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Seeking solutions to Vulnerability in Old Age:

Preferences, constraints, and alternatives for coverage under Peru's pension system[*]

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Abstract: Exploiting new data from a survey and behavioral experiment conducted in Peru we analyze individuals' preferences for securing income in old age. We identify a group that is unrationed by the mandate to save in Peru's pension system, and draw insights from their affiliation and contribution behavior. Among the unrationed, those who are more tolerant of risk, have more children, and have a greater share of housing in their accumulated assets are less likely to affiliate and/or contribute to the formal pensions system. Further, the less risk tolerant choose private individual retirement accounts over a publicly administered pension system.

Key words: Pensions, vulnerability, risk preferences, Latin America

JEL classifications: G23, H55, I38, O16, O17.

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I. Introduction

Currently, only a small minority of the world's population is covered by formal pension systems (Holtzman, Packard, Cuesta, 2000). However, with continuing urbanization and the consequent, likely demise of traditional family- and community-based systems of social support, formal pensions are set to become increasingly important. This being the case, there is growing pressure on policy makers to improve the performance of existing pension systems so as to ensure that they fulfill their purpose.

Against this backdrop we pose the following question: When people are free to choose whether and how they secure their wellbeing in old age, do they make predictable and rational decisions that are consistent with the objective of reducing vulnerability to poverty? The answer to this question has implications not only for how paternalistic governments should be with respect to pension provision, but also for how they should go about collecting the information required to support good pension system design and reform. If people are making predictable and rational decisions with respect to the pension system when they are free to do so, policy-makers should take heed of those decisions. This is especially true if a considerable proportion of the population enjoys such freedom, because then, if the system is poorly designed and people choose not to participate as a result, an opportunity to reduce vulnerability will be missed. Further, even if only a small proportion of the population are free to choose, a careful analysis of their behavior will provide valuable insights into beliefs and preferences relating to formal social insurance, private pensions, and alternative, informal mechanisms for reducing vulnerability in old age. These insights may help maximize the welfare enhancing effects of reforms. Such an analysis could also reveal whether and how the failures in other markets, such as those for labor and credit,

impinge on individuals' insurance decisions and, thereby, indicate the steps policy makers could take to ensure that pension reforms have the desired effect.

Here, we address this question using a dataset relating to urban- and peri-urban-dwelling individuals in Peru. Peru provides us with an interesting opportunity to explore these issues as it currently has two national pension systems with very different characteristics running in parallel. The first is a government administered system, operated on a pay-as-you-go (PAYGO) basis with benefits defined according to a final-salary formula. The second is a publicly mandated system of privately administered individual accounts. Here, pensions are determined through defined contributions and the returns earned from the investment of accumulated savings in the capital market.

Many Peruvians, and their employers on their behalf, are mandated to contribute to a pension system, while remaining free to choose between the public and the privately administered options. We exploit this choice in our analysis, while also making use of the fact that self employed Peruvians are not covered by the mandate and that in the informal sector the mandate is frequently ignored.

The analysis builds on empirical work that used similar data from Santiago, Chile (Barr and Packard, 2000a & b, 2002, and Packard, 2002). In Chile, among workers who are free to choose, i.e., the self employed, those that contribute to the pension system have a relatively high tolerance for risk suggesting that there are alternative strategies for securing well-being in old age that are perceived as less risky than the formal pension system. Further analysis revealed that

investment in housing was one such alternative. However, since 1981, Chileans have only had the option of privately managed individual retirement accounts. The choice between the public and private systems offered to Peruvians allows us to examine an additional dimension of pension system participation.

The paper has 6 sections. In section II below, we provide some background information on the Peruvian pension system. In section III we derive two sets of testable hypotheses relating to the first of our questions and outline our empirical strategy. In section IV we present our data and the analysis relating to the first set of hypotheses. Section V contains our results relating to the second set of hypotheses. And finally, Section VI concludes by revising both of our questions.

II. Background

In 1992 the Peruvian government introduced structural reforms to the retirement security system for workers in the private sector, which until then had been administered directly by the government and financed on a PAYGO basis. The reforms allowed workers to redirect their social security contributions into privately managed, individual retirement savings accounts. The government issued bonds to affiliates who switched to the new private system in recognition of their past contributions to the public system.

Since 1993, every new cohort of employees in Peru has chosen between the down-sized public PAYGO regime, and the individual accounts managed by a small number of "dedicated" (that is,

specialized, single-service) private fund managers, the *Adminstradoras de Fondos de Pensiones* (AFPs). If new workers initially choose the public option they can at any time move to the private alternative. However, those who choose private accounts cannot move (or return) to the public PAYGO system.[1] By law, employees must affiliate and contribute to one or other systems, while the self employed are free to choose either or to ignore both.

Also in 1992, the special pension regime for public sector employees was closed to all but a few new entrants.[2] So since 1993, most new public sector employees have faced the same pension choice as new private sector employees. Public sector employees already affiliated to the special regime could if they wished join the new private pension system. The special pension regime for the military was unaffected by the 1992 reforms.

The specialized AFPs manage individuals' private accounts and invest their accumulated savings in tightly regulated portfolios. A portion of all contributions to the AFPs pays for the financial services provided by the fund managers and covers the premia for group disability and life insurance policies that the AFPs are required to provide for their contributing affiliates. Individuals are allowed to choose their fund manager and those who have been with a fund manager for a specified period are allowed to switch. Upon retirement, individuals can either

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[1] A similar choice is offered in the United Kingdom, Argentina and Colombia (although in Colombia, workers are even allowed to alternate their choice every three years).

[2] Only judges and magistrates are still legally allowed to enter the special separate pension regime for civil servants. However, the generous parameters of the regime are difficult for organized public sector employment groups to ignore and numerous groups have managed to secure entry into the regime through the courts.

negotiate a gradual draw down of their savings or use the accumulated balance to purchase private annuities.

To help mitigate the risks of a defined contribution system based on relatively volatile investment returns from an emerging capital market, AFP affiliates were promised a minimum pension guarantee. An affiliate to the AFP system who contributed to a pension system for at least 20 years was to receive some specified minimum annuity guaranteed by the government on retirement. However, the regulation necessary to implement the minimum benefit was never prepared and passed due to cost concerns.

Since the PAYGO system is only partially funded by affiliates' contributions, largely subsidized by transfers from general government revenue, and represents a contingent liability that is difficult to quantify (Kane, 1995), the government is eager for individuals to choose the private pension system. The government has made successive changes to the parameters of the two systems to this end. At its inception in 1992, an individual's contribution to the new private system was approximately 13.9 percent, while contributions to the PAYGO system were 9 percent of wages (see Table 1).[3] Further, the retirement age in the private system was 65, while that in the public system was 60. Although there was a surge of affiliation to the private system, especially among younger, more educated, and higher earning workers (Palacios and Whitehouse, 1999), the higher contribution rate to the private system created a disincentive for individuals to switch out of the public plan (Kane, 1995). In 1995 the government raised the

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[3] Only an approximate contribution rate can be given for the private AFP system, since a portion of the contribution rate consists of variable insurance premia and AFP service fees.

contribution rate to the PAYGO system to 11 percent, and the retirement age to 65. The contribution rate to the PAYGO system was raised again in 1997 to 13 percent, while that to the private system was reduced to 11.6 percent. Finally, in 2001, greater recognition was afforded to rights acquired under the public system at the time of entry into the private system and a minimum guaranteed benefit was provided for private system affiliates aged 55 and above.

III. Hypotheses and empirical strategy

The mandate to participate in the formal pension system affects only employees, while leaving the self and unemployed free to choose. Further, the wording of the mandate implies that all employees are rationed in the sense that they are bound by law to affiliate and contribute a proportion of their earnings to one or other part of the formal pension system. However, there are many employees working in enterprises that operate outside the reach of the legal system and before conducting our analysis, we need to decide whether these, so called, informal sector employees are rationed or enjoy the same freedom of choice as the self and unemployed.

Here, it is important to bear in mind that it is the employer who makes the affiliation and contributions to the pension system on behalf of an employee. Thus, while, as both employer and employee, the self employed have full freedom of choice, employees are, at least to some extent, compromised by the preferences of their (separate) employers. If an employer chooses not to affiliate or contribute to the formal pension system on behalf of an employee who wishes to affiliate and contribute, that employee has three options: to neither affiliate nor contribute, i.e.,

act in accordance with the preferences of their employer; to alert the authorities to the illegal stance taken by their employer, possibly jeopardizing their job in the process; or to affiliate and/or contribute while pretending to be self employed, i.e., while lying about their employment status.

