A Re-Reform of the Peruvian Pension System: welfare, inequality and financial consequences*

-PRELIMINAR VERSION-
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Abstract

We propose to create a multi-pillar system by merging the Peruvian public and private pension systems. In this system, part of the worker's contribution goes to a "solidarity fund" and the remaining is accrued in his individual capitalization account. This fund will finance a targeted minimum pension scheme. So, the first pillar is this minimum pension, the second one is a pension financed by the own compulsory contributions to the pension fund and the third one is a pension financed by contributions to a voluntary scheme. We use unique samples of workers' administrative data to estimate the actuarial debt, inequality on pensions and welfare. Overall, our results show that preserving the current welfare level, the actuarial debt and the inequality can be substantially reduced. Thus, the proposed multi-pillar system allows recovering the principle of solidarity and save fiscal resources.

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1. Introduction

1.1 The current pension system

Peru did not escape from the Latin American pension reform wave of 90's. It created a new pension system based on individual capitalization without dismantling the old defined benefit system. The first is the so called SPP (Private Pension System) and the second is the SNP (National Pension System)[1]. The SPP is supervised by the Superintendence of Banking and Insurance (SBS), whilst that the SNP is administrated by the Bureau of Pensions (ONP). As a DB system, the SNP offers a pension amount computed according to pension rules, within a minimum and maximum value. At least 20 years of contributions are needed to obtain a minimum pension. Furthermore, the sustainability of this system depends on the relation between the number de contributors and pensioners and other pension parameters. In contrast, the SPP is a self-financed system. Individual contributions and fund returns through labour life are accrued in individual accounts. In the SPP, each insured must choose one of the firms that are in charge of managing pension funds (AFP in short). And at the retirement age, the insured must buy an annuity with the total balance of his individual account or to acquire scheduled withdrawals from his AFP.

The retirement age is 65 for women and men in both systems, but early retirement is also possible. Each month, the insured have to contribute a fixed percentage of wages, which is 13% and 10% for the SNP and SPP respectively. In addition, the AFP charges an administrative fee and collects the insurance premium that covers the risks of disability and death. The fee and insurance premium are 1.81% and 0.88% in average, respectively, and both are charged to the salary.

According to the current pension system design, workers have to choose only one of the two systems available. If SNP is chosen, the insured is able to shift to SPP later on, but the contrary is not possible. An individual who chooses one of AFP may leave it and move to another one as many times as he wants and according to specific SPP regulation. If an insured moves from SNP to SPP, the State entitles a recognition bond (BR) as a way to compensate for the contributions made to SNP, only if some legal requirements are fulfilled. The value of the bond is actualized by a prices index up to retirement date, and only at this date the bond is paid and deposited in the individual pension account.

The SPP does not offer an open minimum pension. This guarantee was only reachable for individuals born before 1945, with earnings larger than or at least equal to the minimum legal income and 20 years of contributions made to any pension system[2]. In general, the SNP may be preferred by low income earners, who might obtain a pension at least equal to a minimum pension, whilst the SPP may be favoured by medium and high income workers.

1.2 Why a re-reform of the pension system?

There have been many adjustments in the pension system aimed to correct mistakes of the reform. The recent Law 28991 that permits insured of SPP returning to SNP is one more, perhaps the most important, of these adjustments. Before, in the SPP were created some special regimes such as early retirement for long-term unemployed and high risk occupation workers. The minimum pension was also regulated, but only for a small group of insured. Overall, these changes led to increase public debt by creating new types of complementary recognition bonds and.

The apparent source of these adjustments is the pressure exerted by the insured of the SPP that, previous to reform, belonged to the SNP. They realized that the expected or already

[1] Although the SNP and SPP are the main pension systems, there are smaller schemes exclusively designed for some occupational groups such the army, fishermen, and public servants (the latter does not allow more enrolments).

[2] This regulation was valid between December 2001 and March 2007. And then, the birth date requisite was abolished but the minimum pension was restricted to persons that shifted from SNP to SPP.

received benefits in the SPP were lower than in the SNP. Indeed, in the SNP they could obtain a minimum pension at least, a benefit that is not guaranteed in the SPP. Many of these insured shifted to SPP expecting to receive a large BR and capitalize more contributions in the pension fund system with the aim to reach better pensions. However, these insured failed to fulfil legal requirements to receive a BR or the estimated value of this bond was much under insured's expectation. Additionally, a large number of these individuals were not young enough to capitalize their contributions; and worst, they could acquire an early or normal retirement benefit in the SNP if they had remained there.

In some way, the expectations of this generation to acquire in the SPP (whether or not returning to SNP) benefits comparable to SNP's can be achieved with the adjustments in the pension system, particularly with the Law 28991. However, there are two groups of insured who potentially would demand better benefits, and hence more fiscal resources. The first one is the group of low-income insured of the SPP who are not able to capitalize enough to reach a pension that meets their needs in old age. Although in practice there is no minimum pension in the SPP, it is expected that insured of the SPP still look at the SNP's minimum pension as a reference point to demand higher pensions. A similar warning is made in Holzmann et al (2005). The other group is composed by the current and future insured of the SNP. The creation of the SPP attracted a considerable number of insured from the SNP and new workers who preferred enrol in the new system. This, in turn, weakened the financial sustainability of the SNP, which depends crucially on the dependency ratio (i.e. the ratio between the number of contributors and pensioners). Under current parameters, the dependency ratio should be 4.4 contributors for each pensioner in order to keep the system balanced; however, this ratio is only 1.3[3]. This is one of the reasons behind the large actuarial reserve, which amounts to US$26 billion, i.e. 23% of GDP.

The reform has generated a large debt. Apart from the large actuarial reserve, there is US$4,700 million corresponding to normal and complementary BR. Furthermore, the implementation of the Law 28891 represents a fiscal cost of US$ 2,137 billion in actuarial terms (MEF, 2008). Since these figures are expressed in current and actuarial terms, they cannot be aggregated, although are useful to highlight the significant size of the pension debt.

Table 1
Pension debt (2007, US$ million)

In current terms		In actuarial values	
Normal recognition bonds a/	4,230	Law 28891 c/	2,137
Complem. recognition bonds b/	448	SNP 's Actuarial net reserve d/	25,887

Source: a/ SBS, recognition bond applications; b/ MEF (2007); c/ MEF (2008); d/ ONP's summary of annual economic study of pension reserves.

The creation of the SPP broke the principle of solidarity, a key element for redistribution and financing of pensions. Before reform, the system design allowed to finance pensions from richer to poorer, young to elders, healthy to disabled, etc. The pension reform led the system to the other extreme, breaking any solidarity mechanism in order to promote individual capitalization. Moreover, the solidarity is important to promote universality, which is another key social security principle. Without solidarity is not possible to finance benefits for a larger population (Titelman y Uthoff, 2003).

We favour the recommendations made by the World Bank (Holzmann et al, 2005; World Bank, 1994) to create a mixed model of pensions, based in three pillars: i) a mandatory public pillar (collective capitalization with financial reserves), ii) a funded pillar with mandatory individual capitalization accounts, and iii) a funded pillar with voluntary individual accounts.

[3] The Government may modify parameters and pension rules, but within reasonable limits. But the imbalance is so large that this policy is not effective. For instance, if the contribution rate is the unique adjustable parameter, this would rise up to the impracticable rate of 43.8% to balance the system.

Under the first pillar, all insured receive a minimum or basic pension. The second pillar allows insured to capitalize contributions according to his income level, and hence raise the pension. And the goal of the third one is to allow the insured to further increase his expected pension if he is able to save more.

In this way, this paper aims to present and analyze a proposal to reform the Peruvian pension system by introducing the multi-pillar pension system. This design will reinstate the principle of solidarity. Thus, the State may face current and future pressures of pension debt and also improve income distribution among pensioners. To our knowledge, there are not other studies that analyse a pension reform, and its consequences, in Peru as our proposal. If so, those studies do not include a deep reform, just some changes within each system (e.g. Bernal et al, 2008 and MEF, 2008).

The emphasis of the reform implemented in Peru and other Latin American countries is mainly focussed on the spillovers on the financial markets, public debt and growth. Furthermore, research is concentrated in such issues and some important aspects such as fees levels, competition and enrolment rates. However, there is little emphasis on equity and welfare consequences (Arza, 2008). In order to fill this gap, welfare and equity analysis is central in our research.

In the next section, the reform proposal is presented together with the methodology to estimate the actuarial reserve. And then, a section is devoted to discuss the effects of the reform on the pension debt, pension inequality and welfare. The paper finalizes with some concluding remarks.

2. A reform proposal

2.1 Description

We propose to implement a multi-pillar pension system by merging the SNP and SPP. Since reform date, each insured will have the same rights, regardless the system origin. Both in the case of the SPP's and SNP's insured, the number of contributions made to any system up to the reform date accounts for the entitlement evaluation of a minimum pension. Additionally, the insured of SPP are allowed to keep their pension balance. Each insured has to contribute a rate α from his wage to his individual account and a rate β to a solidarity fund. The aim of this fund is financing the minimum pension scheme. In the new pension system, the requisites to obtain a minimum pension are the same as in the SNP:

- 20 years of contributions (to SNP and SPP).
- The wage used to calculate the contribution must be equal to the minimum wage.

At the retirement age, the pension is computed with the pension balance. If the pension is lower than the minimum pension P_m, then additional resources are added from the solidarity fund until the pension equals the minimum pension. This means that this guarantee is targeted and redistributive. It is targeted because it is directed only to individuals who are unable to finance a pension higher than P_m with their own pension balance. And it is redistributive because the contributions from high income workers, who will obtain a high pension, are used to finance minimum pensions for low income workers.

