillated between 12 and 14, but since new regulations have relaxed the entry of labour organisations and regional bodies into the market, their number has risen to 22. It is a highly concentrated market, with the three largest AFPs having 68% of the affiliates and 53% of the pension funds' assets.

The AFPs are subject to regulation on their liquidity, investment portfolio, rates of return, and information flows to customers. The Chilean Central Bank has powers to determine the range of assets in which AFPs are permitted to invest, and maximum levels for investment in specific instruments or issues. Equity investment, for example, was not permitted to the AFPs in the initial stages, but since 1985 up to 30% of their portfolio can be invested in equities. Roughly 40% of their combined portfolio is in government instruments, another 30% in equities, and the remainder in financial institution, corporate, and mortgage bonds.

The regulations also cover the AFPs' rates of return, which should not be lower than the average of their rates of return for the previous 12 months minus 2%, nor lower than 50% of this average. Consistent with its regulatory powers, the government provides a number of guarantees. It guarantees contributors' funds in the event of AFP failure, a minimum pension for those with a 20-year contribution record, and also a proportion of pension annuity contracts in the event of insurance company failure.

The individual capitalisation pension scheme is compulsory for wage and salary workers, and is the only form of pension provision available for workers who have entered the labour market since 1982. It is therefore expected to generate workers' entire pension income. Workers in the old pension scheme and the self-employed were given the option to join the new pension scheme. Nearly three-quarters of workers in the Chilean labour force are affiliated to the new pension scheme, but around one-third of these fail to make regular contributions.

3. Individual capitalisation pension plans and low-paid workers

To examine whether the individual capitalisation pension scheme in Chile can provide low-paid workers with adequate pension benefits, we shall project benefits directly from workers' earnings. Then we shall evaluate the adequacy of the projected pension benefits using two criteria: the extent to which pension benefits replace final earnings, and the extent to which pension benefits reach a minimum income level.

The Chilean pension scheme lacks any explicit intra- or inter-generational redistributive features. What you save—and the returns achieved by your savings—is what you get. It is therefore not clear that individual pension plans are the most appropriate pension scheme for low-paid workers. In terms of replacement rates, actuarial models of defined contribution pension plans (Vittas, 1993B; Bonilla, 1992; and Margozzini, 1988 for Chile) predict pension replacement rates will turn out to be adequate only if real rates of return exceed real rates of wage growth by a substantial margin. And a number of studies have concluded that the pension plans of one-third to one-half of workers will generate pension benefits below the minimum pension level, the government guaranteed pension floor (Arellano, 1990; Wagner, 1990; Ortuzar and Peña, 1986; Gillion and Bonilla, 1992).

The success of the first decade of operation of the new pension scheme in Chile has obscured these concerns. The real rates of return applying to the individual capitalisation accounts for the period 1981–1991 averaged 10% annually, while real wage growth averaged just below 1%. If these conditions continue, even low-paid workers with regular contributions can expect adequate pension benefits.

But these favourable conditions cannot be projected safely into the future. All pension schemes enjoy a 'feel-good' factor in their initial stages, when beneficiaries are a very small proportion of contributors and thus impose few restrictions on their asset portfolio. The new pension scheme in Chile was introduced in highly favourable conditions. Pension funds avoided potentially disastrous equity losses at the beginning of the decade as they were not permitted equity investment until 1985, but took full advantage of high equity earnings later in the decade. The transitional period ensured substantial government financing requirements to underwrite the old pension scheme, edging interest rates upwards. And the need to place the huge inflow of funds has put sustained upward pressure on equity prices. It is highly improbable that these favourable conditions will continue into the next decades.

In addition, the political conditions which ensured low wage-growth rates are also unlikely to repeat themselves. The index of real salaries, set at 100 in 1970, has never risen above that value since 1973, and shows a sharp drop to 61 in 1975, and another low of 81 in 1985 (Jadresic, 1990). Currently, low rates of unemployment, the restoration of a democratic government committed to reducing poverty and inequality, and remarkable growth in output and productivity all point to higher rates of wage growth in the medium term (García, 1992; Cortázar, 1993).

With the transitional process completed, and the new individual capitalisation pension scheme firmly established, it is important to probe its appropriateness for the more vulnerable section of the labour force. In order to move beyond the actuarial models, we shall simulate the accumulation of the pension fund for typical groups of workers, from age-earnings profiles estimated with the use of a large data set.

4. Simulation of pension fund capitalisation

The simulation of the pension fund in this section proceeds by estimating a wage equation, constructing age-earnings profiles for selected types of workers, and finally estimating from these profiles the workers' contributions and the accumulation of the pension fund to retirement age.

4.1. Age-earnings profiles

Retirement pension benefits under individual capitalisation pension plans depend on the contributions made and the returns these accumulate over time. A simulation of the build-up of individual pension funds starts by generating reliable age-earnings profiles for selected groups of workers from which contributions to the individual accounts can be estimated. We have used data from CASEN 1990 (Mideplan,

1991B) to estimate a standard wage equation relating the log of gross hourly earnings to a set of individual characteristics, and a set of variables describing job, industry, and occupation characteristics. In addition we have included variables on pension and health scheme membership, and region. (For a description of the data set, variables, and the regression results, see Appendix 1.)