Which of these options dominates is an empirical question, but for the time being we will assume that informal sector employees always take the first option. Under this assumption, employees are always rationed. They are rationed to participate if their employer acts in accordance with the mandate and rationed not to participate if their employer ignores the mandate. We will return to the verisimilitude of this assumption below.

Now, we can derive two pairs of testable hypotheses relating to the question posed above. The first pair of hypotheses, our 'Participation Hypotheses', relates in part to whether we can address the question at all. If only rationed individuals actually participate in the formal pension system, while we can predict the behavior of the unrationed, we cannot tell whether that behavior is rationally based on their preferences, beliefs, and alternatives. Thus, our *Participation Hypotheses* are:-

H_0:   Individuals who are unrationed never participate in the formal pension system;

H_1:   At least some unrationed individuals participate in the formal pension system.

In order to test these hypotheses we use data on individuals and look at two outcome variables relating to participation in the formal pension system: whether they are affiliated to one or other part of the pension system and whether they are contributing. If at least some unrationed

individuals are affiliated and contributing we take it as evidence in support of our alternative hypothesis.

If we find that at least some unrationed individuals participate in a pension system and, if a sufficient (to support analysis) proportion of our unrationed sample are participants, we can move on to our second pair of hypotheses, our '*Rationality Hypotheses*'. These are:-

H_0: Unrationed individuals are not making predictable and rational decisions about participation in the formal pension system;

H_1: Unrationed individuals are making predictable and rational decisions about participation in the formal pension system in the sense that they are consistent with their preferences, beliefs, the availability of substitutes, and the objective reducing vulnerability to poverty in old age.

In testing these hypotheses we look at whether a worker is affiliated to one or other part of the pension system, whether they are contributing, and whether they are affiliated to the private or the public system. Affiliation and contribution are choices for unrationed workers, but only outcomes for those who are rationed due to the mandate and the decisions of their employers. For the unrationed, affiliation to a pension system is akin to acquiring an option to accrue rights or save in order to receive a pension in the future. This option is then exercised when an affiliate decides to contribute. It is at this point that current consumption or the accrual of some other asset is sacrificed in order that rights to or savings for a formal pension can be accrued.

The public-private choice applies only to those who have chosen or are constrained to participate in the formal pension system. Among these no one is rationed by the mandate, although employees may, once again, be constrained by the decisions made by their employers. The decision about which pension system to affiliate to is a choice between bundles of specified contribution rates, expected rates of return, bureaucratic procedures, and perceived risks. At the time of the survey, specified contribution rates and expected rates of return were higher in the public system, with the latter being considerably higher for public sector employees.[4] Interviews with key informants suggested that for the self employed the bureaucratic procedures associated with affiliating to the private system might be less onerous, while for public sector employees affiliation to the private system would be equally if not more onerous.

Especially in the absence of a minimum pension guarantee, a defined-contribution system of individual accounts places more risk on the individual. Perceptions of the riskiness of the two systems might also take account of the rarity of cases in which the Peruvian government has reneged on pension promises and rights acquired under the public pension system. On the other hand, recent political scandals implicating the Fujimori administration and the political upheaval that followed may have lowered confidence in government institutions. Further, governments

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[4] If a man earning an average wage contributes 13% of his salary his entire working life to PAYGO, his internal rate of return from the system would be 6.3%. If the same man contributes 11.6% of his salary to an individual account, out of which he pays 3.6% in fees in accumulation "pay in" phase and 1% in the pay-out phase his internal rate of return is 3.4%. The assumptions for this calculation are as follows. The man: starts his career at age 19; has the average length of service; mortality multiplier 100%; starting wage equal to 100% of average at that age; productivity growth 100% of average, as long as not below minimum wage. We are indebted to Asta Zviniene at the World Bank for these calculations.

across the region have cut public defined-benefit pensions and misused public pension funds. How each of these factors affects public perceptions of the relative riskiness of the two systems is an empirical question that we can address with our data.

Each of the three outcome variables can be represented by a dichotomous, dependent variable in a regression analysis. We call these variables: *affiliate*, which takes the value one for individuals who are affiliated to either the public or the private system and zero otherwise; *contributes*, which takes the value one for affiliates who are currently contributing and zero for affiliates who are not contributing and non-affiliates; and *public*, which takes the value one for affiliates to the public system, zero for affiliates to the private system, and is undefined for non-affiliates.

In order to test our Rationality Hypotheses, we regress *affiliate*, *contributes*, and *public* on two vectors of right-hand side variables. The first vector, $\mathbf{x_i}$, contains variables that may capture aspects of an individual's preference set, beliefs, and alternatives but may also capture or affect the characteristics of their job. Because they may capture job characteristics, such variables can affect participation in the formal pension system regardless of whether a worker is rationed or not. The second vector, $\mathbf{d_i}$, contains variables that capture only an individual's beliefs and preferences, the extent to which they have access to alternative ways of reducing vulnerability in old age, and any constraints other than those relating to the labor market that may impact on their decision about formal pension system participation. Only unrationed individuals are free to choose whether to participate in the formal pension system conditional on the variables in $\mathbf{d_i}$.

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If, in each case, we perform regressions for a sample of individuals who are unrationed and find coefficients on the variables in $\mathbf{d_i}$ that are significant and have the appropriate signs, it may be taken as evidence against our null and in favor of our alternative Rationality Hypothesis. However, ending our analysis there could lead to the erroneous rejection of the null hypothesis if any of the variables in $\mathbf{d_i}$ are significant because they are either capturing variability in job characteristics that is not captured by $\mathbf{x_i}$ or affected by or simultaneously determined with the dependent variables. With longitudinal data one can address such problems of omitted variable and endogeneity bias. However, our data is cross-section. Two-stage estimations using instrumental variables are an option only if valid and sufficiently strong instrumental variables can be found and this proved impossible with our data.

There is an alternative, albeit less formal, approach to these problems. Suppose that elements of $\mathbf{d_i}$ are capturing variability in job characteristics that is not captured by $\mathbf{x_i}$ and/or are affected by or simultaneously determined with the dependent variables. Then, we would expect those elements of $\mathbf{d_i}$ to be significant in the regressions not only for a sample of unrationed individuals, but also for a sample of rationed individuals. This being the case, we can avoid the erroneous rejection of the null if we only reject it when the coefficients on the variables in $\mathbf{d_i}$ are significant for an unrationed sample while being insignificant for a rationed sample. Finally, this strategy is only valid if we correctly identify who within our sample of individuals is and is not rationed and highlights the importance of being cautious when considering the informally employed.

IV. The data and a test of the Participation Hypotheses

We draw our data from the Peruvian PRIESO (*Encuesta sobre Prevision de Riesgos Sociales*), a combined survey and behavioral experiment.[5] The PRIESO was conducted in May 2002 and involved 1002 individuals randomly drawn from the list of Lima-dwelling, working respondents to the ENAHO (*Encuesta Nacional de Hogares*) survey in the third quarter of 2001. At the time of the ENAHO survey (July – August 2001), 63 percent of working respondents were employees and 37 percent were self employed.

The PRIESO sample of workers was stratified by affiliation status in order to ensure sufficient degrees of freedom for the analysis of pension contributions and choice between the public and private systems conditional on affiliation to a system. The sampling proportions for affiliates and non-affiliates were 75% and 18% respectively.

In the following analysis, we use data relating to 965 of the respondents to the PRIESO. The remaining 37 passed the retirement age during the eleven months since the ENAHO. An additional 46 respondents became unemployed during the same period, but we include them in the analysis to see how the lifting of the mandate with entrance into unemployment affects participation. We treat them as unrationed throughout.

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[5] Behavioral experiments are most commonly conducted in university laboratories with graduate students as subjects, as in Poterba (1988), Kotlikoff, Samuelson and Johnson (1988), and Schubert, *et al.* (1999). Here, the experiment is an integral part of the field work designed to generate proxies for the surveyed individuals' underlying preferences relating to risk.

IV. i Survey data

The distribution of the sample of 965 Peruvian workers with respect to employment status and sector is presented in Table 2. Sixteen percent of the sample works in the public sector, 53 percent are employees in the private sector, 26 percent are self-employed, and 5 percent are unemployed.

Table 3 provides information on the personal and economic characteristics of the sample and shows how these characteristics vary with employment status and sector. (The corresponding standard deviations for each of the continuous variables are presented in Appendix 1.) The mean age is just under 37 years; 38 percent are female; 44 percent are married; and the average respondent spent 13.6 years in formal education. All of these factors vary significantly with employment status and sector. Public sector employees and the self-employed tend to be older and are more likely to be married. Public sector employees also tend to be more educated, while the self-employed tend to be less educated. Women are overrepresented among the unemployed.