In addition, the reform is intended to reduce the pension debt. Recall that the creation of the SPP in 1993 attracted many workers from the SNP and eroded its base of contributors. Given that the SNP is a DB system, the final effect was an increase in the actuarial reserve and insufficiency of funds to pay the pension roll. In order to cope with this problem, the State has to assign significant resources to pay these obligations, which might be used to other social programs otherwise[4]. It means that tax revenues, that are paid by pension covered and not covered workers, are used to pay pensions, which reinforce inequality (Arza, 2008). This is particularly critical due to the fact that the group of pension covered workers is much more

[4] Only in n 2007, the SNP's pension roll assumed by the State was S/. 2,455 million, i.e. 0.73% of the GDP.

advantaged than the non-covered. The former work in the formal sector, has higher and more stable incomes and better education, etc.

We simulate the reform, first by estimating the pensions of the insured from both systems (with a without reform) and then, by computing the corresponding actuarial reserves. The pensions and actuarial reserve for the multi-pillar system are computed using different values for α and β. In order to compare the reform results with that of the current system, we must choose values for α and β such that $\alpha + \beta = 0.10$. Thus, we obtain different pension distributions and actuarial reserves, which allow us to make welfare and inequality comparisons between the current situation and different scenarios of reform. In the simulations, the enrolment of new workers is not considered but the death of current insured it is possible.

2.2 Data

One important advantage of this study is the availability of administrative records for pension schemes' members. We use two representative samples of the insured from the SPP and SNP, being December 2006 the cut-off date; so the simulations are made to that date. Databases contain information on wage, age, gender, age of enrolment in SPP, pension balance, Recognition Bond value and its corresponding number of contributions.

The sample of the SPP is random and stratified according to gender, age group (group of 5 years) and age of enrolment. Although the sample originally consisted of 65,534 records, 337 people were removed with inconsistent information. A significant number of insured had no information on wages, so that those were also dropped, leaving a final sample of 31,719 individuals (see table 2).

Table 2
Sample of insured (December 2006)

	SPP		SNP	
Population	3,882,185		1,329,510	
Sample	31,719		26,168	
≤65 years old	31,534	(0.818%)	24,992	(1.970%)
>65 years old	185	(0.628%)	1,176	(1.935%)

Source: SBS, ONP. Author's elaboration.
The values in parenthesis are the relative size of the sample with respect to the population it represents.

The sample of the SNP is also random and stratified by gender and age group. The original sample consisted of 26,589 individuals, i.e. 2% of the population enrolled in December 2006, but 59 records of individuals with not trustable information were removed (those aged under 18 or over 90 years old or earning more than S/. 100,000 a month). After we dropped individuals without wage information, the sample was finally composed of 26,168 records.

It should be noted that for computational purposes, the value of monthly wage was changed for some individuals. This has to be at least equal to minimum wage (S/. 500 in 2006); thus we set the wage up to that amount for those individuals who had a lower wage. The reason for this is that in both systems, workers must make contributions based on a wage equal or higher than the minimum wage. This wage adjustment is also carried out by the ONP when it computes the actuarial reserve of the SNP.

It also had to estimate the enrolment age of the SNP's insured since this variable is not included in our sample. We use the database PRIESO to estimate the enrolment age in the SNP[5] for males and females. The dependent variable was the enrolment age and the dependents were the current age (at May 2002) and its square. The corresponding coefficients were used to

[5] The "Social Risk Management Survey" (PRIESO) is a household survey combined with a large scale field experiment conducted by the World Bank in Lima Metropolitana during May 2002. The database contains 1,002 individuals randomly chosen from the respondents of the National Household Survey (ENAHO), which was applied during the third quarter of 2001. See Barr and Packard (2005) for more details on this survey.

impute the enrolment age for the individuals of our SNP sample. We prefer this method to that of assuming a fixed number of contributions for all insured (which is used by the ONP to calculate the SNP's actuarial reserve) because there are important differences in the enrolment age due to the gender and cohort. According to the estimations, males enrolled between 18 and 26 years old regardless current age. In contrast, old cohorts of females enrolled much older than young cohorts of females.

2.3 Computation of pensions

The computation of pensions is made by using pension rules and some assumptions. In general, variables show subscript *i* and *k*, which refer to a particular individual and his current age at Dec 2006, respectively. The pensions in the SNP are computed according to pension rules stated in norms Ley 27617 and DS 099-2002-EF. The SNP offers 14 pensions per year, but due to comparability reasons with the SPP and the reform proposed, we recalculate those pensions to consider only 12 pensions per year. The next expression calculates the number of contributions and pensions in the SNP:

$$\tilde{A}_{ik}^{snp} = t_0^{snp}(k - k_{snp}) + t_1^{snp}(65 - k) \qquad (1)$$

$$A_{ik}^{snp} = \begin{cases} \tilde{A}_{ik}^{snp} & if \quad \tilde{A}_{ik}^{snp} \geq 20 \quad o \quad (\tilde{A}_{ik}^{snp} < 20 \quad y \quad 65 - k_{snp} < 20) \\ 20 & if \quad \tilde{A}_{ik}^{snp} < 20 \quad y \quad 65 - k_{snp} \geq 20 \end{cases} \qquad (2)$$

where:

A_{ik}^{snp} : Number of contributed years between enrolment age k_{snp} and 65 (the retirement age).

t_0^{snp} : Density of contributions between k_{snp} and current age k.

t_1^{snp} : Density of contribution between current age and 65.

Since the record of contributions (t_0^{snp}) is unavailable and the future contributions (t_1^{snp}) are uncertain, it must be assumed some values for the density of contributions to be able to compute pensions. Those values must be between 0% and 100%. The above equations imply that the insured will contribute for at least 20 years. The reason for this is that such period is the minimum amount of years needed to be entitled a minimum pension; and hence, the insured will find ways to fulfill this requisite, otherwise he will not obtain a pension. Likewise, there is a maximum value for the pension. Thus, the SNP pension is computed as:

$$P_{ik}^{snp} = [TRB_{ik} + 0.02(A_{ik}^{snp} - 20)S_{snp}]Y_{ik} \qquad (3)$$

$$\text{with} \quad TRB_{ik} + 0.02(A_{ik}^{snp} - 20)S_{snp} \leq 1 \quad \text{y} \quad P_{ik}^{snp} \in [P_{\min}^{snp}, P_{\max}^{snp}] \qquad (4)$$

where:

P_{ik}^{snp} : Retirement pension for individual *i* and current age *k*.

TRB_{ik} : Basic replacement rate, which depends on the insured's cohort[6].

S_{snp} : It takes value 1 if $A_{ik}^{snp} - 20 > 0$ and zero otherwise.

Y_{ik} : Wage of individual *i* and current age *k*.

[6] For those insured born until 1947, the TRB_{ik} is 50%. Between 1948 and 1952, it is 45%; between 1953 and 1962, it is 40%, between 1963 and 1972, it is 35%; and since 1973, it is 30%.

$P_{\min}^{snp}$: Minimum pension in the SNP.

$P_{\max}^{snp}$: Maximum pension in the SNP.

The density of contributions, which will be used later to compute the actuarial reserve, is obtained from the next expression:

$$d_{ik}^{snp} = \frac{A_{ik}^{snp}}{65 - k_{snp}} \qquad (5)$$

In contrast with the SNP's pension computation process, in the SPP the computation follow the principle of individual capitalization:

$$P_{ik}^{spp} = \frac{\frac{14}{12} Y_{ik} \times 10\% \times d_{ik}^{spp} \frac{[(1+\tilde{r})^{65-k} - 1]}{(1+\tilde{r})^{1/12} - 1} + CIC_0 (1+\tilde{r})^{65-k} + BR_{ik}}{CRU_{65,y}} \qquad (6)$$

where:

CIC_0 : Initial balance in the Individual Capitalization Account.

BR_{ik} : Recognition Bond, at Dec-2006 value.

$\tilde{r}$: Pension fund yearly return rate.

$CRU_{65,y}$: Annuity price at retirement age, including a spouse of y years old.

In the SPP is also necessary to estimate the number of contributions paid in order to assess the entitlement of a minimum pension and to build the density of contributions. Members of the SPP entitled to receive a minimum pension are those who were previously enrolled to the SNP (before the creation date of the SPP) and who have contributed at least 20 years to any of the systems. Since information on the number of years contributed to the SNP is unavailable, it is assumed that it is equal to the number of years recorded in the Recognition Bond, which indicate the years of contribution officially recognized by the ONP.

$$\tilde{A}_{ik}^{spp} = A_{ik}^{BR} + t_0^{spp}(k - k_{spp}) + t_1^{spp}(65 - k) \qquad (7)$$

$$A_{ik}^{spp} = \begin{cases} \tilde{A}_{ik}^{spp} & if \quad \tilde{A}_{ik}^{spp} \geq 20 \quad or \quad (\tilde{A}_{ik}^{spp} < 20 \quad and \quad 65 - k_{spp} < 20) \\ 20 & if \quad \tilde{A}_{ik}^{spp} < 20 \quad and \quad 65 - k_{spp} \geq 20 \end{cases} \qquad (8)$$

where:

A_{ik}^{spp} : Number of years contributed to the SNP and SPP until age 65.

A_{ik}^{BR} : Number of years contributed to the SNP recorded in the Recognition Bond.

t_0^{spp} : Density of contributions between k_{spp} and current age k.

t_1^{spp} : Density of contributions between current age and age 65.