Our study focuses on three groups of workers: blue-collar men, self-employed women, and women in the service sector. These workers were chosen to enable a closer examination of groups in the labour force who are the least obvious beneficiaries from the switch to individual capitalisation pension plans. At the same time, these groups of workers constitute a majority of the Chilean labour force. From the figures reported by Mideplan (1991A) for the year 1990, blue-collar workers constituted 44.4% of the male labour force, while women in the service sector made up 46% of the female labour force.[1] Self-employed workers comprised 22.5% of the labour force. Moreover, the liberalisation of the Chilean labour market in the late 1970s has fuelled the expansion of the flexible and self-employed labour force (Infante and Klein, 1992).

Using the estimation results, controlling for some characteristics, and interacting experience, and the variables including it, age-earnings profiles were constructed.[2] Apart from reference variables (sex, occupation, hours worked, status), and personal pension affiliation (only affiliation to AFPs is considered), the profiles control for differences in size of establishment, region, industry, and health programme affiliation. We focus on workers who entered the labour force in 1990 aged 20, and therefore did not participate in the old pension schemes.[3] The resulting age-earnings profiles are shown in Fig. 1.

Age-earnings profiles estimated from cross-sectional data have well-known drawbacks. As the measurement is made at a point in time, neither economy-wide productivity growth nor labour market transitions are observed in the cross

[1] Mideplan reports that men at 3.268 million constituted 67.4% of the labour force, while women at 1.581 million made up 32.6% of the labour force (Mideplan, 1991A, p. 3).

[2] Earnings were predicted using the methodology proposed by Duan (1993). The estimated model is

$$\ln Y_i = X_i'\hat{H} + \mu_i, \tag{i}$$

with μ_i as the residuals. A 'naive' predictor of Y_j is

$$\hat{Y}_j = \exp(X_j'\hat{H}), \tag{ii}$$

but since the transformed variable is non-linear,

$$E(\hat{Y}_j) = E[\exp(.)] = E[\exp(X_j'\hat{H} + \mu_j)] \neq \exp(X_j'\hat{H}). \tag{iii}$$

However, a consistent predictor is

$$\hat{Y}_j = 1/N \sum_{j=1}^{n} \exp(X_j'\hat{H} + \mu_j). \tag{iv}$$

[3] For workers who participated in the old pension scheme, transitional arrangements apply. A complex formula calculates their pension entitlement from the old pension scheme at the time they opt to transfer to the new pension scheme. This entitlement, or 'Recognition Bond', is then guaranteed by the government to capitalise at a real annual rate of 4% until retirement. At retirement, this bond is used together with the individual capitalisation pension fund to make the chosen pension arrangements. See Arellano (1990) and Ortuzar and Peña (1986) for a projection of pension benefits for these workers.

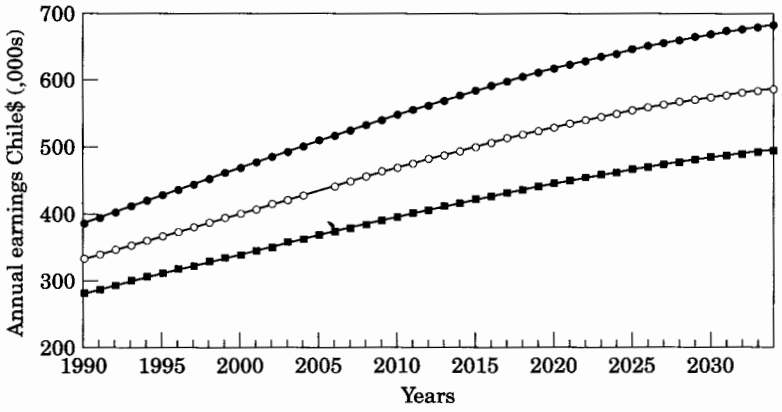

Fig. 1. *Age earnings profiles. Key:* —■—, *Female Services;* —○—, *Female Self-employed;* —●—, *Male Blue-collar.*

Table 1. *Unemployment rates by age in Chile 1990*

Age	20–24	25–29	30–54	55+
Unemployment rate	16.3	8.6	5.7	5.4

Source: Mideplan (1991A).

sectional.[1] With regards to the former, we have chosen to adjust the raw age-earnings profiles assuming two benchmark economy-wide annual rates of productivity growth of 1% and 3% for the period 1990–2034, in the expectation that this will capture a lower and upper bound of productivity growth.[2] With regards to the latter, we adjusted for interruptions caused by unemployment via an earnings density factor, which is set equal to one minus the unemployment rate. As the rate of unemployment is considerably higher for younger workers in Chile, and early pension contributions have disproportionate effects on individual capitalisation pension funds, we have used unemployment rates by age as reported in Table 1.