Average holdings of assets, other than accrued pension rights or savings, are around USD11,000 although, once again, there is significant variation with employment status and sector; the self employed and public sector employees have higher asset holdings. For workers in all sectors, housing accounts for a significant proportion of asset holdings and this proportion also varies with employment status and sector. The self employed maintain the largest proportion of their assets in houses, while private sector employees maintain the smallest.

The mean income from work for the sample is just under USD 24,000. However, this figure is heavily influenced by the top income decile, all of whom are self employed. If this top decile is removed, the mean falls to USD 2,131. Mean income varies widely with employment status and sector with the unemployed earning nothing and the self-employed earning over two times the full sample mean. However, these variations are not significant because the means conceal considerable variation within sectors. Among private sector employees for example, there is a dramatic difference in earnings between those who are formally and informally employed.

Our proxy for formality is whether the respondent stated that they held an employment contract. It is important to bear in mind that this variable is highly subjective: a legally contracted employee may not be aware of the contract between their employer and themselves, while an employee may state that they have an employment contract while being unaware of whether it would be recognized in a court of law. Thus, as a signal of the legal status of an employee's relationship to their employer, responses to this question are likely to be noisy. Of the private sector employees in our sample, 39 percent stated that they did not hold a contract. Their earnings are less than half the earnings of private sector employees with contracts.

The households from whence our respondents come vary in size significantly but only marginally across sectors. The full sample mean is 5.4 members. The proportion of children (under the age of 15) within each household is also fairly stable around the full sample mean of 0.24, while the proportion of elderly (over the age of 65) varies significantly with employment status between 0.02 and 0.05.

Ten percent of our sample gave responses to questions about securing loans that suggested that they were credit constrained. We classified a respondent as credit constrained if in the last year they either (i) applied for a loan from a formal financial institution, and were rejected; (ii) did not apply to a formal financial institution, but asked family and/or friends for a loan, and were nonetheless rejected; or (iii) did not apply to a formal financial institution, nor asked friends and family for a loan because they did not know how to apply, found it too difficult, or thought they would not be successful. The percentage of credit constrained individuals varies considerably across sectors with the self and unemployed being the most likely to be constrained.

Finally, 27 percent of the sample expects to live with their children in old age, although once again, there is significant variation across sectors. Public sector employees are considerably less likely to hold this expectation.

IV.ii Experimental data

To generate a proxy for preferences relating to risk we used a simplified version of a behavioral experiment originally implemented in Chile (see Barr and Packard, 2001a & b). This experiment, is similar to the laboratory-run experiment of Schubert, Brown, Gysler and Brachinger (1999), although in the field we apply a stronger frame in order to aid understanding, and work in our respondents' homes rather than in a laboratory. The respondents were confronted with a gamble

framed first as an investment and then as an insurance decision and, in each case, required to reveal their certainty equivalent.

Examples of the decision cards used by the trained numerators in the field are shown in Figure 2. Using the cards, the numerators asked the respondents to imagine themselves as investors choosing whether to invest in Firm A, whose profits were determined by its chances of success or failure, or Firm B, whose profits were fixed and secure. The numerators explained the probabilities of Firm A's success and failure linking them to the roll of a die, the pay-offs from Firm A in each state, and the fixed pay-off from Firm B.[6] The respondents were then asked to decide in which firm to invest. After registering their answer, the numerators would raise the amount of the pay-off from Firm B, and ask the respondents to choose between the two firms again. They ran several repetitions of this exercise raising the pay-off from Firm B each time. As the pay-off from Firm B increases, investing in Firm A looks less attractive to a risk or loss averse respondent and at some point they are likely to switch from investing in A to investing in B. The pay-off from Firm B at which they switch reveals the value of the respondent's certainty equivalent to the gamble represented by Firm A.

The insurance gamble was similarly presented. Respondents were asked to imagine they were the owners of a good that they could sell at any time, but that there was a possibility that the good could be damaged decreasing its market value by a certain amount. The likelihood that damage

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[6] The pay-off for Firm A if successful was S/.20 (twenty Peruvian Soles). At the time of the survey, this represented twice the average respondent's hourly income of S/. 10 Soles, or US$3.00 given the prevailing exchange rate of S/. 3.36 : US$1.

would occur depended on the roll of a die. Respondents could choose to either purchase an insurance policy that would protect the value of their good, or not to take up the policy and accept the loss were the damage to occur. After registering their decision, the numerators would slightly reduce the cost of insuring and ask again whether they would insure. As the cost of insurance declines, the option to protect the value of the good becomes more attractive to the respondent. This time, the cost of insurance at which they switched from not buying to buying the insurance reveals the value of the respondent's certainty equivalent to the gamble. This certainty equivalent is equal to the value of the asset minus the highest cost of insurance that the respondent would choose to pay.

Respondents were informed repeatedly, both prior to and after the exercise, that any one of their decisions to invest or insure could determine their earnings from the experiment. At the end of the interview, the respondent randomly selected one of their decisions by pulling a token from a bag. If they had chosen the gamble in the selected decision they rolled the die. Finally, they were paid according to their choice and the outcome of the die.

We could derive risk aversion parameters from the certainty equivalents elicited during the experiment to use in our analysis. However, this would require that we make assumptions about the shape of the respondents' utility functions which we are reluctant to do. So, throughout our analysis we work with the certainty equivalents. A higher certainty equivalent implies a greater tolerance for risk. Figures 3 and 4 show histograms of the certainty equivalents elicited under the investment and insurance frames respectively and Figure 5 shows the cumulative distributions.

Around 20 and 30 percent of the sample settled for a certainty equivalent equal to the lowest possible return from the gamble in the investment and the insurance frames, respectively. And around 60 and 65 percent settled for certainty equivalents below the expected value of the gamble (S/. 14) in the investment and insurance frames, respectively. This suggests a tendency to towards risk or loss aversion on the part of our respondents, which is reassuring. However, there are some disturbing features in our experimental data, especially the strong modes at the lowest and highest certainty equivalents, the modes at S/. 10, and seven non-responses under the investment frame, all of which suggest that the task comprehension of some respondents may have been limited. This will have added to the noise associated with these data points and could bias any coefficients on these variables towards insignificance in our regressions.

A comparison of the cumulative distribution functions in Figure 5 suggests that the certainty equivalents elicited under the investment frame tended to be higher. This finding is consistent with *loss* as opposed to pure *risk* aversion. Figure 6 plots one certainty equivalent against the other for each respondent. It suggests that the two certainty equivalents are highly correlated. However, the points that are farther away from this diagonal, especially those along the two axes, give further cause for concern.

Returning to Table 3 we see that the mean certainty equivalents for our sample are 11.6 and 12.7 for the insurance and investment frames respectively. The certainty equivalents elicited under each of the frames vary significantly with employment status. In particular, the unemployed are more risk or loss averse according to both measures. Note that the self employed are not significantly different from employees with respect to their attitudes towards risk. This finding accords with Barr and Packard's (2001) results for Chile.

IV.iii Pension system participation

Table 3 also presents information relating to involvement in the formal pension system and shows how involvement varies with employment status and sector. Recall that our sample is stratified according to whether individuals are affiliated to the formal pension system and that the sampling proportion for affiliates is significantly greater than that for non-affiliates (75% and 18% respectively). With this in mind, in Table 3 we present proportions of affiliates and contributors first for the sample and then adjusted to take account of the over-sampling of affiliates.

Looking first at the sample proportions, in total, 70 percent are affiliated and 52 percent are contributing to either the public or the private pension system. All the public sector employees are affiliated and currently contributing. Within the private sector, 74 percent of employees are affiliated and 60 percent are currently contributing. As we expected, both affiliation and contribution are highly correlated with whether an employee has a contract. Of those who stated that they have a contract, 94 percent are affiliated and 87 percent are contributing. Of those who stated that they do not have a contract, only 43 percent are affiliated and 19 percent are contributing. Only 45 percent of the self-employed are affiliated and only 11 percent are currently contributing. Among the unemployed, 57 percent are affiliated, while only 11 percent are currently contributing.

Turning to the adjusted or inferred population proportions, 36 percent of workers are affiliated and 26 percent are contributing to either the public or the private pension system. Nothing changes with respect to the public sector employees. Within the private sector, 41 percent of employees are affiliated and 33 percent are currently contributing, while only 17 percent, of the self-employed are affiliated and a very low 4 percent are currently contributing. Among the unemployed, 24 percent are affiliated and 5 percent are currently contributing.