Therefore, the density of contributions used to compute pensions in the SPP is:

$$d_{ik}^{spp} = \frac{A_{ik}^{spp} - A_{ik}^{BR}}{65 - k_{spp}} \qquad (9)$$

The calculation of the annuity price implies the use of survival probability computed from a mortality table and a discount rate. The formula is as follows:

$$CRU_{65} = 12\left(\sum_{j=0}^{M-65}\frac{p_{65,65+j}}{(1+\hat{r})^{j}} - \frac{11}{24}\right) \qquad (10)$$

$$CRU_{65,y} = CRU_{65} + 12\theta_{spp}\left(\sum_{i=0}^{M-y}\frac{q_{y,y+i}(1-p_{65,65+i})}{(1+\hat{r})^{i}}\right) \qquad (11)$$

where:

$p_{65,65+j}$: Probability of survival from age 65 to $65+j$.

M : Maximum survival age according to mortality table.

$\hat{r}$: Annuity discount rate.

θ_{spp} : Percentage of the husband's pension that the widow will receive.

$q_{y,y+i}$: Probability of survival from age y to age $y+i$ for the widow.

Equation 10 might be used for a single insured, while equation 11 is used for a married insured. The θ_{spp} is determined by SPP's regulation, but it is still possible that insured chose another value if he contracts a complementary product instead of a default life annuity.

Finally, the capital to calculate the pension in the mixed pension system comes mainly from the individual capitalization (contribution rate α); and from the solidarity fund if it is needed getting extra resources in order to reach a minimum pension. As explained before, the pension minimum is entitled only to those insured that contributed for at least 20 years to SNP and SPP:

$$\tilde{A}_{ik}^{mix} = A_{ik}^{BR} + t_0^{sis}(k - k_{sis}) + t_1^{mix}(65-k) \qquad (12)$$

$$A_{ik}^{mix} = \begin{cases} \tilde{A}_{ik}^{mix} & si \quad \tilde{A}_{ik}^{mix} \geq 20 \quad o \quad (\tilde{A}_{ik}^{mix} < 20 \quad y \quad 65-k_{sis} < 20) \\ 20 & si \quad \tilde{A}_{ik}^{mix} < 20 \quad y \quad 65-k_{sis} \geq 20 \end{cases} \qquad (13)$$

Where:

A_{ik}^{mix} : Number of years contributed to the mixed system (SNP and SPP included) up to age 65.

t_0^{sis} : Density of contributions between k_{sis} and current age *k*. *sis = snp, spp.*

t_1^{mix} : Density of contributions between current age and age 65.

Thus, the pension in the mixed system is computed as:

$$Pc_{ik}^{mix} = \frac{\frac{14}{12}Y_{ik} \times a \times d_{ik}^{mix}\frac{[(1+\tilde{r})^{65-k}-1]}{(1+\tilde{r})^{1/12}-1} + CIC_0(1+\tilde{r})^{65-k} + BR_{ik}}{CRU_{65,y}} \qquad (14)$$

$$P_{ik}^{mix} = \begin{cases} Pc_{ik}^{mix} & if \quad Pc_{ik}^{mix} > P_{\min}^{mix} \\ P_{\min}^{mix} & if \quad Pc_{ik}^{mix} \leq P_{\min}^{mix} \quad and \quad A_{ik}^{mix} \geq 20 \\ Pc_{ik}^{mix} & if \quad Pc_{ik}^{mix} \leq P_{\min}^{mix} \quad and \quad A_{ik}^{mix} < 20 \end{cases} \qquad (15)$$

$$d_{ik}^{mix} = \frac{A_{ik}^{mix} - A_{ik}^{BR}}{65 - k_{sis}} \qquad (16)$$

As is observed, Pc_{ik}^{mix} expresses the pension computed by individual capitalization when the contribution rate is α, and it also includes the value of the Recognition Bond. P_{ik}^{mix} indicates the final value for the pension in the mixed system.

2.4 Simulation of the actuarial reserve

The actuarial reserve is the capital needed to address the payment of current and future pensions. Since this payment is contingent to the death date of current and future insured and pensioners, it must be taken into account the probability of death (from mortality tables) and a discount rate to bring the payments to present value. In a DB system like the SNP and in a multi-pillar system as we propose, these payments should be compared with the present value of contributions in order to know the final balance, i.e. deficit, equilibrium or surplus. The appendix show the methodology used to estimate the actuarial reserve in the SNP, SPP and proposed mixed system.

2.5 Parameters

Mortality

On this topic, it is important to note that Peru use three different mortality tables, and all make a distinction by gender. The SPP has not its own tables, it has always used Chilean tables. Until 2006, the SPP used the complete set of Chilean tables built in 1985; and since that date, the tables used are also Chilean but built with information of 2004[7]. Currently, the 2004 tables are used to calculate the annuity price for pension holders, while the 1985 tables are still used to calculate the annuity price for disabled persons and beneficiaries. Differently, the ONP used the 1985 Chilean tables until 2006 to estimate the actuarial reserves in the SNP. But since 2007 it uses mortality tables built with Peruvian data (SP-2005)[8]. It is paradoxical that the SPP does not use the table SP-2005, despite reflecting (in theory) the real mortality profile of the Peruvian insured.

In order to compare actuarial reserves from the current pension system and multi-pillar system, it is necessary to use the same mortality tables in all cases. Thus, we adopt the tables currently used in the SPP, i.e, the RV-2004 for pension holders and the B-85 for beneficiaries. In all these tables, the maximum age of survival is M=110. Regarding the number and type of beneficiaries, it is assumed that each insured has a spouse and none not-adult child. It is also assumed that the age difference between spouses is 4 years, and always in favour of males[9].

Interest rates

Since the simulation of actuarial reserves implicitly assumes that there is no inflation, it must be assumed an interest rate free of price changes. Furthermore, this is long-term rate given the long period of years a person contributes. The pension fund's yearly real return from the start of SPP, i.e. August 1993, to each subsequent year varies between 6.3% and 11.7%; and the average

[7] The 1985 tables are RV-85, MI-85 y B-85, for pension holders, beneficiaries and disabled persons respectively. The 2004 tables are named RV-2004.

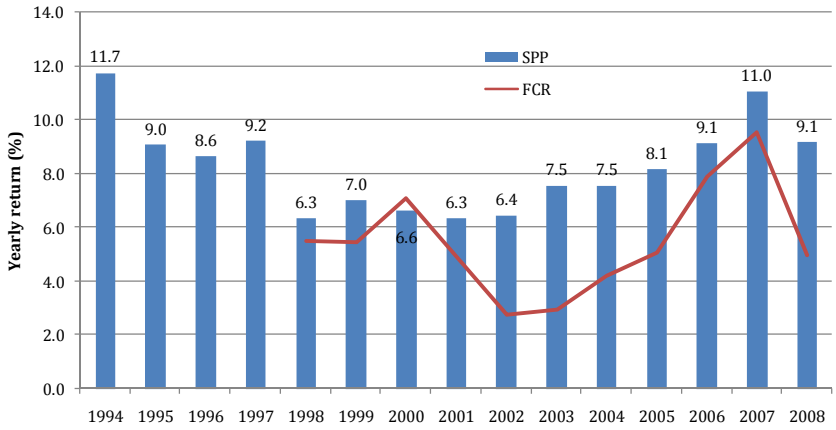
[8] The Chilean MI-85 table is still used in the SNP for disabled persons.

[9] The average age difference between the heads of household under 65 years and their wives is 3.6 according to the National Household Survey (ENAHO-2006). MEF (2008) also assumes that the spouse is the sole beneficiary, but with an age difference of 5 years, while in Bernal et al (2008) this difference is 3 years.

is 8.2% (see next figure). In contrast, the yearly return of the fund (Consolidated Fund of Reserves (FCR) which is in dollars) used to pay benefits in the SNP varies between 2.8% and 9.5%; with 5.5% as average rate.

Instead, it is also possible to calculate the pension fund's yearly real return during the last 5 or 10 years at each moth. In this exercise, the average rate is 9.3% for both length of time, although the range of variation is between 4.0% and 20.9% or between 7.1% and 12.2% for the 5 or 10 year period, respectively.

Figure 1
Pension fund's yearly real return and FCR's yearly return



Source: SBS, ONP. Author's elaboration.

The estimation of pensions and actuarial reserves is very sensitive to the value of the return rate. While in the 15 years of operation of the SPP, the average real return is about 9%, it is best to assume a conservative value. Therefore, let's assume $\tilde{r}$ = 6%. This same value is assumed in other studies that show long-term projections for the Peruvian pension system, as is the case of Moron and Carranza (2003) and Bernal et al (2008); however, MEF (2008) uses a too conservative rate of 5%.

According to available data, the gross average of the annuity's discount interest rate ranges between 4.7% and 4.9% as shown in the table below[10]. In contrast, the discount interest rate used to calculate the scheduled withdrawal, that is another type of pension, is between 4.06% and 4.10%. This rate is chosen by the AFP given these firms pay the pension withdrawals to its pensioners. The AFP have kept these values since October 2003. Furthermore, the interest rate specified in the SPP's regulation for evaluating the entitlement of benefits such as regular and special early retirement and minimum pension is 4.6%. Therefore, given that there is not much discrepancy among all those values, we assume the official interest discount rate $\hat{r}$ = 4.6% in our simulations.

Table 3
Annuity's interest rates[a] (in %)

Type of retirement pension	Dec-2006	Dec-2007	Oct-2008
Deferred life annuity	5.09	4.94	4.64
Deferred life annuity with guaranteed period	4.88	4.79	4.68
Life annuity	5.15	4.91	4.65
Life annuity with guaranteed period	4.78	4.51	4.54
Total	4.91	4.80	4.65

a/ Annuities in Dollars and obtained at the legal retirement age of 65.
Source: SBS. Author's elaboration.