The age-earnings profiles for women employed in the service sector, adjusted for the benchmark measures of economy-wide productivity increases and the earnings density reflecting the age unemployment rate, are shown in Fig. 2. As can be seen, the adjustments made to the raw earnings profile have the effect of making the profile steeper, due to the compounding of the productivity growth assumption, but also of pivoting the profile, which is due to the differential unemployment rate by age.

[1] In addition, the estimation of age-earnings profiles from longitudinal data has shown that cohort-adjusted profiles are steeper than those obtained from the cross sectional (Klevmarken, 1993). This has important implications for replacement rates (see Barrientos and Firinguetti, 1994).

[2] A long series on *per capita* productivity produced by Jadresic (1990) shows an annual mean growth of 0.9% for the period 1961–1989, but only a 0.5% annual mean growth for the period 1976–1989. More recently, *per capita* productivity increased at annual rates of over 2% in the period 1990–1993 (González, 1993).

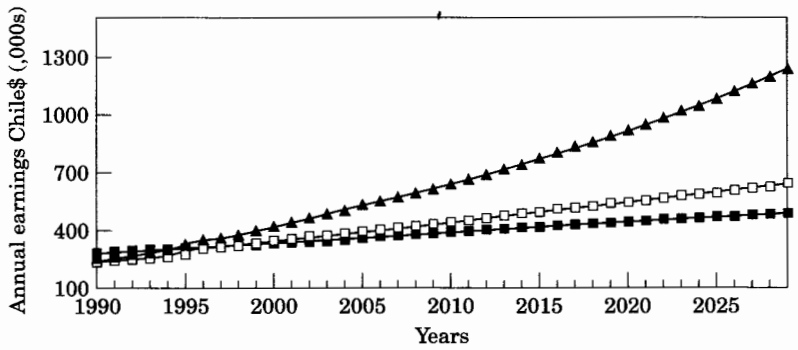

Fig. 2. *Age earnings profiles–female services. Key:* —■—, *Female Services;* —□—, *Female Services 1%;* —▲—, *Female Services 3%. Note: female services is unadjusted; otherwise 1% and 3% refer to assumed wage growth.*

4.2. Accumulation of the pension fund

From the adjusted age-earnings profiles we can now estimate a contribution record for the typical cases selected. A rate of return is then applied to these contributions to produce an estimate of the pension fund at retirement. We chose to determine the sensitivity of the accumulated pension funds to different assumptions of rates of return by using a range of rate of return assumptions from a low of 1% per year to a high of 7% per year. The range chosen can be justified as providing lower and upper bounds for a long-term rate of return. The upper bound is below the rates of return obtained by AFPs in the 1980s, but, as discussed above, the 1980s provided extremely favourable conditions for the AFPs. The low point of the range is not in fact unduly pessimistic, as the experience of the 1970s in many countries shows (Hemming and Kay, 1981).

Assuming a constant rate of return r, the amount PX of a pension fund at retirement R resulting from contributions cW in year t is calculated as follows:

$$PX_t = cW_t(1+r)^{(R-t)} \tag{2}$$

and the pension fund PF is simply

$$PF(R) = \sum_{t=1}^{R} PX_t \tag{3}$$

Figure 3 shows the path of PX under alternative assumptions of real rates of return and rates of wage growth for women employed in the service sector. The design of individual capitalisation pension plans results in the early contributions having a large impact on the pension fund at retirement. This effect is exaggerated by higher rates of compounding. At low rates of compounding, the PX profile becomes flatter, as this effect is compensated for by earnings rising with age.

Interruptions in employment and/or falls in earnings capacity associated with contingencies at different stages of a worker's life cycle will have different impact upon their pension fund depending on the rates of return which apply to the individual capitalisation accounts. Figure 4 shows the path of PX for a woman in the

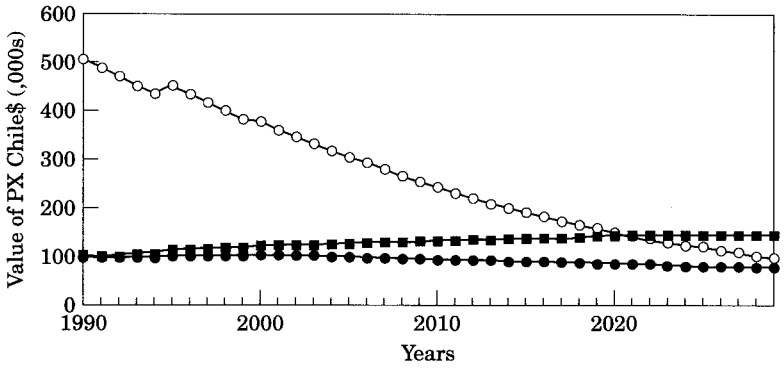

Fig. 3. *Path of* PX*–female services. Key:* —●—, *FemServ g=1%; r=3%;* —■—, *FemServ g=3%; r=3%;* —○—, *FemServ g=1%; r=7%. Note: g=rate of wage growth; r=rate of return.*