Focusing now on affiliates only (no adjustments required), 36 percent are affiliated to the public system. It is the self employed who are most likely to be affiliated to the public system, possibly because of the time at which they affiliated: on average the self employed have been involved in the pension system longer than the individuals in any other sector. Average elapsed time since initial affiliation is around 180 months (15 years) and variations across sectors roughly reflect variations in age. The mean numbers of contributing months since affiliation is around 140 and, once again, variations across sectors roughly reflect variations in age. However, if we divide the number of contributing months by months of affiliation to get a measure of contribution density since affiliation, a different and potentially more informative pattern emerges. Then we see that, while public and private sector employees have contribution densities of 91 percent and 77 percent respectively, the self and unemployed have significantly lower contribution densities of 50 percent and 52 percent respectively.[7]

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[7] Note that, here, we are looking at how the *history* of participation varies with *current* employment status and sector. We are taking no account of employment *history.*

Participation in the formal pension system is significantly and dramatically lower among those workers who are not rationed by the mandate. This notwithstanding, some, albeit a small proportion, of unrationed individuals are participating in the formal pension system and so we can reject our null hypothesis, that unrationed individuals do not participate in the formal pension system, in favor of the alternative, that at least some do participate. Further, partly due to our sampling strategy, the proportion of unrationed individuals in our sample who are participating is sufficiently large that we may address our second set of hypotheses.

IV.iv Applying the data to the Rationality Hypotheses

Before proceeding to our regression analyses of affiliations, contributions, and the choice of public or private system, we need to distribute the variables described above between the vectors $\mathbf{x_i}$ and $\mathbf{d_i}$ being careful to ensure that the vector $\mathbf{d_i}$ is limited to those variables that are likely to affect the participation of unrationed workers only.

In the regressions that take either *affiliate* or *public* as their dependent variable, the vector $\mathbf{x_i}$ contains the five personal characteristics: a dummy variable that takes the value one for *female* respondents and zero otherwise; the *age* of the respondent in years; their years of formal *education*; a dummy variable that takes the value one if they are *married* and zero otherwise; and a dummy variable that takes the value one if they live in a *peri-urban* as opposed to an urban area. It also contains seven variables relating to the respondent's current position within the labor market. These are dummy variables taking the value one if the respondent is *self-employed*,

unemployed, an *uncontracted* employee, a *public employee*, employed in private mining, manufacturing, or utilities, employed as a professional in the private sector, employed in the private social services sector, employed in the private retail or transport sectors, employed in other private sectors, respectively and zero otherwise.[8] Also in vector $\mathbf{x_i}$ are the respondents' *income* from employment, the value of their accumulated *assets* other than those relating to their pension, and the size of the *household* within which they live. Each of these three may impact on pension system participation directly: income determines the budget constraint prevailing in any particular period; wealth affects the respondents' ability to smooth short-term consumption while continuing to save for the longer term by accruing a highly illiquid asset; and household size may capture current consumption needs. However, they might also affect labor market position.

In the regressions that take *contributes* as their dependent variable the vector $\mathbf{x_i}$ includes two additional variables. First, *public* is included to control for any variations in enforcement across the two systems. Second, the *density* of contributions is included as a summary of the individual's history of pension system participation that may control for some of the otherwise unobservable heterogeneity in labor market position and related variation in pension system enforcement.

In the regressions that take *affiliate* as their dependent variable the vector $\mathbf{d_i}$ contains seven elements. Following Packard (2002), to capture the workers' involvement in substitute strategies for reducing vulnerability in old age, we include the proportion of their assets, other than their

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[8] For certain sub-samples, some of these dummies do not vary or are perfectly collinear. Where this is the case, they are omitted from the regressions. We do not report the coefficients relating to the last four of these dummy variables.

accumulated pension rights, that is held in the form of *houses*. The proportion of *children* and the proportion of *elderly* in their household could be viewed as proxies for involvement in informal income smoothing arrangements. However, these proportions might more conservatively be seen as controlling for variations in other household income and other demands on income such as the cost of schooling and health care. Whichever view is taken, only the unrationed will be free to take account of these factors when deciding whether and how to participate in the formal pension system. We also include a dummy variable *fsecure* which takes the value one if the worker expects to live with his or her children in old age and zero otherwise as an additional proxy for informal income smoothing arrangements.

To capture the potential impact of imperfect market functioning elsewhere in the financial sector, we include *credit*, a dummy variable that takes the value one if a worker is credit constrained and zero otherwise. Credit-constrained individuals may prefer not to accumulate illiquid assets such as formal pension rights. However, only unrationed workers will be able to exercise this preference.

To proxy for an individual's perceived need for an income after retirement we include the age at which the individual expects to *die*. And to proxy for preferences relating to risk we use the experimentally derived certainty equivalent relating to the insurance decision, *ceins*.

In the regressions that take *contributes* as their dependent variable the vector $\mathbf{d_i}$ includes two additional variables. The first of these is a dummy variable that takes the value one for respondents who are receiving a *pension*. If this pension relates to a disability, an individual may

choose not to contribute as it could alert the authorities to the fact that they are now working again. However, only unrationed individuals would be free to take this precaution. The second variable is *accrued*, the total number of months in which the worker has made a contribution to their pension system. If pension rights are subject to the law of diminishing marginal returns, unrationed individuals will be less likely to contribute the greater their accrued pension rights or savings.[9]

In the regressions that take *public* as their dependent variable vector $\mathbf{d_i}$ differs from that used in the analysis of *affiliate* in two ways. First, attitudes towards risk are captured using *ceinv* rather than *ceins*. The former performs better in the analysis of affilitation and contribution, while the latter performs better in the analysis of sector choice. If we view the affiliation and contribution decisions as insurance decisions and the sector choice as an investment decision made only after the insurance decision has been made, the relative performances of the two risk preference measures indicates that the decision frames had externally valid effects on the respondent's decision making.

Second, three extra variables are added. *aflmonths*, the number of months that the individual has been affiliated to a pension system, and *pre'93*, a dummy variable that takes the value one if the individual affiliated prior to the creation of the private system in 1993, jointly control for any inertia on the part of individuals to transfer out of the public system. And *pension* (defined

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[9] In Chile, Packard (2002) found that, *ceteris paribus*, the likelihood of an individual contributing declined significantly once he or she had reached the eligibility threshold for minimum pension guarantee. In Peru, there is no minimum pension guarantee at the time of the PRIESO survey.

above) is included because all the pensions being received by individuals in our sample are likely to be from the public system and relate to disability or retrenchment. In the case of the former, an individual who is either rationed or wishes to contribute may be able to conceal his or her return to work by affiliating and contributing to the private system, while retaining their public affiliation for the purpose of drawing their pension. In the case of retrenchment, the right to the pension can be retained following a return to work and the administrative burden associated with being affiliated to two systems may act as a disincentive to private affiliation. Which of these effects dominates is an empirical question.

V. Econometric results

Table 4 presents the regressions that take *affiliate* as their dependent variable. In every case we use a Probit model and report the marginal effect evaluated at the mean of each continuous right hand side variable and the effect of a discrete change from zero to one of each dichotomous variable on the probability of being affiliated. All of the public sector employees in our sample are affiliated to a pension system, so they have been omitted from the analysis leaving us 809 observations (see the regression for the full sample in the first column of Table 4).
Many of the variables included in the vector x_i are significant in the regression for the full sample. The self and unemployed are significantly less likely to be affiliated and so too are those employees who do not have formal contracts. Further, even after controlling for employment status and sector, females, the young, the less educated, the unmarried, those in peri-urban as opposed to urban areas, those with lower incomes, and those from larger households are less

likely to be affiliated. Some of these effects loose significance when we split the sample, but the overall results remain fairly consistent.

Of the seven variables in vector $\mathbf{d_i}$ only one is significant in the regression for the full sample: credit constrained workers are less likely to be affiliated. However, if we restrict our sample to the self and unemployed (second column) two additional variables, the proportion of children in the household, and the risk preference variable gain significance. Those with more children and those who are more tolerant of risk or loss are less likely to be affiliated.

In contrast, if we restrict our sample to employees only (third column) none of the variables in vector $\mathbf{d_i}$ are significant. Note, however that the negative coefficient on '*uncontracted*' remains large and highly significant.