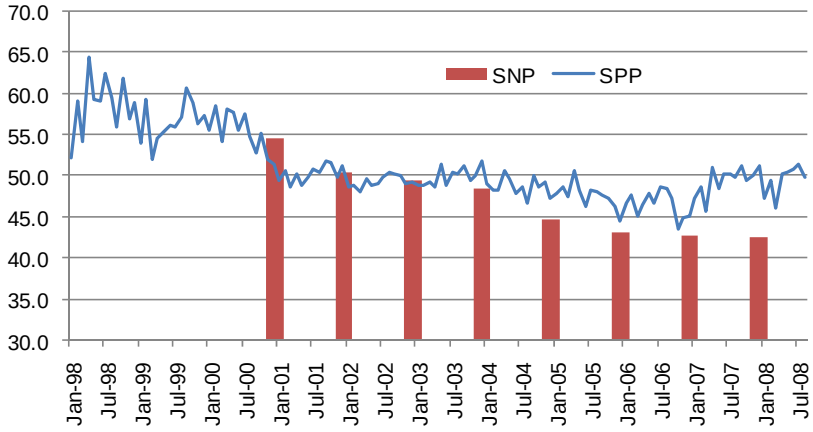
[10] The information on annuities in Dollars is enough to have an idea on the value of the interest rate because the majority of retirees choose this currency. According to available information, 98% of the annuities were given in Dollars.

The discount interest rate is needed to find the present value of a life annuity, and consistently we must use the same interest to estimate the actuarial reserve and present value of contributions, i.e. $r = \hat{r} = 4.6\%$[11]. Other authors that estimate the actuarial debt for Latin American countries use similar rates; Zvinieni and Packard (2002) use a discount rate of 4%, Holzmann et al (2004) use values between 2% and 5%.

Parameters of the pension systems

Since 1998, the SPP publish a proxy for the density of contributions, which is defined as the quantity of contributors over the total of insured, excluding those who never contributed to the SPP. The mean of this indicator is 51.1% between January 1998 and August 2008. Although this variable is not calculated in the SNP, it is still possible to construct a proxy by using the information available in the ONP's summary of annual economic study of pension reserves. Thus, the average yearly ratio between contributors and insured in the SNP is 47.1% between 2000 and 2007 (see figure).

Figure 2
Density of contributions in the SNP and SPP



Source: SBS, ONP. Author's elaboration.

Given that information regarding past and future contribution density is not available, it is assumed that $t_0^{snp} = t_1^{snp} = t_0^{spp} = t_1^{spp} = t_1^{mix} = 50\%$ with the goal to simplify the estimation of pensions, actuarial reserves and contributions[12]. This assumption is not far from more accurate figures estimated in other funded pension systems such as in Chile and Argentina (Arenas de Mesa et al, 2008; Bertranou and Sánchez, 2003). MEF (2008) uses a contribution density of 60% but this value is too optimistic and has not a clear empirical base.

The minimum pension for the insured in the SPP and SNP is S/. 484. The SNP also offers a minimum pension for beneficiaries (the insured's spouse), which is S/.315. All these same values are assumed for the multi-pillar system. Moreover, the maximum pension offered in the SNP is S/. 1,000. Finally, in the SPP the widow or widower will receive 42% of the insured's pension; while that in the SNP this value is 50%. In the SNP, the widow always receives a survival pension but the widower receives such a pension only if he is disabled or has more than 60 years and depended economically on his wife. Therefore, in the simulation of reserves for the

[11] A discount rate of 4% is used by other authors that estimate actuarial reserves in Peru (MEF, 2008 y Bernal et al, 2008). The ONP also uses this rate to estimate the actuarial reserves of the SNP.

[12] Similar to other Latin American pension systems, the distribution of the contribution density might be bimodal, i.e. the distribution might show concentrations of values near to 0% and 100%. This is the case for Chile (Arenas de Mesa et al, 2004), Uruguay (Bucheli et al, 2009) and Argentina (Bertranou and Sánchez, 2003 and Farall et al, 2003).

SNP, θ_{snp} =50% and it is assumed that survival pensions are only entitled to widows. In the SPP and multi-pillar system, $\theta_{spp} = \theta_{mix}$ = 42% for widows and widowers.

3. Effects of the reform

3.1 Actuarial reserve

The estimation of the actuarial reserve is extremely sensitive to assumptions, pension rules and parameters used. For instance, the evolution of the SNP's reserve responds to changes in the parameters of the pension system, pension rules and pension values. Table 4 shows that the actuarial net reserve estimated has almost doubled between 2000 and 2007. The evolution of some components of the net actuarial reserve, such as number of pensioners and pension increases, it not enough to explain the significant growth. There must be other factors that explain this significant increase. Among them may be using the mortality table SP-2005 instead of the RV-85 from the year 2007, which assumes higher longevity[13].

Table 4
Actuarial reserve of SNP (US$ millions)

Year	Pensioners (a)	Insured (b)	Total (a)+(b)	Present value of contrib. (c)	Net reserve (a)+(b)-(c)	(b)-(c)
ONP estimation:						
2000	5,672	12,518	18,190	4,787	13,403	7,731
2001	7,739	13,027	20,766	5,249	15,517	7,778
2002	7,598	12,531	20,129	4,978	15,151	7,553
2003	7,988	13,418	21,406	5,680	15,726	7,738
2004	8,846	15,449	24,295	6,579	17,717	8,870
2005	9,390	16,239	25,629	7,142	18,487	9,097
2006	10,606	19,318	29,924	9,360	20,564	9,958
2007	12,653	24,272	36,924	11,038	25,887	13,234
Author's estimation:						
2006	n.a.	14,255		4,550		9,704

Sources: ONP's summary of annual economic study of pension reserves and author's simulation.

Moreover, in table 4 there are striking differences between the results of our estimation for 2006 and ONP's. The main reasons for this discrepancy are i) the use of a discount rate for the actuarial reserve and annuity price equals to 4.6%, while the ONP uses 4%; ii) the assumed density of contributions is 50%, and implies an average contribution density of 20.9 years for the insured from our SNP sample; this sharply contrast to the 33 years supposed by the ONP[14]; iii) the use of the mortality table RV-2004 instead of the RV-85 that is used by the ONP; iv) the not inclusion of the insured without age information in the SNP sample; while the ONP supposes them are 41 and 43 years old; v) the age difference between spouses is 4 years while the ONP assumes 7 years. It is worth mentioning that the simulation uses the same exchange rate by ONP in 2006, i.e. S/. 3.194.

The actuarial reserve for current SNP's pensioners is not estimated because the proposed reform will not affect current pensions and therefore will not change its reserve. Accordingly, the concept of net reserve will be henceforth the difference between the actuarial reserve for insured workers and the present value of their contributions. This is precisely the concept expressed in the last column of Table 4. Our estimation is US$9,704 billion (10.4% of GDP), not far from ONP's. We must add to this amount the reserve of minimum pensions offered to some insured in the SPP in order to obtain the actuarial reserve of the pension system as a whole.

[13] According to table SP-2005, 65 years old males and females are expected to live 18.06 and 24.79 additional years, respectively. In contrast, table RV-85 forecasts 17.15 and 20.71 for males and females, respectively.
[14] Until 2006, the ONP assumed that insured contribute up to 33 years; but since 2007, the assumption changed to 27.

Thus, before any reform the actuarial reserve amounts to US$10,296. Precisely, the reduction of this implicit debt (or actuarial debt) is one of the main reform objectives.

Table 5
Actuarial debt with and without reform (US$ million)

No Reform									
a. Present value of contributions	4,550								
b. Reserve for SNP insured	14,255								
c. Reserve for SPP insured	592								
d. Net reserve: c+b-a	10,296								
With Reform	*Contribution rate to individual account*								
	α=1%	*α=2%*	*α=3%*	*α=4%*	*α=5%*	*α=6*	*α=7%*	*α=8%*	*α=9%*
e. Present value of contributions	20,763	18,456	16,149	13,842	11,535	9,228	6,921	4,614	2,307
f. Reserve for insured	21,204	19,803	18,522	17,354	16,284	15,305	14,412	13,595	12,848
g. Net reserve: f-e	441	1,347	2,373	3,512	4,749	6,077	7,491	8,981	10,541
Savings from reform: d-g	9,855	8,949	7,923	6,784	5,547	4,219	2,805	1,315	-245

Source: Author's simulation.

Table 5 shows the reform's effect on actuarial debt under different combinations of contribution rates α and β, subject to α+β=10%. Each column exhibits the estimated value of the actuarial reserve and the amount of savings for the State due to reform. For instance, in the first column, 9% of salary is contributed to the solidarity fund and only 1% to the individual account; i.e. the multi-pillar system would be close to work as a PAYG system. In this scenario, the actuarial debt is reduced to only US$441 million, so the State may save up to US$9,855 million, which is equivalent to 10.5% of GDP[15]. Although this is an extreme scenario, it is instructive. If the contribution rate to individual account is higher, as shown in the other columns of the table, the State may still obtain substantial savings. The other extreme case is shown in the last column of table 5. In that scenario the multi-pillar system would be similar to the SPP with only a small contribution rate to the solidarity fund, although with a general guaranteed minimum pension scheme. This alternative slightly raises the actuarial debt by US$245 million instead of generating savings.

A social planner only interested in reducing the actuarial debt will chose the scenario with the lowest contribution rate for the individual account. Although this choice might lead to less inequality among pensioners, it could also imply some adverse consequences in welfare. The next section is devoted to these issues.

3.2 Equity and welfare

Apart from reducing the actuarial debt, the reform also has distributional and welfare effects. The effect on the distribution of pensions is quantified by the Gini coefficient (G). While this indicator is widely used to measure income inequality, this lacks any normative judgement. In contrast, the Atkinson index (Atkinson, 1970) is built on explicit ethical basis since it takes into account the inequality aversion of the planner[16] (Lambert et al, 2008).