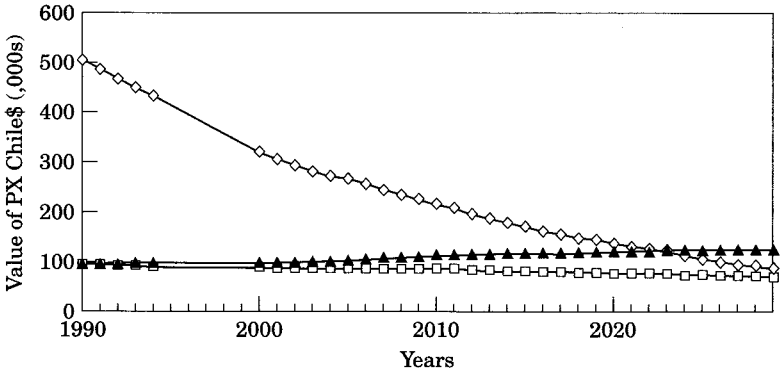

Fig. 4. *Path of* PX*–female services (with 5-year job interruption). Key:* —□—, *g=1%; r=3%;* —▲—, *g=3%; r=3%;* —◇—, *g=1%; r=7%. Note: g=rate of wage growth; r=rate of return.*

service sector who experiences a 5-year interruption in her employment starting at age 25, assuming she returns to work without experiencing downward mobility or loss of seniority. The impact on her accumulated fund is greater at higher rates of compounding.

5. Pension benefits, replacement rates, and minimum pensions

5.1. Choice of pension arrangements and minimum pensions

The Chilean pension scheme provides a choice of pension arrangements (Díaz, 1993). At retirement, contributors can purchase a Life Annuity, or can opt for a Scheduled Withdrawal Programme, or choose a Scheduled Withdrawal Programme with a Life Annuity at a later age. Life Annuities are offered by insurance companies, and are contracted in inflation-indexed 'Unidades de Fomento', or UFs (the value of a UF is set daily by the Central Bank and maintains a constant purchasing power). The pension benefit is calculated by dividing the pension fund at retirement less the present value of a funeral benefit by a pension annuity factor

which takes account of the expected survival of the retiree and his/her dependants, commissions and costs, and expectations on rates of return (Santander Compañía de Seguros de Vida, 1990). The Scheduled Withdrawal Programme is offered by the AFPs and annually fixes monthly withdrawals from the pension fund based on an 'as-if-annuity' formula. The Scheduled Withdrawal Programme allows the pension fund to continue to accumulate, and in the event of the death of the contributor, the fund becomes part of his or her estate.

5.2. Replacement rates

The ratio of pension benefit to pre-retirement net income is a standard indicator of the extent to which standards of living are maintained into retirement. This measure can be grounded on life-cycle models of consumption (Boskin and Shoven, 1987), suggesting that, under conventional assumptions, utility is maximised by constant lifetime consumption. With dissaving expected to occur later in life, constant consumption is consistent with income declining at later ages. In this context, a replacement ratio of less than one may be adequate. But in the case of low-paid workers, with little accumulated wealth, and with evidence for Chile highlighting the high incidence of poverty among the old, and their dependence on pension benefits as their sole source of income,[1] an adequate replacement ratio would have to be close to one.

Table 2 reports the ratio of net pension annuity to net final salary (the replacement ratios for self-employed women are not reported as they are very similar to women employed in the service sector).

From the figures reported in Table 2, it is clear that only high rates of return coupled with low wage-growth rates could provide the conditions in which replacement rates close to 100% of final net earnings can be achieved. For low-paid workers, rates of return of 7% and over are required, and the margin between rates of return and of wage growth needs to be around six percentage points. The impact of job interruptions for women is also apparent, as rates of return in excess of 7% are needed to provide a replacement rate close to 100%.

5.3. Pension benefits and minimum pensions

It is important to compare the pension benefits generated by individual capitalisation pension plans against the minimum income standard for retired people provided by the minimum pension. The level of the minimum pension is set by the government at regular intervals. It is a policy variable which has shown considerable fluctuation over time. As a proportion of the minimum wage, for example, it had a low of 61% in 1982, rising to 91% in 1987, and declining to 75% in 1993. It represents a low minimum income standard. In December 1993, the minimum pension was 25% of average earnings for the whole economy, and 19% of average covered earnings of AFP contributors.

The government minimum pension guarantee only applies to workers with at least 20 years of contributions, and consists of a subsidy covering the difference between their pension benefit and the minimum pension level. In our analysis, we shall focus on a comparison of the estimated pension annuity benefit and a

[1] See survey evidence reported by Díaz (1993).