Table 5 presents the results relating to the regressions that take *contributes* as their dependent variable. Once again we use a Probit model and report marginal and discrete effects for continuous and dichotomous variables respectively. All of the public sector employees in our sample contribute, so they have been omitted from the analysis. We have also omitted all non-affiliates, as they, by definition cannot contribute. So, we are left with 519 observations. (See the regression for the full sample in the first column of Table 5.) The full sample indicates that the self-employed, unemployed and uncontracted employees are all significantly less likely to be contributing than contracted employees. Contribution density has a positive and highly significant coefficient in all the regressions. Among the self and unemployed, affiliates to the public system are significantly less likely to be contributing, suggesting either that it is easier to

evade in the public system, possibly because employees of the AFPs exert greater effort than bureaucrats when collecting and chasing up late contributions, or that the desire to evade the public system is greater. Income has a positive and significant effect only for the full sample and the self and unemployed.

Of the nine variables in vector $\mathbf{d_i}$ both the proportion of asset holdings invested in housing, and the proportion of children in the household assume negative and significant coefficients for the self and unemployed only. In contrast and contrary to our initial assumptions, accrued pension rights or savings have a negative impact on current contributions for employees. To further explore this result we change the way in which we divide the sample, grouping uncontracted employees with the self and unemployed and leaving contracted employees separate (see columns 4 and 5 of Table 5). This adjustment having been made, both the proportion of children in the household and accrued pension rights have a negative impact on the contributions of the self and unemployed and uncontracted employees, while none of the variables in $\mathbf{d_i}$ affect the decisions of employees with contracts. This suggests that the impact of an employer's decision on the participation of an employee is greatest at the point of affiliation. Once an uncontracted employee is affiliated, regardless of whether this accords with their current employer's decision, they have at least some freedom to choose whether to contribute.

Table 6 presents the results relating to the regressions that take affiliation to the public system, *public* as their dependent variable. Once again we use a Probit model and report marginal and discrete effects for continuous and dichotomous variables respectively. Public sector employees are included here, but we have omitted all non-affiliates regardless of sector of employment. This

leaves us with 679 observations (see the regression for the full sample in the first column of Table 6), although 7 more of these are dropped when we split the sample, as self and unemployed drawers of pensions are always in the public system.

Focusing, first, on the regression for the full sample, we see that the self-employed, uncontracted employees and public sector employees are more likely to be affiliated to the public system. Older, less educated and less urbanized workers are also more likely to be in the public system. In addition, those who affiliated to the public system prior to the creation of the private alternative in 1993 are likely to have remained in that system and those who are more tolerant of risk are more likely to be affiliated to the public system, although these last two results apply only to the unrationed once we split the sample. For the unrationed sample only, those with more children are less likely to affiliate to the public system.

VI. Conclusion

The primary objective of this paper was to provide an answer to the question – when people are free to choose whether and how they secure an income in old age, do they make predictable and rational decisions and are these decisions consistent with the objective of reducing vulnerability to poverty?

The ENAHO survey indicates that a substantial share of the working population in Lima are free to choose whether to participate in the formal pension system, while our findings indicate that, of

these, a small proportion do indeed participate. Our findings also suggest that we can, albeit imperfectly, predict who, among those who are free to choose, participate as well as how they participate. Further, and more importantly, there is evidence that their decisions are both rational and consistent with the objective of reducing vulnerability in old age. First, among the fully unrationed self and unemployed, it is the less risk tolerant who are affiliated to the formal pension system. This is rational as long as the formal pension system is a functional and safe solution to the problem of vulnerability in old age. Second, those who are credit constrained are less likely to affiliate suggesting that rational trade-offs are being made between vulnerability in the current period and in old age. Third, those with more children are less likely to either affiliate or, conditional on affiliation, contribute to the pension system. This is rational and consistent with the stated objective if children provide an effective substitute for the accrual of pension rights. Fourth, the greater the share of housing in an unrationed individual's accumulated asset holdings the less likely they are to contribute to the pension system. This is rational and consistent with the stated objective if investments in housing can provide an alternative source of security in old age. And finally, if uncontracted employees are treated as being free to choose, in accordance with diminishing marginal returns, the likelihood of contributing in the current period declines as accrued pension rights increase.

That the variables capturing preferences, beliefs, alternatives, and non-labor market constraints predict participation *only* among those who are free to choose and not among the rationed provides some assurance against omitted variable and simultaneity bias. However, note that the way in which we defined the rationed and unrationed samples ultimately varied between the affiliation and contribution analyses. In the case of former, uncontracted employees were treated

as rationed, while in the case of latter, early results prompted us to reclassify them as unrationed. Our stated rationale for this switch was that the constraining force of the employer's decision affects affiliations but not necessarily contributions conditional on affiliation.

That our decision to treat uncontracted employees as rationed was upheld by the data during the analysis of affiliations has important implications for policy makers. It suggests that, because the mandate is imperfectly enforced and because employers and not employees are the ones who are interacting directly with the pension system, there may be individuals who cannot participate in the formal pension system even though they would like to do so. Further, in the light of this finding, we should characterize the uncontracted employees' apparent freedom of choice with respect to contributions as a freedom to opt out of the system that is not matched by a freedom to opt in. This unintended consequence of the mandate may be adding to rather than reducing some individual's vulnerability to poverty in old age.

In the regressions relating to the choice between the public and private pension systems, the variables capturing preferences, beliefs, alternatives, and non-labor market constraints, once again, were significant only for the unrationed. This lends further support to the assumption that employees' are constrained by the decisions taken by their employers with respect to pension system affiliation. Rather than having prior expectations about the signs on the coefficients relating to these variables, we saw this analysis as an opportunity to learn something about the way in which Peruvians perceive the two pension systems. We found three significant effects. First, those who affiliated to the public system prior to the creation of the private alternative are likely to have remained with the public system, suggesting that there is some inertia among

individuals. Second, those with more children are more likely to be affiliated to the private system, suggesting that the public system is seen as a better substitute for relying on children for security in old age. And third, those who are more risk tolerant are likely to be affiliated to the public system, suggesting that in peoples' minds the real risks associated with saving in private accounts with no minimum pension guarantee are outweighed by their distrust in government institutions.

In summary, our analysis shows that policy makers aiming to reform the Peruvian or indeed any other formal pension system could gain considerable insight from watching and analyzing the decisions of those who are free to choose whether or not to participate in such systems. Focusing on Peru specifically, our analysis shows that there considerable room for improvement in the current systems. That so few of those who are free to do so choose to participate in the formal pension systems suggests that the systems are not ideally designed to serve their needs. Whether continuing to rely on offspring for security in old age is a good strategy in a rapidly changing world, only time will tell. Further, the security of investments in housing depends greatly on the security of property rights and the ease with which houses can be sold as and when required to finance consumption. In many areas of Lima, land property rights are poorly defined and the market for land and real-estate functions imperfectly as a result. Finally, the partially rationed status of the informally employed renders this group particularly vulnerable.

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Figure 1. New affiliates to the public and private branches of Peru's retirement security system, 1992 – 2002
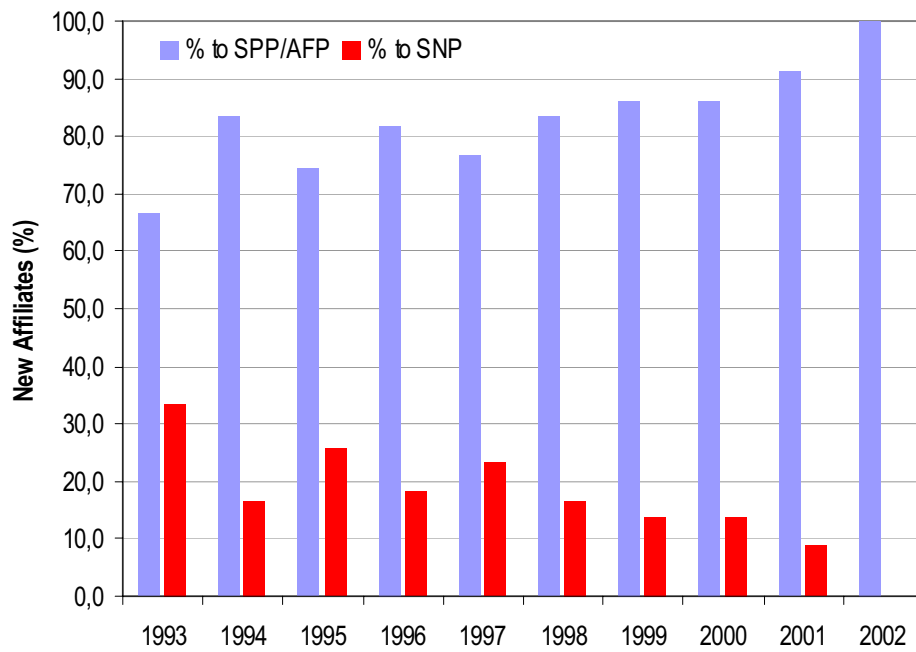
Source: PRIESO Peru 2002

Figure 2. Experimental investment and insurance decisions in the PRIESO Survey

Investment Decision

FIRM A

FIRM B

Very successful
Profit = **20 Soles**, with
probability of 50%, that is if

Profit = **8 Soles***

Less successful
Profit = **8 Soles**, with
probability of 50%, that is if

Do you choose to invest in Firm A or Firm B?