In the context of pension systems, the Atkinson index may be interpreted as the fraction of national income on pensions which can be lost in order to achieve equality in the distribution of pensions; or in other words, it is the price that the planner is willing to pay for complete equality. If $e \rightarrow 0$, the planner is neutral to inequality and the index tends to zero, thus it is not willing to sacrifice pension amounts in exchange for perfect equality. However, a planner more

[15] This result implies that the merger of insured from the SPP and SNP alleviates the actuarial deficit; and it also brings support to the idea that the creation of the SPP, which attracted a considerable number of insured from the SNP, increased the actuarial debt in the SNP.

[16] The index is defined as I(e); e is the parameter of inequality aversion of the social planner.

averse to inequality exhibits an index that tends to 1, so that it tolerates large losses in the pensions in exchange for greater equality.

With Regard to the effects on welfare, the planner should be able to build social welfare functions (SWF) with the resulting pension distributions from the reform, and then rank them. As pointed in Lambert (2001), the SWF must be increasing in the income mean and decreasing in the inequality index. Thus, if μ indicates the pension mean, then the SWF built with the Gini coefficient and Atkinson index are $W_G=\mu(1-G)$ and $W_{I(e)}=\mu(1-I(e))$ respectively. Table 6 shows inequality measures for each pension distribution derived from different contribution rates α[17].

Table 6
Inequality indexes

No Reform	Pensions			Wages		
	SNP	SPP	Total	SNP	SPP	Total
Mean	542.8	967.2	879.4	1003.0	1562.1	1446.4
Gini	0.095	0.509	0.473	0.397	0.507	0.496
I(e=0.1)	0.003	0.050	0.046			
I(e=0.5)	0.014	0.217	0.195			
I(e=1.0)	0.026	0.370	0.327			
I(e=2.0)	0.044	0.638	0.573			
I(e=2.5)	0.051	0.829	0.787			

With Reform	Pensions								
	α=1%	*α=2%*	*α=3%*	*α=4%*	*α=5%*	*α=6*	*α=7%*	*α=8%*	*α=9%*
Mean	659.9	681.9	706.1	732.5	760.8	790.9	822.7	856.0	890.6
Gini	0.278	0.296	0.313	0.330	0.347	0.362	0.377	0.390	0.402
I(e=0.1)	0.027	0.029	0.030	0.032	0.033	0.035	0.036	0.037	0.039
I(e=0.5)	0.111	0.117	0.123	0.130	0.136	0.143	0.148	0.154	0.159
I(e=1.0)	0.192	0.199	0.208	0.217	0.227	0.236	0.245	0.254	0.262
I(e=2.0)	0.578	0.529	0.508	0.498	0.495	0.495	0.497	0.501	0.506
I(e=2.5)	0.849	0.810	0.790	0.779	0.774	0.772	0.773	0.775	0.778

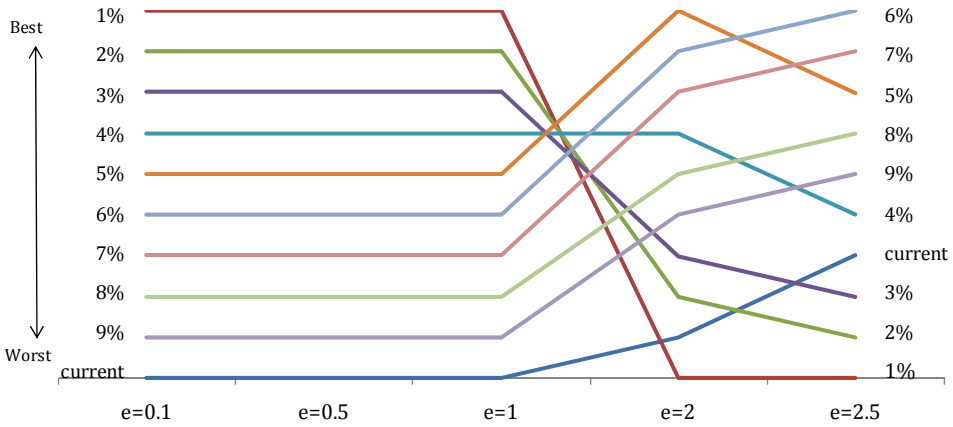
Source: Author's simulation.

It is interesting to note how different the two pension systems transmit inequality from labour life to retirement. For instance, in the SNP the Gini coefficient for wages drops from 0.4 to 0.1; this is simply explained by the system design on which the pension value must be within a minimum and maximum value. In contrast, in the SPP the wage inequality is transmitted almost perfectly to pensions, which is due to the individual capitalization scheme.

The reform always reduces pension inequality when the distributional effect is analyzed with the Gini coefficient; and the inequality monotonically decreases as α lowers. The same results are observed when the Atkinson index is used until e=1. Higher values of aversion to inequality lead to changes in the ranking of pension distributions. Figure 3 allows us to see this effect.

[17] In this table and henceforth, inequality and welfare measures are referred to insured younger than 65 years old.

Figure 3
Ranking of pension distributions



Source: Author's simulation.

The best distribution in the ranking is one that shows less inequality according to planner's view. For this reason, a distribution may exhibit different positions for two planners that differ on their aversion to inequality. For example, a planner very averse to inequality (e=2.5) prefers the scenario with a contribution rate α=6%, while that a less averse planner (e≤1), the best scenario is that one with α=1%.

Draws attention that the pension distribution with α=1%, i.e. the maximum rate of contribution to the solidarity fund among all distributions, is at the worst position of the ranking when the planner is highly averse to inequality. However, this result is not entirely unexpected. As the aversion to inequality increases, it gives more weight to the bottom of the pension distribution; therefore, a distribution more inequality distributed at the end of the scale would be worst ranked (Atkinson, 1970). At the bottom of the pension distribution there are insured who obtain a minimum pension and who obtain a pension below such value; for the latter the pension value is even lower when the contribution rate for individual capitalization is low. This in turn leads to greater inequality in the bottom of the distribution of pensions.

Table 7
Ratio de pension averages (richest 10% / Poorest 10%)

No Reform	Pensions				Wages		
	SNP	SPP	Total		SNP	SPP	Total
	1.96	28.53	22.34		7.38	13.91	12.74

With Reform	Pensions								
	α=1%	*α=2%*	*α=3%*	*α=4%*	*α=5%*	*α=6*	*α=7%*	*α=8%*	*α=9%*
	5.81	6.16	5.02	5.34	5.66	7.69	8.09	8.50	8.92

Source: Author's simulation.

An additional way to observe the degree of inequality is through the ratio of pension averages at the extremes of distribution (see table 7). In the SPP, the richest 10% of the distribution will earn a pension nearly 30 times than that of the poorest 10%, a ratio even higher than the one built with wages (nearly 14 times). Overall, the ratio between the extremes of pension distribution is 22.3 before our proposed reform. After the reform, this ratio might range between 5.8 and 8.9.

Likewise, the planner is able to rank the resulting pension distributions according to its welfare implications. As mentioned before, a SWF may be computed for each contribution rate α. For instance, by using the Gini criterion the contribution rate α=9% offers the best effects on

welfare; and as this rate decreases, the position of the WFS in the ranking decreases (see table 8). The SWF corresponding to the current scenario (without reform) is at the bottom of the ranking.

Table 8
Ranking of social welfare functions

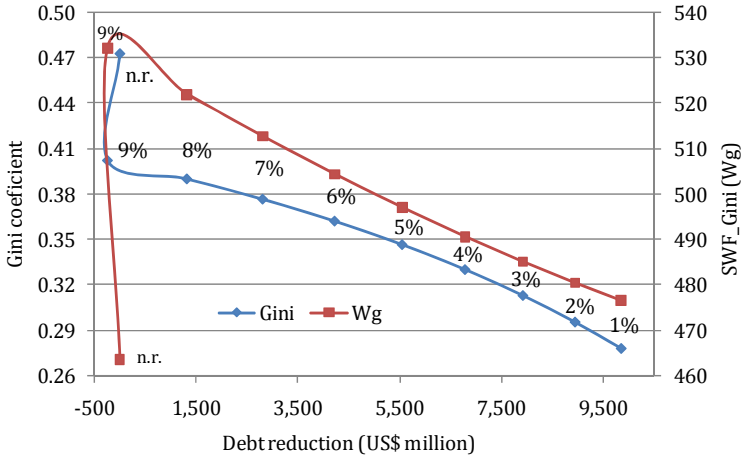
SWF	*α=1%*	*α=2%*	*α=3%*	*α=4%*	*α=5%*	*α=6*	*α=7%*	*α=8%*	*α=9%*	*(No reform)*
Gini	9	8	7	6	5	4	3	2	1	10
I(e=0.1)	10	9	8	7	6	5	4	3	1	2
I(e=0.5)	10	9	8	7	6	5	4	2	1	3
I(e=1.0)	10	9	8	7	6	4	3	2	1	5
I(e=2.0)	10	9	8	7	5	4	3	2	1	6
I(e=2.5)	10	9	8	7	6	5	4	2	1	3

Source: Author's simulation.

The ranking of the scenarios change slightly if the SWF are measured with the Atkinson criterion, except the current scenario that presents a rather different position to that found with the Gini criterion. Since the effect of average mean on the SWF is larger than the effect of greater inequality, the scenario of no reform is not too bad ranked.

Overall, there are important consequences of the reform on the actuarial debt, pension inequality and welfare. It is worth to present these effects all together in order to observe trade-off for policy-making.