Table 2. *Pension annuity replacement ratios*

A. *Male Blue-collar starts work at 20 and retires at 65, with continuous employment, spouse aged 62*

	Rate of return			
Rate of wage growth	1%	3%	5%	7%
1%	0.35	0.55	0.90	1.56
3%	0.25	0.37	0.59	0.98

B. *Female Service Sector, starts work aged 20 and retires at age 60, continuous employment, single*

	Rate of return			
Rate of wage growth	1%	3%	5%	7%
1%	0.28	0.43	0.66	1.08
3%	0.21	0.31	0.47	0.72

C. *Female Service Sector, starts work aged 20, leaves labour force at age 25 and returns at 30, retires age 60, suffers no employment or earnings downward mobility from job interruption*

	Rate of return			
Rate of wage growth	1%	3%	5%	7%
1%	0.25	0.36	0.56	0.87
3%	0.19	0.27	0.40	0.62

Note: Own estimates using projected pension funds, and pension annuity factors of 12.06 for males and 12.9 for females reported in Arrau (1991), as quoted from a life insurance company on 20 December 1990. The reported ratio is that of predicted pension benefit minus health insurance premium to final salary minus health insurance premium and pension contribution (7% and 13% or earnings, respectively).

predicted minimum pension level.[1] Table 3 reports on the ratio *at retirement* of gross pension benefits to the minimum pension. As the calculations below assume the minimum pension is indexed to real wage growth, positive real rates of wage growth will progressively reduce this ratio *after retirement.*

The values reported in Table 3 confirm that adequate pension benefits for workers experiencing low pay and/or irregular employment depend on real rates of return exceeding the rates of wage growth by a substantial margin. A margin of five percentage points is needed to lift the pension benefits of male blue-collar and

[1] In practice, pension annuities are restricted to those workers whose pension funds can generate a pension benefit at least equal to the minimum pension. Workers who do not meet this requirement must take up a scheduled withdrawal pension until the benefit falls below the minimum pension, whereupon, and providing they have an adequate contribution record, they become entitled to the minimum pension. See Barrientos and Firinguetti (1994) for a scheduled withdrawal pension simulation for low-paid workers.

Table 3. *Pension benefit at retirement as a proportion of minimum pension*

A. *Male Blue-collar as above*

	Rate of return			
Rate of wage growth	1%	3%	5%	7%
1%	0.74	1.15	1.89	3.24
3%	0.47	0.70	1.10	1.80

B. *Female Self-employed, starts work aged 20, retires at 60, continuous employment, single*

	Rate of return			
Rate of wage growth	1%	3%	5%	7%
1%	0.51	0.76	1.17	1.88
3%	0.34	0.49	0.73	1.12

C. *Female Service Sector, continuous employment, rest as above*

	Rate of return			
Rate of wage growth	1%	3%	5%	7%
1%	0.43	0.64	0.99	1.59
3%	0.29	0.41	0.62	0.95

D. *Female Service Sector, with job interruption, rest as above*

	Rate of return			
Rate of wage growth	1%	3%	5%	7%
1%	0.35	0.51	0.76	1.19
3%	0.22	0.31	0.45	0.69

Note: Own estimation, with Minimum Pension projected to increase in line with wage growth.

female self-employed workers to the minimum pension level. For female service sector workers, the required margin is six percentage points.

These findings show that in the absence of high rates of return coupled with low rates of wage growth, low-paid workers will come to rely on the government guaranteed minimum pension. The government guarantee covers the difference between the pension workers would have obtained with their pension fund, and the level of the minimum pension. The failure by the new pension scheme to generate high rates of return will therefore directly increase future government liabilities.

It is notoriously difficult to provide reliable estimates of the likely cost to the government of the minimum pension guarantee. It will depend on future economic

conditions applying to both the labour and capital markets. Wagner (1990) estimated this cost, under steady-state conditions and assuming a constant 3.5% pension fund rate of return, at 0.5% of GDP. Zurita (1994) found that when rate of return volatility is taken into account this estimate rises to between 3 and 4% of GDP. It is a weakness of the minimum pension guarantee that it is not formally indexed to prices or earnings, and it will be vulnerable if its cost to the government turns out to be high.

This also raises questions concerning the incentives workers with low pay or irregular employment have to join an individual capitalisation pension plan. In order to qualify for the minimum pension guarantee, workers need to have a 20-year contribution record (which could include up to 3 years of unemployment spells). Workers with low earnings who are unlikely to complete the minimum pension qualifying contribution period of 20 years can apply for a discretionary public assistance pension, of around one-third the value of the minimum pension. These workers have strong incentives to work in the non-covered sector, thus avoiding the compulsory contributions (Wagner, 1990).

Unless the highly favourable conditions of the 1980s can be sustained indefinitely into the future, the individual capitalisation pension scheme introduced in Chile will not generate adequate pension benefits for a substantial proportion of workers experiencing low pay or irregular employment. As these workers constitute a large portion of the Chilean labour force, consideration should be given to policies which could enhance their pension provision. Some of the policies which need to be considered include raising the contribution rate, raising the retirement age for women to 65, and, perhaps most importantly, formalising a comprehensive safety net minimum pension.[1]