*The amount of profit for Firm B varies through the course of the task

Insurance Decision

The good is
worth **20 Soles**

The good is damaged and its
Value falls 12 Soles

The good does not
suffer any damage.
It's value does not
fall. It is worth
20 Soles

The good is worth
8 Soles

**50% probability
That this will happen,
that is if**

**50% probability
That this will happen,
that is if**

Do you choose to insure?

*The cost of insurance varies throughout this task

Figure 3: Distribution of certainty equivalents under the investment frame
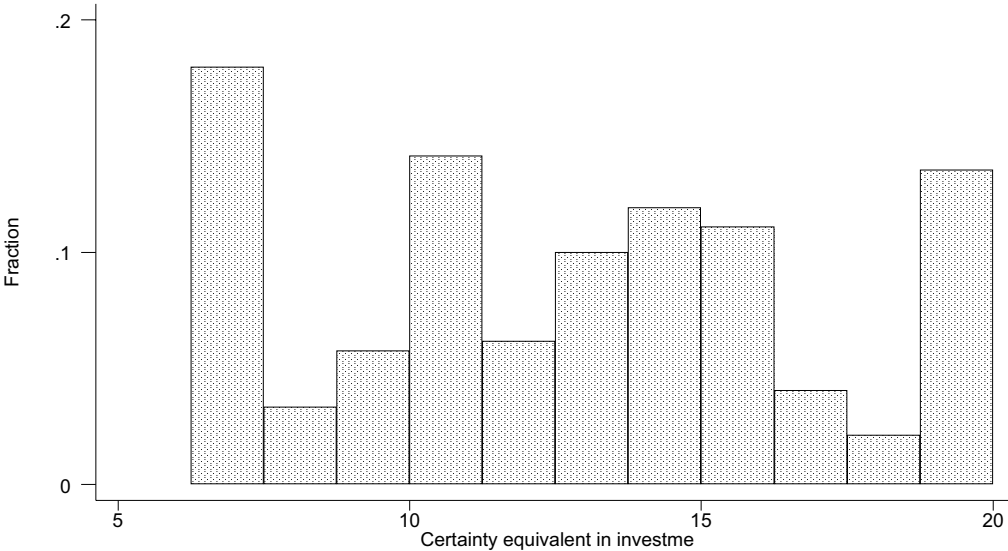
Figure 4: Distribution of certainty equivalents under the insurance frame
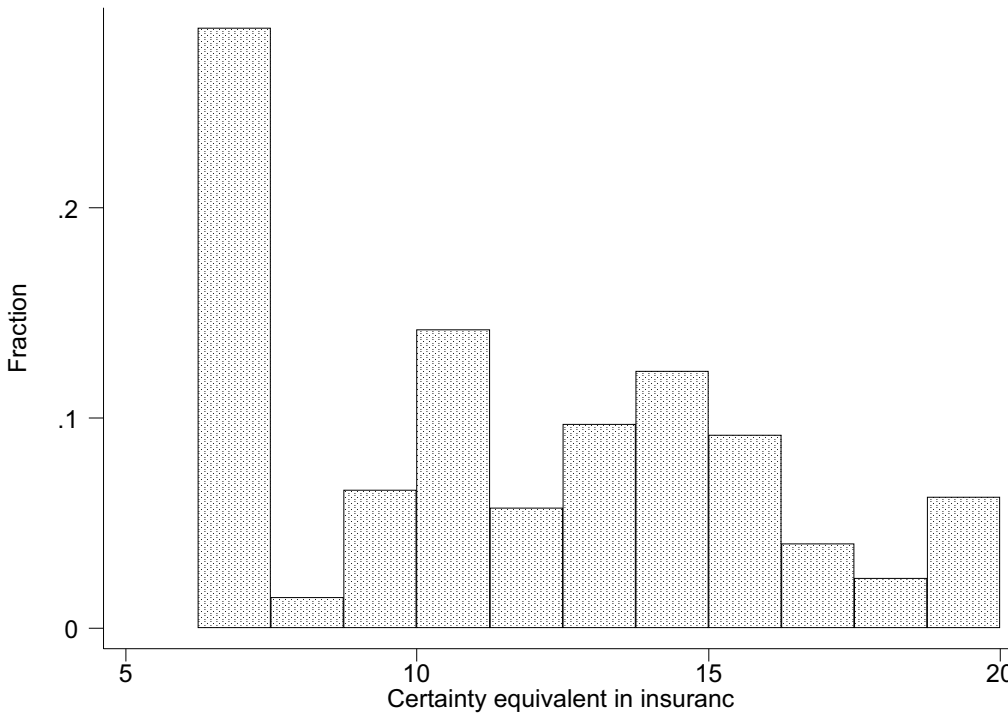
Figure 5: Comparison of the distributions of certainty equivalents under the insurance and investment frames
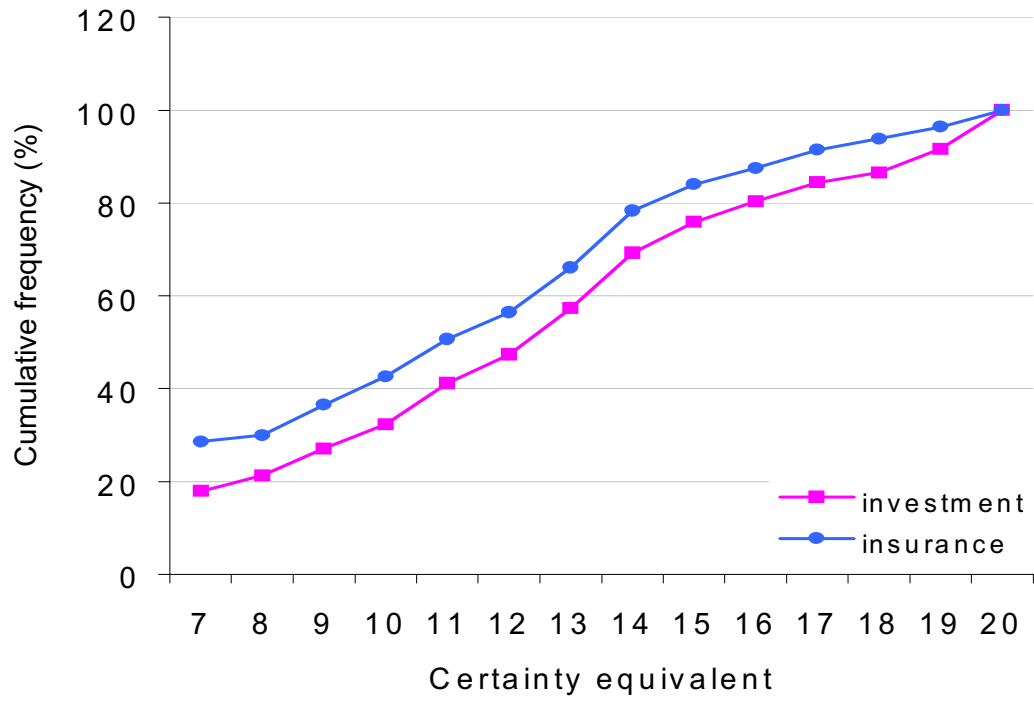
Figure 6: The correlation between the certainty equivalents under the insurance and investment frames
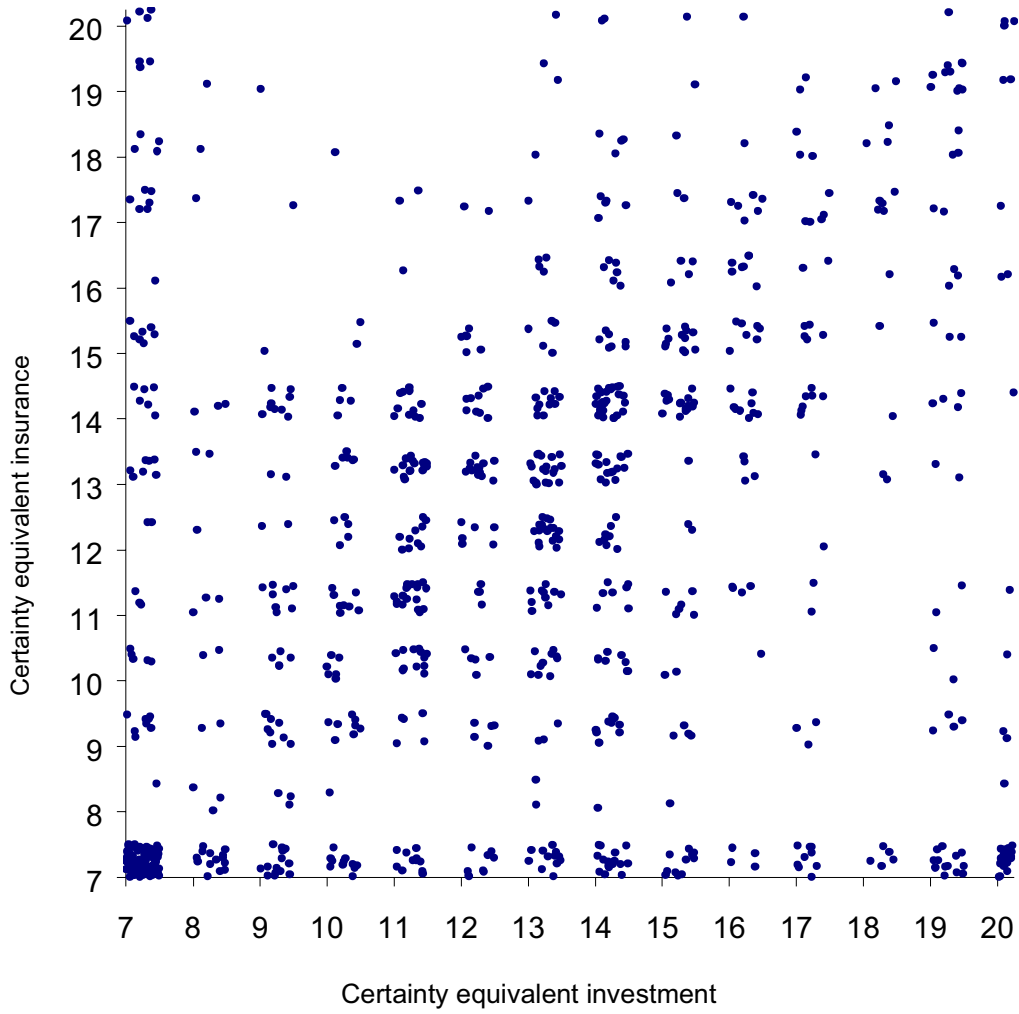
Table 1. Contribution rates to Peru's public and private pension systems
(% of earnings)