Figure 4
Debt reduction, inequality and welfare (Gini criterion)

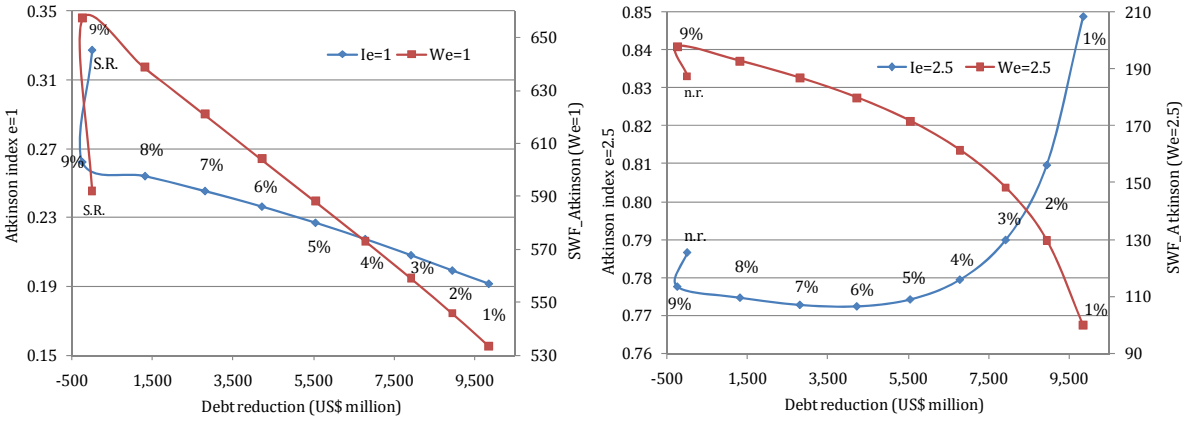


Source: Author's simulation.
n.r. = no reform.

Figure 4 shows the effects of reform on actuarial debt, inequality and welfare according to the Gini criterion. As noted in the figure 4, any scenario of reform involves improvement in welfare and equity with respect to the current situation. If the planner is only interested in the effects on welfare, then he chooses the contribution rate α=9%, given that this scenario offers the highest level of welfare. However, this scenario increases the pension debt by US$ 245 million. In contrast, a planner more concerned with achieving greater savings in the pension debt will choose a lower rate of contribution to the individual account, which will reduce inequality in pensions as well. Finally, if the criterion for choosing a scenario is to keep pensioners as well off as they would be with no reform, then the contribution rate α should be only 1%, which in turn implies the largest save of debt and the more equity pension distribution.

These results change when using the Atkinson criterion. According to the left panel of figure 5 (with *e*=1), the planner favors a contribution reate α between 5% and 6% as this rate ensures at least the same welfare that would be there with no reform. Furthermore, it saves between US$4,200 and US$ 5,500 million and reduces inequality. Similarly, in the right panel (with *e*=2.5) the α preferred by the planner is between 7% and 8%, it generates savings between US$1,300 and US$2,800 million and also reduces inequality. However, if the first goal of the planner is to reduce inequality, then he prefers a contribution rate of α=6%.

Figure 5
Debt reduction, inequality and welfare (Atkinson criterion)



Source: Author's simulation. N.R. = No Reform.

In summary, there are several effects of the reform proposal and its relative importance depends on the planner's view. The trade-offs shown in this section, rather than serve as a manual for making an accurate decision on the best possible scenario for reform, are useful to instruct and highlight the different policy objectives and their interplay.

3.3 A marginal contribution rate

While the reform proposal recovers the principle of solidarity in the pension system, it is still possible to consider additional measures to ensure greater transfers from high-income to low income insured, and in turn reduce the actuarial debt. It is instructive to study the effect of an marginal contribution paid by those insured who earn above a threshold amount. We present two different possible schemes:

i) The contribution rate to the solidarity fund is β for $Y_{ik} \leq Y_m$ and $\beta+t_1$ for $Y_{ik}-Y_m$, given $Y_{ik}>Y_m$. The contribution rate to the individual account is α, applied to total wage. It still holds that α+β=10%.

ii) The contribution rate to the solidarity fund is β for $Y_{ik} \leq Y_m$ and $\beta+\alpha t_2$ for $Y_{ik}-Y_m$, given $Y_{ik}>Y_m$. The contribution rate to the individual account is α for $Y_{ik} \leq Y_m$ and $\alpha(1-t_2)$ for $Y_{ik}-Y_m$, given $Y_{ik}>Y_m$. It still holds that α+β=10%.

In the first scheme, the base rate of contribution (to individual account and solidarity fund) is 10%; only those members who earn more than threshold Y_m contribute more to the solidarity fund. So, a majority of insured contributes 10% while only those placed at the top of income distribution contribute $10\%+t_1(1-Y_m/Y_{ik})$. On the other hand, if the second scheme were applied, the contribution rate of 10% would common to all insured, although the allocation between the individual account and solidarity fund will depend on the income distribution position. Table 9 shows the results on actuarial debt of applying marginal contributions when Y_m is S/.60,000 per

year, t_1=2% and t_2=25%[18]. Although these values are rather arbitrary, those are still instructive to assess the effectiveness of applying marginal contributions to reduce the actuarial debt.

Table 9
Actuarial debt with marginal contribution (US$ million)

No Reform									
a. Net Reserve	10,296								
With Reform	*Contribution rate to individual account*								
	α=1%	*α=2%*	*α=3%*	*α=4%*	*α=5%*	*α=6*	*α=7%*	*α=8%*	*α=9%*
i) With marginal contribution t_1=2%									
b. Present value of contributions	20,763	18,456	16,149	13,842	11,535	9,228	6,921	4,614	2,307
c. Present value of marg. contr.	712	712	712	712	712	712	712	712	712
d. Reserve for insured	21,204	19,803	18,522	17,354	16,284	15,305	14,412	13,595	12,848
e. Net reserve: d-b-c	-271	635	1,661	2,800	4,037	5,365	6,779	8,269	9,829
f. Savings: a-e	10,567	9,661	8,635	7,496	6,259	4,931	3,517	2,027	467
ii) With marginal contribution t_2=25%									
g. Present value of contributions	20,763	18,456	16,149	13,842	11,535	9,228	6,921	4,614	2,307
h Present value of marg. contr.	89	178	267	356	445	534	623	712	801
i. Reserve for insured	21,212	19,811	18,529	17,360	16,290	15,311	14,418	13,600	12,852
j. Net reserve: i-g-h	360	1,177	2,113	3,162	4,310	5,549	6,874	8,274	9,744
k. Savings: a-j	9,936	9,119	8,183	7,134	5,986	4,747	3,422	2,022	552

Source: Author's simulation.

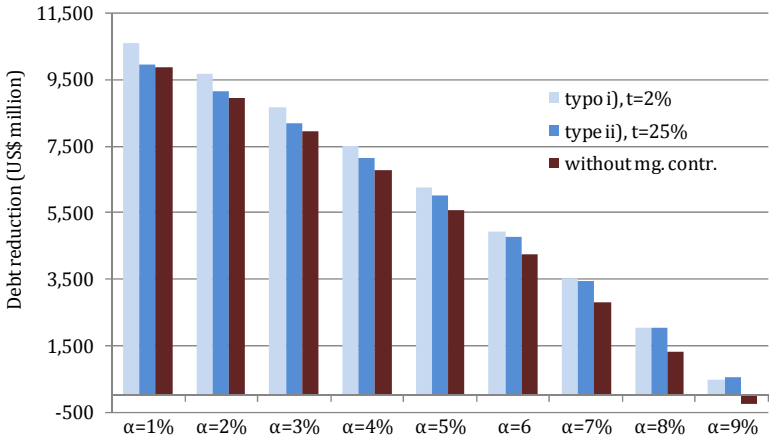
If the first scheme were implemented, the marginal contribution might increase the present value of contributions in US$712, which in turn lead to an additional reduction of same amount in the actuarial debt. This saving is relatively less important when the contribution rate α is lower, which suggests that the choice of a high value of α should include the implementation of a marginal contribution in order to obtain significant effects in reducing the actuarial debt. Similarly, the savings achieved with the second scheme gains significance when α is greater. However, the present value of marginal contribution is not fixed as in the first scheme, but it is increasing with α. Overall, the first scheme may achieve greater savings than the second one, though only up to α=8%; since this threshold, the second scheme is better to enhance savings.

Individuals who earn more than Y_m may prefer the second scheme because the amount contributed to the solidarity fund comes from the resources that had been contributed to the individual account anyway ($\alpha t_2(Y_{ik}-Y_m)$), which does not affect the disposable income. Since resources of individual account can be annuitized only at retirement and that disposable income can be spent immediately or invested in other forms of savings, it is clear that the insured would prefer the scheme that offers more disposable income.

Given that marginal contribution is only applied to insured in the top of income distribution, the advantage of the first scheme is that it provides a clearer mechanism of solidarity from high-income to low-income insured. In any case, if the implementation of a marginal contribution were strongly resisted, the multi-pillar system itself offers significant reduction of the actuarial debt (see figure 6) and improvements in welfare and inequality.

[18] Insured earning more the S/60,000 a year belong to top 5% of wage distribution.

Figure 6
Actuarial debt reduction with and without marginal contribution



Source: Author's simulation.

The first scheme does not change inequality and welfare measures as these are calculated with pension, which values are not affected by the marginal contribution. In comparison to a reform without marginal contribution, the second scheme produces a very slight reduction in inequality according to Gini coefficient and Atkinson index (when e≤1), and less welfare whether using Gini coefficient or Atkinson index[19].

3.4 What if the SPP shifts to a SNP system type?

Our reform proposal differs from others planned for the Peruvian pension system (e.g. MEF (2008) and Bernal et al (2008)) that are aimed at preserving the *status quo* in the pension system, i.e. the maintenance of the SNP and SPP as two separate entities. Those proposals include partial reforms within each system without an integral vision on pension insurance at all. Indeed, Bernal et al (2008) propose further deterioration of current conditions of the SNP (e.g. reduction of basic replacement rate and salary to calculate benefits) in order to decrease the actuarial debt.