Individual capitalisation pension schemes are therefore not very appropriate for low-paid workers and workers with irregular employment, and countries attracted by the Chilean experience with pension reform will need to consider this very carefully. Of the Latin American countries which have introduced pension reform recently, Peru's 1993 pension reform adopted the Chilean scheme almost to the letter. Mexico in 1992, and Colombia and Argentina in 1993, have also introduced retirement saving pension schemes, but they have retained a wider range of pension schemes on offer. Argentina's new pension system, for example, includes a first pillar basic pension which is government provided and financed by employer contributions. This is expected to generate a pension benefit of 25% of covered earnings. A second pillar, financed by employee contributions, offers a choice of either a private retirement saving plan, as in Chile, or a public-defined benefit pension scheme (in which pension benefits are related to years of service and final salary). The first pillar has the advantage over the minimum pension guarantee in the Chilean scheme that its financing, and the benefit promised, are more formally set—although the contribution prerequisite extends to 30 years. This may be more appropriate for low-paid wage and salary workers, but the long contribution prerequisite makes it less attractive to workers with irregular employment.

[1] For a discussion of these policies, see Barrientos and Firinguetti (1994).

6. Conclusions

In this paper we have examined the appropriateness of the Individual Capitalisation Pension Scheme introduced in Chile for workers with low pay and irregular employment. After simulating the accumulated pension funds for selected groups of workers, pension annuities were estimated. The sensitivity of the pension annuities to the rate of return of the funds and the rate of growth of real wages was then examined. The conclusions are as follows.

Only the combination of sustained high real rates of return and low real rates of wage growth can ensure that low-paid workers have adequate pension benefits. Our simulation shows that for male blue-collar workers, female self-employed, and female service sector workers with continuous employment, real rates of return which exceed the rate of growth of wages by five to six percentage points are needed to generate pension benefits close to 100% of net final earnings.

Job interruptions have an important effect on pension benefits. For women with interrupted work experience, a seven percentage point margin is needed to achieve replacement rates 100%. Similar conditions are needed to generate for these workers pension benefits greater than the minimum pension. For women with a 5-year work interruption, a six percentage point margin is required to ensure their pension benefits exceed the minimum pension.

Projected pension benefits close to, or lower than, the minimum pension level have important implications for pension plan membership of low-paid workers, for their choice of non-covered sector employment, for government's future pension liabilities, and for the incidence of poverty among the old.

Although the rates of return achieved by the AFPs in the 1980–1991 period were on average 9–10% per year, expectations are they will decline in the medium term. At the same time, the conditions which ensured low rates of wage growth in the 1980s are unlikely to persist, and wage growth rates are expected to pick up. In this scenario, the provision of adequate pension benefits for workers experiencing low pay and/or irregular employment will be threatened.

Highly favourable conditions are required for these workers to be adequately provided for by individual capitalisation pension plans. Countries wishing to emulate the Chilean pension reform will need to pay close attention to the problem of providing adequate pension benefits for vulnerable workers. In particular, they will need to look at the need to supplement the individual capitalisation pension plans with a well-designed, first pillar, safety net minimum pension scheme.

Bibliography

Arellano, J. P. 1990. *El Desafío de la Seguridad Social: el Caso Chileno*, Santiago, PREALC

Arrau, P. 1991. La reforma previsional Chilena y su financiamiento durante la transición, *CIEPLAN*, vol. 32, June

Barrientos, A. 1993. Pension reform and economic development in Chile, *Development Policy Review*, vol. 11, no. 1, March

Barrientos, A. and Firinguetti, L. 1994. *Pension Reform and Low Paid Workers*, Working Paper UHBS:9, University of Hertfordshire Business School

Blanchet, D. and Kessler, D. 1992. Pension systems in transition economies: perspectives and choices ahead, in Pestieau, P. (ed.), *Public Finance in a World of Transition Supplement to Public Finances/Finances Publiques*, vol. 47

Bodie, Z., Marcus, A. J. and Merton, R. E. 1988. Defined benefit vs. defined contribution pension plans: what are the trade-offs? in Bodie, Z., Shoven, J. B. and Wise, D. (eds), *Pensions in the US Economy*, Chicago, University of Chicago Press

Bonilla, A. 1992. 'Matemáticas Financieras y Actuariales Mínimas para el Análisis de Fondos Individuales de Pensiones', I.L.O. Social Security Department (mimeo)

Boskin, M. J. and Shoven, J. B. 1987. Concepts and measures of earnings replacement during retirement, in Bodie, Z., Shoven, J. and Wise, D. (eds), *Issues in Pension Economics*, Chicago, University of Chicago Press

Cortázar, R. 1993. *Politica Laboral en el Chile Democrático: Avances y Desafíos en los Noventa*, Santiago, Dolmien, Economía y Gestión

Diamond, P. 1993. *Privatization of Social Security: Lessons from Chile*, NBER Working Paper 4510, October

Díaz, C. A. 1993. *Análisis Crítico de las Modalidades de Pensión y Propuestas Alternativas*, Documento de Trabajo 156, Instituto de Economía, Pontificia Universidad Católica de Chile

Disney, R. and Whitehouse, E. 1992. *The Personal Pension Stampede*, London, The Institute for Fiscal Studies, May

Dorsey, S. 1987. The economic function of private pensions: an empirical analysis, *Journal of Labor Economics*, vol. 5, no. 4, part 2