	1992	1995	1997
PAYGO	9.00	11.00	13.00
AFP	13.91	11.61	11.61
Civil Service	6.00	6.00	6.00

Source: ONP

Table 2: Employment status and sector

	Full sample	Self-employed	Uncontracted employees	Contracted employees
Full sample	965			
	100.00%			
Unemployed	46			
	4.77%			
Public sector	156			
	16.17%			
Private sector	763	247	203	313
	79.07%	25.60%	21.04%	32.44%
Of which…				
mining, manufacturing, and utilities	185	40	47	98
	19.17%	4.15%	4.87%	10.16%
professionals	96	22	16	58
	9.95%	2.28%	1.66%	6.01%
social sector	64	8	11	45
	6.63%	0.83%	1.14%	4.66%
retail and transport	321	152	85	84
	33.26%	15.75%	8.81%	8.70%
other	97	25	44	28
	10.05%	2.59%	4.56%	2.90%

Note: All proportions stated as percentages of full sample

Table 3: Characteristics by employment status and sector

	Variable names in regressions	Full sample	Self-employed	Unemployed	Private sector employees	Public sector employees	Variation across sectors (P-value)#
Number of observations		965	247	46	516	156	
Females	*female*	0.38	0.36	0.54	0.36	0.43	0.0560
Age (years)	*age*	36.85	39.67	35.30	34.22	41.54	0.0000
Formal education (years)	*education*	13.62	11.89	13.39	13.40	17.20	0.0000
Married	*married*	0.44	0.51	0.35	0.37	0.58	0.0000
Peri-urban	*peri-urban*	0.06	0.12	0.02	0.05	0.04	0.0004
Income from work ('000 USD)	*income**	23.78	59.43	0.00	11.84	13.88	0.4123
Has no employment contract	*uncontracted*				0.39		
Total assets ('000 USD)	*assets**	11.28	14.18	10.68	8.92	14.69	0.0988
proportion in houses	*houses*	0.35	0.46	0.36	0.29	0.35	0.0224
Number of people in household	*household**	5.39	5.45	5.96	5.41	5.08	0.1263
proportion of which - children	*children*	0.24	0.27	0.22	0.23	0.25	0.0672
proportion of which - elderly	*elderly*	0.04	0.02	0.02	0.05	0.05	0.0036
Credit constrained	*credit*	0.10	0.15	0.11	0.09	0.04	0.0065
Expected age at death	*die*	70.93	69.83	70.98	71.38	71.17	0.3359
Expect to live with children	*fsecure*	0.27	0.28	0.24	0.29	0.17	0.0160
Attitude towards risk (insurance)	*ceins*	11.61	11.93	11.11	11.53	11.54	0.0028
Attitude towards risk (investment)	*ceinv*	12.68	12.80	11.02	12.77	12.70	0.0439
		[958]	[245]		[512]	[155]	
Affiliated	*affiliate*	0.70	0.45	0.57	0.74	1.00	0.0000
Contributing	*contributes*	0.52	0.11	0.11	0.60	1.00	0.0000
Receiving a pension	*pension*	0.02	0.01	0.11	0.02	0.02	0.0001
Inferred population proportions…							
Number of observations		965	347	56	482	80	
Affiliated	*affiliate*	0.36	0.17	0.24	0.41	1.00	
Contributing	*contributes*	0.26	0.04	0.05	0.33	1.00	
Receiving a pension	*pension*	0.01	0.00	0.05	0.01	0.02	
Of affiliates…							
Number of observations		677	112	26	383	156	
Contributing	*contributes*	0.73	0.23	0.19	0.81	1.00	0.0000
Affiliated to the public system	*public*	0.36	0.70	0.38	0.22	0.45	0.0000
Months as an affiliate	*aflmonths*	180.78	259.46	173.19	148.84	205.05	0.0000
		[670]	[111]		[382]	[151]	
Months as a contributor	*accrued*	140.56	147.31	135.01	120.09	188.35	0.0000
		[670]	[111]		[382]	[151]	
Contribution density since affiliation	*density*	0.75	0.50	0.52	0.77	0.91	0.0000
		[670]	[111]		[382]	[151]	

the reported p-values relate to the significance of a regression taking the listed variable as the dependent variable and
  only three dummy variables relating to employment status and sector as right-hand side variables.

* natural log used in regression analysis, one added to income and value of assets prior to taking logs.

Numbers of observations are as reported at top of table section unless stated in square brackets below particular statistic.

Table 4: Regression analysis of affiliations

		Full sample		Self-employed and unemployed		Employees	
		dF/dx	s.e.	dF/dx	s.e.	dF/dx	s.e.
x_i	self-employed	-0.7026	0.0459 ***				
	unemployed	-0.4714	0.1387 ***	0.2141	0.2106		
	uncontracted	-0.5481	0.0538 ***			-0.3644	0.0451 ***
	female	-0.2149	0.0403 ***	-0.4286	0.0681 ***	-0.0791	0.0348 **
	age	0.0179	0.0022 ***	0.0243	0.0038 ***	0.0118	0.0021 ***
	education	0.0252	0.0043 ***	0.0330	0.0080 ***	0.0187	0.0041 ***
	married	0.0806	0.0410 *	0.1181	0.0809	0.0413	0.0380
	peri-urban	0.1024	0.0483 *	0.1164	0.1246	0.0793	0.0325 *
	income	0.0173	0.0090 *	0.0099	0.0221	0.0121	0.0075
	assets	0.0012	0.0070	0.0031	0.0123	-0.0013	0.0068
	household	-0.0730	0.0378 *	-0.1618	0.0746 **	-0.0170	0.0338
d_i	houses	-0.0132	0.0634	-0.0924	0.1178	0.0458	0.0631
	children	-0.0682	0.1005	-0.3999	0.1911 **	0.0514	0.0942
	elderly	-0.2369	0.2147	-0.3840	0.4636	-0.1278	0.1760
	fsecure	-0.0274	0.0386	-0.0320	0.0783	-0.0211	0.0322
	credit	-0.1011	0.0610 *	-0.2109	0.0934 **	-0.0164	0.0515
	die	-0.0017	0.0017	-0.0044	0.0035	-0.0003	0.0013
	ceins	-0.0025	0.0045	-0.0283	0.0097 ***	0.0058	0.0039
Obs.		809		293		516	
Pseudo R^2		0.4314		0.3590		0.4739	

Notes: Regressions include four private sector of employment dummy variables for which we have not reported dF/dx and s.e. For dummy variables, reported dF/dx is for discrete change from 0 to 1. * significant at 10 percent level, ** significant at 5 percent level, *** significant at 1 percent level.