The scheme design of the SNP, which is defined benefit system, is not the reason by itself of the current imbalances[20]. In the past, there might have been a bad choice of pension rules and parameters, incompetent administration and investment management, political interference and lack of transparency. If all these problems had could be isolated, the current SNP might be balanced if and only if its contributors had not been moved to the SPP. Consequently, reunite both systems should be part of the solution of the imbalances. We do not pretend to overlook the advantages of an individual capitalization scheme, but the recovering of the principle of solidarity (that was broken with the introduction of the SPP) is crucial in our reform proposal. In order to be provocative and support the above mentioned, table 10 shows the effects on the SPP's actuarial debt when the SPP is transformed into a system with the same rules of the SNP[21].

[19] The reason is that the effect of reducing the average pension (pensions of high-income insured) dominates any improvement in inequality. Therefore, the first scheme might be preferred to the second one according to its best results in welfare.
[20] The Ageing phenomenon in Peru is moderated, as it is defined in Bertranou (2008); and hence the demographic composition of Peruvian population is not a limitation for the implementation of a defined benefit system.
[21] The same parameters and assumptions from previous simulations are used for this exercise.

Table 10
Actuarial debt when the SPP shifts to a SNP system type (US$ million)

	No Reform	*With Reform*
a. Present value of SPP insured 's contributions	0	25,440
b. Reserves for SPP insured	592	37,607
c. Recognition bond of SPP's insured /1	-	2,407
d. Pension funds (at Dec-2006)	-	14,260
e. Net reserve: b-a-c-d	592	-4,501

1/ Actuarial value of recognition bond applications of the SPP sample.
Source: Autrhor's simulation.

Under Current conditions, the State should reserve US$592 for the insured in the SPP (as explained before, this is the payment of minimum pensions to some insured). The SPP may reach a surplus of US$4,501 million if it shifts to a system as the SNP. The recognition bonds are included in the actuarial debt because those are resources contributed by insured that were previously enrolled in the SNP. In comparison to our original reform proposal, this SPP transformation leads to important improvements in pension inequality weather it is measured with the Gini coefficient or Atkinson index. Furthermore, according to Gini criterion this exercise implies more welfare than the proposed reform for values $\alpha \leq 4\%$. Welfare is also larger under the Atkinson criterion when $e \geq 2$. Whereas there are some positive effects of transforming the SPP into a SNP system type, the aim of our proposal is reforming the current pension system into a multi-pillar system.

3.5 The third pillar

So far the reform analysis has focused on the effects of first and second pillar as these are mandatory and are the basis on which the new pension system is sustained. The third pillar is voluntary and is intended for workers willing to save more in order to obtain better pensions. In general, low-income individuals might are not interested in this scheme because they must allocate its limited resources on more immediate needs. The third pillar should be designed to alleviate rigidities of first and second pillar (Holzmann et al, 2005). This may attract individuals who are already enrolled in the pension system, and even those who are not insured (e.g. professional self-employed workers) but willing to participate in a third pillar if incentives are adequate in their view.

A possible scheme of third pillar is fixing a wage ceiling to charge the AFP's administrative fee. So, insured that earn more than that ceiling and choose the third pillar will pay the fee only up to the ceiling; in addition, the AFP may establish other fee schema for those who earn less than the ceiling or who are not enrolled in the pension system. While it is expected to find resistance in the AFP as the main portion of its revenues relies on the fees charged to high-income insured, it is also true that the proposed reform would increase significantly the number of its contributors (those coming from SNP) and revenues. In December 2006, there were 1.4 and 0.57 million contributors in the SPP and SNP respectively; which means that, at the reform date, the number of AFP contributors would rise by 40%. This increase contrasts sharply with the yearly growth rate of the number of contributors noticed until December 2006 and calculated with the available data, which was only 8.2%. Furthermore, if the same administrative fee charged previous reform (1.8075% of wages) is kept, the multi-pillar system would allow the AFP to increase its revenues in 23%, which is larger than the yearly growth rate of AFP revenues (8.1% between Dec-1997 and Dec-2006). Table 11 shows potential gains from reform for the AFP.

Table 11
Administrative fee Revenues (S/. thousands, dec-2006)

Concept		
SNP		
Number of contributors	568,847	
Gross collection	837,906	
SPP		
Number of contributors	1,412,001	
Administrative fee revenues	505,695	
With Reform		
Number of contributors	1,980,848	
Administrative fee revenues from SNP	116,501	
Administrative fee revenues from SPP	505,695	
Total administrative fee revenues	622,196	
With reform and third pillar		
Variation in total administrative fee revenues	marg. rate=0%:	marg. rate=0.9%:
Wage ceiling: S/. 6,000	-38,124	39,189
Wage ceiling: S/. 7,000	-17,889	49,306
Wage ceiling: S/. 8,000	-1,860	57,320
Wage ceiling: S/. 9,000	10,479	63,490
Wage ceiling: S/. 10,000	20,994	68,748

Source: Author's simulation, SBS and ONP.

Without implementing the third pillar, AFP's revenues would increase automatically by S/.116.5 million, but a wage ceiling of S/.6,000 a month would reduce revenues by 38 million (first column of table 11). As wage ceiling rises, AFP find positive variation in its total revenues; for instance, a ceiling of S/.10,000 would increase revenues by S/.21 million. Second column of table 10 shows the variation on AFP's revenues if the fee scheme of the third pillar is varied slightly. Instead of charging no fee beyond wage ceiling, the AFP can charge half the fee, i.e. 0.90375%. By this way, the revenues are reduced less than in the first fee scheme. For example, a ceiling of S/.10,000 would raise revenues by S/.68.7 million.

Although the arrival of insured from the SNP increases AFP's administrative costs, this increase should not be directly proportional to the number of new insured. The reason of this is the existence of economies of scale in the pension fund industry[22]. Therefore, it is feasible to set a fee schedule for the third pillar without an increase of fees. In addition, the third pillar would be open to non-enrolled workers and insured who earn less than the ceiling, which would allow AFP to collect extra fees and revenues. The setting of this fee may also serve as an additional vehicle for competition among AFP.

On the other hand, the AFP would no longer have a system competitor (the SNP) for recruiting new workers, which ensures a better and broader base of contributors. Moreover, the AFP are very profitable firms that already recovered their initial investment as is seen in their high profits and large levels of Return on Equity obtained during last years, even higher than in other Latin American pension systems (World Bank, 2004). Among Peruvian industries, the AFP industry is the sector with best returns (Gerens, 2006).

4. Concluding remarks

A multi-pillar system as proposed in this paper enables to reinstate the principle of solidarity in the Peruvian pension system. Peruvian workers are not unfamiliar to this social security principle. The pension system that prevailed before the establishment of individual capitalization was the SNP, a system that includes, by design, the principle of solidarity. Moreover, the insured of the SPP contributed, until 1995, 1% of their wages as a solidarity contribution to IPSS (Peruvian Institute of Social Security), which was the predecessor of SNP.

[22] Galarza and Olivera (2001) and Moron and Carranza (2004) show evidence of economies of scale in the Peruvian pension fund industry.

As is clear from our proposal, solidarity is a valued characteristic in social security in general, and particularly in a pension system. Furthermore, the recovery of this principle allows us to use the pension system as an additional tool for income redistribution. Although must be noted that this usage comes from the approach of social security as part of redistributive policies. This contrasts with the view of social security as an efficient social insurance.

It is worth to mention that a multi-pillar system diversifies the risks better. The factors that affect labour variables and hence the first pillar are not perfectly correlated with factors that affect financial variables, which in turn determine the pension funds performance in the second pillar (Holzman et al, 2005; Lindbeck and Persson, 2003).

The proposal has three important effects. First, pension inequality is notably reduced, which break the transmission of inequality from labour income to pensions. Second, the reform is welfare enhancing, although it depends on the value of the contribution rate chosen for the individual account. And in third place, actuarial debt is importantly reduced. The key aspect of our results is that the proposed reform shows improvements in all these three issues.

As minimum pensions are financed by contributions from insured rather than transfers from the Treasury, the State would allocate these freed resources to other social programs, which enhances the social spending. Furthermore, the implementation of a general minimum scheme and open to all insured give the same rights to all insured whether these come from SPP or SNP.

The proposed third pillar may attract high-income insured and workers who are not obligated to enrol in the pension system due to rigidities of the first and second pillar. It is expected that AFP will not increase their fees due to the existence of economies of scale in the pension fund industry and the fact that the SNP will not be longer a competitor. Indeed, the creation of a third pillar is another mean for enhancing competition among AFP. For these reasons, the reform proposal may also be though as an opportunity to bring down administrative fees.

Organizational aspects of the reform are beyond the scope of our proposal but may have interesting effects. For example, insured of the SNP could choose any AFP or could be "assigned", by any criterion, to each of these firms. In the first case, firms would compete for those insured (over 600 thousand contributors in the SNP at Dec-2007); although instead of competing via fees reductions, they could compete via advertising, sellers or gifts, which increase administrative expenses. The second case prevents the increase of administrative costs but not ensure the reduction of fees. Another option is to offer the entire group of SNP insured to a new AFP through a tender (choosing the offer with the lowest fee). Some companies might be interested in this scheme as they can avoid the high sunk costs of starting activities, which are typical in the pension funds industry. In turn, this fee should be lower than that of the rest of AFP and influence them to bring down their own fees. We do not address the design characteristics of the tender, but this should minimally include clauses of temporal loyalty for the SNP insured and the commitment not to raise the fee agreed for a certain period. Although politically risky and controversial, it might be created a governmental AFP with the automatic inclusion of all insured from the SNP; and its management and regulation would be identical to those of the AFP. In this case, the fee charged by the Government might work as a mechanism to reduce fees of the other AFP.