Duan, N. 1983. Smearing estimate: a non-parametric retransformation method, *Journal of the American Statistical Association*, vol. 78, no. 383

García, N. 1992. Formación de salarios y precios: Chile, 1986–91, *Investigaciones sobre Empleo* 36, Santiago, PREALC

Gillion, C. and Bonilla, A. 1992. Analysis of a national private pension scheme: The case of Chile, *International Labour Review*, vol. 131, no. 2

González, P. 1993. Algunas reflexiones en torno al vínculo entre mercado laboral y educación, *CIEPLAN*, vol. 37, June

Gustman, A. and Steinmeier, T. L. 1989. An analysis of pension benefit formulas, pension wealth and incentives from pensions, *Research in Labor Economics*, vol. 10, Jai Press Inc.

Hagemann, R. P. and Nicoletti, G. 1989. *Ageing Populations: Economic Effects and Implications for Public Finance*, Working Paper 61, OECD Department of Economics and Statistics, January

Hemming, R. and Kay, J. 1981. Real rates of return, *Fiscal Studies*, vol. 2, no. 1

Iglesias, A. and Acuña, R. 1991. *Chile: Experiencia con un Régimen de Capitalización 1981–1991*, Santiago, CEPAL/PNUD

Infante, R. and Klein, E. 1992. *Chile, Transformaciones en el Mercado Laboral y sus Efectos Sociales: 1965–1990*, Santiago, PREALC

International Labour Review. 1994. Privatization of pensions in Latin America, vol. 133, no. 1

Jadresic, E. 1990. Salarios en el largo plazo, Chile 1960–89, *CIEPLAN*, vol. 29, September

Johnson, P. (ed.) 1992. *Income: Pensions, Earnings and Savings in the Third Age*, Research Paper 2, The Carnegie Inquiry into the Third Age, Fife, The Carnegie United Kingdom Trust

Klevmarken, N. A. 1993. On ageing and earnings, in Johnson, P. and Zimmerman, K. (eds), *Labour Markets in an Ageing Europe*, London, Cambridge University Press

Marcel, M. and Arenas, A. 1992. *Social Security Reform in Chile*, Occasional Paper 5, Washington, D.C., Inter-American Development Bank

Margozzini, F. 1988. Estimaciones de las pensiones de vejez que otorgara el actual sistema de pensiones, in Baeza, S. and Manubens, R. (eds), *Sistema Privado de Pensiones en Chile*, Santiago, Centro de Estudios Públicos, November

Mideplan. 1991A. *Situación y Características del Empleo en Chile en 1990*, Documentos Sociales, Santiago, Ministerio de Desarrollo y Planificación, November

Mideplan. 1991B. *Manual Encuesta CASEN 1990*, Documentos Sociales, Santiago, Ministerio de Desarrollo y Planificación

Mitchell, O. S. 1993. *Trends in Retirement Systems and Lessons for Reform*, Policy Research Working Papers, WPS 1118, Washington, D.C., The World Bank, March

Ortuzar, P. and Peña, J. 1986. 'El nuevo Sistema Previsional y la situación de los Trabajadores más Pobres', Santiago, Odeplan (mimeo)
Santander Compañía de Seguros de Vida S.A. 1990. *Rentas Vitalicias en el Sistema de Pensiones*, June
St John, S. and Ashton, T. 1993. *Private Pensions in New Zealand: Can they avert the 'Crisis'?*, Wellington, Institute of Policy Studies
Turner, J. A. and Beller, D. 1992. *Trends in Pensions 1992*, Washington, D.C., U.S. Department of Labor
Vittas, D. 1993A. *Swiss Chilanpore: The Way Forward for Pension Reform?*, Policy Research Working Papers, WPS 1093, Washington, D.C., The World Bank, February
Vittas, D. 1993B. *The Simple(r) Algebra of Pension Plans*, Policy Research Working Papers, WPS 1145, Washington, D.C., The World Bank, June
Vittas, D. and Iglesias, A. 1992. *The Rationale and Performance of Personal Pension Plans in Chile*, Policy Research Working Papers, WPS 867, Washington, D.C., The World Bank, February
Wagner, G. 1990. *La Seguridad Social y el Programa de Pensión Mínima Garantizada*, Documento de Trabajo 133, Instituto de Economía, Pontificia Universidad Católica de Chile, December
World Bank. 1994. *Averting the Old Age Crisis*, Oxford, Oxford University Press
Zurita, S. 1994. Minimum pension insurance in the Chilean pension system, *Revista de Análisis Económico*, vol. 9, no. 1

Appendix

Data source, variables, and estimation results

The data used for the estimation of the wage equation comes from the 'Encuesta de Caracterización Socio-Económica Nacional' (CASEN) carried out by the Ministerio de Desarrollo y Planificación (Mideplan) in November 1990, with the objective of identifying the impact of Government Welfare Expenditure (Mideplan, 1991B).