Table 5: Regression analysis of contributions

		Full sample		Self-employed and unemployed		Employees		Self-employed, unemployed, and uncontracted employees		Contracted employees	
		dF/dx	s.e.	dF/dx	s.e.	dF/dx	s.e.	dF/dx	s.e.	dF/dx	s.e.
x_i	self-employed	-0.6421	0.0667 ***								
	unemployed	-0.5602	0.1717 ***	0.2410	0.3399			0.2489	0.2757		
	uncontracted	-0.4970	0.0681 ***			-0.3381	0.0621 ***	0.2191	0.0906 **		
	female	0.0375	0.0532	0.0438	0.0830	0.0337	0.0306	-0.0429	0.0870	0.0404	0.0217 *
	age	0.0016	0.0040	0.0055	0.0049	0.0002	0.0026	0.0077	0.0052	-0.0021	0.0021
	education	-0.0001	0.0054	0.0006	0.0075	0.0014	0.0031	-0.0005	0.0077	0.0004	0.0022
	married	0.0186	0.0525	-0.0054	0.0744	0.0166	0.0311	0.0154	0.0727	0.0052	0.0241
	peri-urban	0.0440	0.0819	-0.0168	0.1210	0.0473	0.0335	0.1079	0.1563	0.0023	0.0454
	income	0.0225	0.0122 *	0.0091	0.0227	0.0107	0.0066 *	0.0246	0.0168	0.0028	0.0052
	assets	0.0115	0.0097	0.0312	0.0139 **	0.0004	0.0056	0.0290	0.0149 *	-0.0005	0.0038
	household	-0.0444	0.0494	-0.0041	0.0604	-0.0126	0.0355	-0.0078	0.0666	-0.0326	0.0289
	density	0.6685	0.0861 ***	0.6099	0.1864 ***	0.3406	0.0641 ***	1.0700	0.1611 ***	0.1327	0.0443 ***
	public	-0.1532	0.0629 ***	-0.1242	0.0872	-0.0977	0.0511 **	-0.1275	0.0768 *	-0.0971	0.0566 **
d_i	houses	-0.0084	0.0858	-0.2114	0.1097 *	0.0619	0.0514	-0.1086	0.1219	0.0440	0.0363
	children	-0.2085	0.1298	-0.4404	0.1756 **	-0.0189	0.0707	-0.3471	0.1972 *	-0.0360	0.0468
	elderly	-0.1772	0.2300	-0.2705	0.3718	-0.0370	0.1183	-0.4535	0.4269	0.0839	0.0961
	fsecure	0.0449	0.0487	0.1171	0.0919	-0.0018	0.0321	0.0980	0.0797	0.0119	0.0215
	credit	-0.0466	0.1051	0.0838	0.1519	-0.0645	0.0755	-0.0645	0.1212	-0.0288	0.0497
	die	0.0020	0.0025	0.0026	0.0041	0.0008	0.0014	0.0038	0.0041	0.0005	0.0010
	ceins	0.0001	0.0057	0.0077	0.0071	-0.0018	0.0033	0.0097	0.0085	-0.0026	0.0025
	pension	-0.0605	0.1529	-0.0285	0.1351	-0.0594	0.1086	0.0097	0.1933	-0.0108	0.0551
	accrued	-0.0007	0.0003 **	-0.0009	0.0005	-0.0004	0.0002 *	-0.0018	0.0005 ***	0.0000	0.0001
Obs.		519		137		382		224		269	
Pseudo R^2		0.5251		0.3007		0.4732		0.3608		0.2735	

Notes: Regressions include four private sector of employment dummy variables for which we have not reported dF/dx and s.e. For dummy variables, reported dF/dx is for discrete change from 0 to 1. * significant at 10 percent level, ** significant at 5 percent level, *** significant at 1 percent level.

Table 6: Regression analysis of affiliations to the public pension system

		Full sample		Self-employed and unemployed		Employees	
		dF/dx	s.e.	dF/dx	s.e.	dF/dx	s.e.
x_i	self-employed	0.5173	0.0556 ***				
	unemployed	0.2887	0.1902	-0.2498	0.3318		
	uncontracted	0.3527	0.0642 ***			0.3370	0.0645 ***
	public emp.	0.3156	0.0723 ***			0.2796	0.0699 ***
	female	-0.0339	0.0453	0.2637	0.0869 **	-0.0792	0.0428 *
	age	0.0105	0.0036 ***	0.0140	0.0089	0.0091	0.0036 ***
	education	-0.0201	0.0044 ***	-0.0311	0.0128 **	-0.0162	0.0043 ***
	married	0.0065	0.0449	-0.1368	0.1024	0.0191	0.0433
	peri-urban	-0.1435	0.0648 *	-0.0929	0.1569	-0.1435	0.0583 *
	income	-0.0011	0.0142	0.0140	0.0283	-0.0076	0.0154
	assets	-0.0111	0.0072	-0.0251	0.0164	-0.0057	0.0069
	household	-0.0232	0.0456	0.0806	0.0940	-0.0356	0.0482
d_i	houses	-0.0442	0.0678	0.1420	0.1548	-0.0910	0.0668
	children	-0.0595	0.1139	-0.6968	0.2791 **	0.0624	0.1101
	elderly	-0.0340	0.2069	-0.3187	0.5587	0.0298	0.1917
	fsecure	0.0059	0.0494	-0.0334	0.1230	0.0108	0.0480
	credit	0.0174	0.0797	0.0256	0.1476	0.0433	0.0881
	die	-0.0011	0.0021	-0.0029	0.0045	-0.0007	0.0022
	ceins	0.0108	0.0051 **	0.0217	0.0119 *	0.0062	0.0051
	aflmonths	$-1.27e^{-5}$	$3.44e^{-4}$	-0.0003	0.0008	0.0001	0.0004
	pre'93	0.1552	0.0627 **	0.2779	0.1682 *	0.0978	0.0631
	pension	0.2086	0.1352			0.0480	0.1443
Obs.		679		132		540	
Pseudo R^2		0.2648		0.3299		0.2169	

Notes: Regressions include four private sector of employment dummy variables for which we have not reported dF/dx and s.e. For dummy variables, reported dF/dx is for discrete change from 0 to 1. * significant at 10 percent level, ** significant at 5 percent level, *** significant at 1 percent level.

Appendix 1

Table A1: Standard deviations of characteristics (continuous variables only) by employment status and sector

	Variable names in regressions	Full sample	Self-employed	Unemployed	Private sector employees	Public sector employees
Age (years)	*age*	11.66	12.18	13.82	11.09	9.36
Formal education (years)	*education*	5.55	5.67	5.62	5.21	4.81
Income from work ('000 USD)	*income**	386.40	763.18	0.00	18.16	18.19
Total assets ('000 USD)	*assets**	32.86	35.42	27.96	30.83	36.00
proportion in houses	*houses*	0.46	0.47	0.47	0.44	0.45
Number of people in household	*household**	2.31	2.58	2.35	2.21	2.13
proportion of which - children	*children*	0.20	0.21	0.21	0.19	0.21
proportion of which - elderly	*elderly*	0.10	0.08	0.06	0.11	0.11
Expected age at death	*die*	11.06	11.42	12.07	11.34	9.00
Attitude towards risk (insurance)	*ceins*	4.08	4.24	3.74	4.07	3.87
Attitude towards risk (investment)	*ceinv*	3.90	3.99	3.45	3.91	3.82
Of affiliates…						
Months as an affiliate	*aflmonths*	136.37	159.06	163.22	124.16	114.04
Months as a contributor	*accrued*	125.87	146.51	163.22	116.56	112.09
Contribution density since	*density*	0.34	0.34	0.41	0.33	0.21