Undoubtedly, the reform proposal opens up many possibilities to improve the pension system in areas not considered in the proposal itself, particularly in the fee charged by the AFP. In this sense, another form to organize the reform might just be the negotiation between the AFP and the State with the aim to reduce the fee in exchange for the insured of the SNP. There is not analysis on the characteristics of the solidarity fund, but it may be administrated by the AFP or other private firms specialized in funds management. Again, a tender offer for this fund could enhance conditions for its administration.

Additionally, the pension system may gain efficiency in the collection of contributions. Currently, the National Superintendence of Tax Administration (SUNAT) collects contributions in the SNP, charging 2% of the amount collected. The SUNAT may be in charge of collecting contributions in the new multi-pillar system in order to take advantage of its economies of scale and greater enforcement power to collect taxes. The collection fee could be negotiated to obtain

lower costs in the new system. This reduction is feasible given the collection of contributions (and SUNAT's revenues) will triple after reform. In any case, this is an issue of political coordination between Governmental institutions and AFP.

Finally, merging the SNP and SPP in a multi-pillar system does not mean that we overlook the advantages of an individual capitalization scheme. The main goal of the reform is restoring the principle of solidarity paying attention to financial, welfare and inequality implications.

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Appendix

i. Actuarial reserve for insured of the SNP:

For insured ≤65 years old:

$$RA_{ik}^{snp} = P_{ik}^{snp} \times CRU_{65,y} \quad \text{(A.1)}$$

$$RA_{k}^{snp} = p_{k,65} \times \sum_{i=1}^{N_k} RA_{ik}^{snp} \quad \text{(A.2)}$$

$$RA_{\leq 65}^{snp} = \sum_{k=21}^{65} RA_{k}^{snp} (1+r)^{k-65} \quad \text{(A.3)}$$

$$RA_{sob,k}^{snp} = \sum_{j=1}^{65-k} CRU_{k}^{sob} (1-p_{k,k+j})(P_{sob}^{snp} \hat{N}_k + \theta_{snp} \hat{S}_k)(1+r)^{-j} \quad \text{(A.4)}$$

$$RA_{sob}^{snp} = \sum_{k=21}^{64} RA_{sob,k}^{snp} \quad \text{(A.5)}$$

For insured >65 years old:

$$RA_{ik}^{snp} = P_{ik}^{snp} \times CRU_{k,y} \quad \text{(A.6)}$$

$$RA_{k}^{snp} = \sum_{i=1}^{N_k} RA_{ik}^{snp} \quad \text{(A.7)}$$

$$RA_{>65}^{snp} = \sum_{k=66}^{T} RA_{k}^{snp} \quad \text{(A.8)}$$

And total actuarial reserve for insured is:

$$RA_{snp} = RA_{\leq 65}^{snp} + RA_{sob}^{snp} + RA_{>65}^{snp} \quad \text{(A.9)}$$

where:

RA_{ik}^{snp} : Actuarial reserve for an individual i of current age *k*.

RA_{k}^{snp} : Actuarial reserve for all individuals of current age *k*.

N_k : Number of individuals of current age *k* in the sample.

$RA_{\leq 65}^{snp}$: Actuarial reserve for all individuals of current age *k*≤65.

r : Discount rate.

$RA_{sob,k}^{snp}$: Actuarial reserve for survivors of pension holders of current age k that die before 65.

CRU_{k}^{sob} : Annuity price for previously mentioned survivors.

P_{sob}^{snp} : Minimum pension received by previously mentioned survivors.

$\hat{N}_k$: Number of individuals of current age *k*, with $P_{ik}^{snp} < P_{sob} / q_{snp}$.

$\hat{S}_k$: Sum of pensions of individuals of current age *k*, with $P_{ik}^{snp} \geq P_{sob} / q_{snp}$.

RA_{sob}^{snp} : Actuarial reserve for survivors of pension holders that die before 65.

The formula used for the annuity price in the SNP differs slightly from SPP's. In the SNP, the monthly payment is overdue (at the end of the month and not at the beginning as in the SPP),

there are two additional pensions paid each in July and December, and the percentage of pension received by beneficiaries are different. Finally, it is assumed that individuals older than 65 retire immediately (according to equations A.6-A.8).

ii. Actuarial reserve for insured of the SPP:

Differently from the reserve estimated for the SNP and published by the ONP, there is no official publication on future payments of minimum pensions in the SPP. However, it is necessary to quantify these reserves in order to compare with the estimated costs of reform.

For insured ≤65 years old:

$$RA_{ik}^{spp} = S_{\min}^{spp} \times (P_{\min}^{spp} - P_{ik}^{spp}) \times CRU_{65,y} \qquad \text{(A.10)}$$

$$RA_{k}^{spp} = p_{k,65} \times \sum_{i=1}^{N_k} RA_{ik}^{spp} \qquad \text{(A.11)}$$

$$RA_{\leq 65}^{spp} = \sum_{k=21}^{65} RA_{k}^{spp} (1+r)^{k-65} \qquad \text{(A.12)}$$

For insured >65 years old:

$$RA_{ik}^{spp} = S_{\min}^{spp} \times (P_{\min}^{spp} - P_{ik}^{spp}) \times CRU_{k,y} \qquad \text{(A.13)}$$

$$RA_{k}^{spp} = \sum_{i=1}^{N_k} RA_{ik}^{spp} \qquad \text{(A.14)}$$

$$RA_{>65}^{spp} = \sum_{k=21}^{T} RA_{k}^{spp} \qquad \text{(A.15)}$$

where:
$S_{\min}^{spp}$: Take value 1 if $P_{\min}^{spp} > P_{ik}^{spp}$ and the insured fulfils legal requirements to obtain a minimum pensions; and zero, otherwise.

iii. Present value of contributions for insured of the SNP:

Because the insured who have not yet reached the retirement age are the only possible contributors, we only consider the contributions of 64 years old or younger insured (at 2006).

$$VP_{k}^{snp} = (14 \times 0.13) \sum_{j=1}^{65-k} \sum_{i=1}^{N_k} d_{ik}^{snp} \times Y_{ik} \times p_{k,k+j} \times (1+r)^{-j} \qquad \text{(A.16)}$$

$$VP^{snp} = \sum_{k=21}^{64} VP_{k}^{snp} \qquad \text{(A.17)}$$

iv. Actuarial reserve for insured of the new multi-pillar system

For insured ≤65 years old:

$$RA_{ik}^{mix} = S_{\min}^{mix} \times (P_{\min}^{mix} - P_{ik}^{mix}) \times CRU_{65,y} \qquad \text{(A.18)}$$

$$RA_{k}^{mix} = p_{k,65} \times \sum_{i=1}^{N_k} RA_{ik}^{mix} \qquad \text{(A.19)}$$

$$RA_{\leq 65}^{mix} = \sum_{k=21}^{65} RA_{k}^{mix}(1+r)^{k-65} \qquad \text{(A.20)}$$

$$RA_{sob,k}^{mix} = \sum_{j=1}^{65-k} CRU_{k}^{sob}(1-p_{k,k+j})\tilde{N}_{k}(P_{sob}^{mix} - \theta_{mix}\tilde{Y}_{k})(1+r)^{-j} \qquad \text{(A.21)}$$

$$RA_{sob}^{mix} = \sum_{k=21}^{64} RA_{sob,k}^{mix} \qquad \text{(A.22)}$$

For insured >65 years old:

$$RA_{ik}^{mix} = S_{\min}^{mix} \times (P_{\min}^{mix} - P_{ik}^{mix}) \times CRU_{k,y} \qquad \text{(A.23)}$$

$$RA_{k}^{mix} = \sum_{i=1}^{N_k} RA_{ik}^{mix} \qquad \text{(A.24)}$$

$$RA_{>65}^{mix} = \sum_{k=66}^{T} RA_{k}^{mix} \qquad \text{(A.25)}$$

And total actuarial reserve for insured is:

$$RA_{mix} = RA_{\leq 65}^{mix} + RA_{sob}^{mix} + RA_{>65}^{mix} \qquad \text{(A.26)}$$

where:

$\tilde{N}_{k}$: Number of individuals of current age *k*, with $\tilde{Y}_{k} < P_{sob}^{mix} / \theta_{mix}$.

$\tilde{Y}_{k}$: Average wage of individuals of current age *k*, with $\tilde{Y}_{k} < P_{sob}^{mix} / \theta_{mix}$.

As the SNP, the multi-pillar system provides a minimum pension for survivors of value P_{sob}^{mix}. However, the portion that is guaranteed by the State is the additional capital needed to finance P_{sob}^{mix} after the insurance firm granted a pension of value $\theta_{mix} Y_{ik} < P_{sob}^{mix}$. This estimation implicitly assumes that insured always meet the legal requirements to obtain a survival pension.

Finally, insured older than 65 (at December 2006) receive the largest pension that resulted from the comparison between the multi-pillar pension and the original system's pension. This assumption is necessary to not affect rights of workers who have already reached retirement age.

v. Present value of contributions for insured of the new multi-pillar system:

$$VP_{k}^{mix} = (14 \times b) \sum_{j=1}^{65-k} \sum_{i=1}^{N_k} d_{ik}^{mix} \times Y_{ik} \times p_{k,k+j} \times (1+r)^{-j} \qquad \text{(A.27)}$$

$$VP^{mix} = \sum_{k=21}^{64} VP_{k}^{mix} \qquad \text{(A.28)}$$

It is usual that the actuarial reserve estimation includes the reserve needed to pay pensions of current pensioners in the SNP. This is not presented here as the proposed reform will not affect current pension levels.