The income variables in CASEN 1990 (Mideplan, 1991B) provide information on net income, so that a reconstruction of gross earnings was performed. We are grateful to the MECE Project for access to the formulas needed to recalculate gross earnings. Of the full sample, discarding observations with missing values produced a data file with just over 12,000 observations. Of these, 7261 allowed the reconstruction of gross earnings, and constitute the working data file.

With exceptions, the variable names used are largely self-explanatory. Mideplan (1991B) includes survey questionnaire and codebook. The personal characteristics variables are Sex, Marital Status interacted with Sex, Schooling, and Experience (estimated as the reported age minus schooling minus the school entry age). Among the job characteristic variables, contract and establishment size are self-explanatory, but Hoursweek is the log of reported weekly hours worked. The Industrial Classification used is in Mideplan (1991B). The Occupational Classification was more problematic and the reported results include two occupational groupings. All service sector workers were grouped in one category, while blue-collar workers are a separate category.

The Health Programme membership variable identified four categories: Public Health, which covers the majority of the labour force; Isapres, which are the private Health Insurance Programmes covering top earners; Armed Forces Health Programme; and PrivaHealth, which includes the remainder. In terms of pension

Table A1. *Parameters of wage equation*
Dependent variable is log of hourly earnings

Variable	$\hat{H}$	S.E.	t	X
Constant	5.520	0.202	27.31	1
Male	0.157	0.028	5.55	0.657
Female married	0.062	0.029*	2.13	0.140
Male married	0.185	0.024	7.66	0.457
Schooling	0.195	0.014	13.51	12.118
Experience	0.205	0.002	7.99	16.004
Exp^2	−0.020	0.000	−2.82	379.173
Exp^2 Sex	0.000	0.000*	2.13	265.224
Contract	0.121	0.030	3.92	0.915
Hoursweek	−0.795	0.023	−33.99	3.879
Size (2–5)	0.147	0.026	5.53	0.186
Size (6–9)	0.259	0.035	7.26	0.091
Size (10–49)	0.191	0.030	6.35	0.203
Size (50–199)	0.192	0.032	5.85	0.135
Size (200+)	0.243	0.032	7.59	0.179
Mining	0.394	0.045	8.71	0.038
Industry	0.112	0.024	4.56	0.187
Construction	0.121	0.039	3.05	0.049
Retail	0.145	0.025	5.80	0.227
Government and finance	0.147	0.032	4.55	0.102
Transport	0.229	0.030	7.43	0.097
Services	−0.158	0.022	−6.91	0.356
Blue-Collar	−0.216	0.025	−8.60	0.276
Male Manager	0.222	0.040	5.53	0.048
Female Manager	−0.115	0.041	−2.76	0.047
Male Self-emp	0.198	0.032*	6.08	0.123
Female Self-emp	0.100	0.045	2.21	0.048
Health Programme:				
PublicHealth	0.278	0.026	10.31	0.474
PrivaHealth	0.273	0.030	8.98	0.143
Isapre	0.656	0.031	20.77	0.218
Armed Forces	0.374	0.078	4.76	0.027
Pension Scheme:				
Capreden	0.451	0.092	4.88	0.018
Empart	0.237	0.061	3.86	0.019
AFP	0.226	0.023	9.67	0.660
Other pension	0.341	0.091	3.72	0.008
Region:				
Region 4	−0.100	0.036	−2.73	0.049
Region 5	−0.064	0.034	−1.87	0.056
Region 11	0.204	0.054**	3.71	0.020
Region 12	0.138	0.047	2.91	0.020

*5% significance.
**10% significance.
RSquared 0.4118.
Adj. RSquared 0.4087.
F(38,7222) 133.068.
N 7261.

programme variables, Capreden is the Armed Forces Pension Scheme, Empart is the old pension scheme for white-collar workers, the AFPs is the new pension scheme, and OtherPension includes the remainder. The Regions reported were statistically significant.

The model estimated is

$$\ln Y_i = X_i' \hat{H} + \mu_i \qquad i = 1,2, \ldots n \tag{A1}$$

where Y are earnings, X is a $1 \times k$ vector of observations in the k independent variables, H is the parameter vector, and $\mu \sim N(0,\sigma^2)$.

The results, estimated using O.L.S., are reported in Table A1.

The estimation results show the expected sign and estimates of the parameters. The log of weekly hours worked shows a negative sign, indicating that longer working weeks are associated with lower hourly pay, which is also an indication of job quality. As expected with occupational variables, blue-collar and service sector workers, who together contribute 63% of the sample, have lower hourly earnings. Female Managers receive lower hourly earnings than Male Managers. Both Male and Female Self-employed workers show higher hourly earnings.

Among the Health Scheme variables, membership of ISAPREs and Armed Forces Schemes are associated with higher hourly earnings. Membership of ISAPREs is conditional on high earnings capacity, and the Armed Forces have, over the period they held power in Chile, improved their pay relative to the civilian labour force. Turning to Pension Scheme membership variables, they all show a significant and positive influence on hourly earnings. The Regional variables all conform to expectations generated by regional disparities in pay.