Revealed Preference and Self Insurance: Can We Learn from the Self Employed in Chile?

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Abstract. *Field experiments and questions about hypothetical situations are used to measure agents' risk and time preferences and thereby identify the agent-type that is free to reveal its preferences through decisions about participation in a pension system. We show that in Chile the appropriate focus for policy makers interested in the welfare-enhancing effects of participation are the self-employed. The self-employed are indistinguishable from other economically active agents with respect to time and risk preferences and are free to reveal those preferences. Employees, on the other hand, are rationed. The more patient and less risk averse self-employed participate.*

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I. Introduction

Against the backdrop of social risk management,[1] the a recent flagship study of the Latin America and the Caribbean Regional Office concluded that financial sector development is a critical area of effective social protection policy.[2] A well regulated financial sector and capital market can complement government efforts to keep households from falling into poverty, by supplying the instruments they needed to either pool risks or self insure against losses due to the death or disability of a household member, unexpected loss of employment, or the inability to work in old age. However, many of the policy recommendations that can be drawn from the social risk management framework, rest on the strong assumption that risk and time preferences are uniform across individuals or households.

Policies meant to encourage participation in public pension systems and lower evasion where such systems are mandatory (for example, reforms that lead to closer alignment of benefits with pay-roll contributions, or the introduction of individual retirement accounts) implicitly attempt to emulate the savings behavior of individuals and households faced with fully functioning capital markets and perfect information. If, however, no allowance is made for variation in preferences the welfare effects of policy reforms will vary across the target population. Mandated social security, even if actuarially fair for most, is likely to impose welfare losses on those less inclined to save and insure (Holzmann, Packard and Cuesta, 2000). This said, a clearer picture of individual and household preferences, and how they vary across the population, can help governments design social security systems that complement private savings and insurance instruments.

This paper presents the results of a field experiment designed to produce an empirical measure of the risk aversion and time preferences of selected groups of interest in Chile, which in 1981 pioneered social security reform with a transition to privately invested individual retirement accounts. The experiment was conducted as a follow up to the PRIESO survey on risk management, social security and savings, and was designed to establish primarily whether the time and risk preferences of the self employed differed significantly from those of waged and salaried workers.

The paper has four sections. Following this introduction, Section II sets the context of the field experiment and briefly describes the reform of social security in Chile, presenting the salient features of the new pension system. Section III outlines our methodological framework. Section IV presents our results and Section V summarizes our findings and concludes.

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[1] Holzmann, Robert, and Steen Jorgensen, 2000 *"Social Protection Sector Strategy: From Safety Net to Spring Board"* The World Bank,

[2] De Ferranti, David, Guillermo Perry, Indermit Gill, Luis Serven, with F. Ferreira, N. Ilahi, W. Maloney and M. Rama, 2000, "*Securing our Future in a Global Economy*" World Bank Latin America and Caribbean Studies

II. Revealed Preference and Self Insurance in Chilean Pension System

Imagine that a government is planning to bring about a change in the characteristics of a good with the aim of raising aggregate utility and that it wishes to monitor the effects of this intervention. Imagine also that there are two types of consumer, one rationed to consume the good at a certain level, the other unrationed. The economist in charge of monitoring would most likely focus her attention on the second type of consumer as it is they who are free to reveal their preferences through changes in their consumption patterns. *Ceteris paribus*, such a study would yield findings that could be generalized to the full population of consumers. But what if the consumers sort into type with reference to preference parameters that are also salient to their decisions about the good? Then, it would be inappropriate to generalize and the economist would have to find some other way to quantify the effects of the intervention on the rationed consumers.

This is the conundrum facing the many governments considering or undertaking reforms of their public social security systems. Many require waged and salaried employees to contribute a certain percentage of their income to a pension system by law, while the self-employed are either not covered by or can easily evade the mandate. This renders the self-employed of considerable interest to policy makers. Unlike employees, they are free to reveal their preferences through their decisions about whether to participate in the pension system or not. However, drawing inferences about the welfare-enhancing effects of reforms on the economically active population as a whole from an analysis focused exclusively on the self-employed could be misleading - the preferences relating to time and risk that are of direct relevance to choices about pensions may also play a role in the sorting of the economically active into employees on the one hand and the self-employed on the other.

Much of the theoretical and empirical literature suggests that when self employment is a matter of choice, agents with a lower aversion to risk are likely to self-select into that group (Knight, 1921, Kihlstrom and Laffont, 1979). Empirical evidence from both developed (Taylor, 1996, Uusitalo, 1999, Guiso and Paiella, 2000) and middle income developing countries (Yamada, 1996, Maloney, 1999) supports this view, although none of these studies make use of direct measures of risk aversion. On the other hand, an extensive literature, primarily focused on poorer developing countries, characterizes self employment not as a choice, but as part of a residual sector where workers who have either lost their jobs or recently migrated from rural areas, bide their time and queue for waged employment in modern firms (Lewis, 1954, Harris and Todaro, 1970). Within this literature it is implicitly assumed that the self-employed are no less risk averse than employees. While the role of time preferences on the decision to save for retirement is well established (Samwick, 1997), to our knowledge, the link between peoples' subjective discount rates and labor market choices has not been made. We, nevertheless, include time preferences in our study as they help us distinguish rationed from unrationed consumers.

Although relevant, the literature on sector choice does not currently offer our imaginary economist the guidance she needs. Ideally, such guidance would take the form of answers to three questions. First, are employees and the self-employed distinct in terms of preferences and, in particular, are the self-employed predominantly a self-selected group displaying relatively low risk aversion? Second, are employees truly rationed in the sense that whether

they contribute to a pension system is determined not by their preferences but by or simultaneously with the type of job they have? Third, are the self-employed truly unrationed in the sense that whether they contribute to a pension system or not is determined by their preferences? If the answers to these questions are 'no', 'yes', and 'yes' respectively, then a study of the self-employed only would serve our economist's purpose. If, however, some other combination of answers emerges, then this relatively straightforward approach would not suffice.

In this paper we provide answers to these three questions for Chile, the middle-income developing country that pioneered social security reform in 1981. Fiscal pressures, brought about by overly generous benefits, mismanagement and shifting demographic trends that rapidly increased the share of elderly in the population, forced Chile to dismantle its defined-benefit, pay-as-you-go (PAYGO) pension system, similar to those currently administered across Europe, the United States, and other developing countries (SAFP, 1999). Chile chose to adopt a system in which old age pensions are financed primarily out of publicly mandated, but privately managed, individual retirement accounts (World Bank, 1994).[3] The reform lowered the rate of pay-roll taxation and reduced the pure-tax element of mandated salary deductions by tightening the link between contributions and retirement benefits (Grubber, 1995). However, just as under the PAYGO regime, the self employed were exempted from the mandate to save for retirement in the new system.

Under the reformed system, participating workers contribute 13 percent of their income to institutional investors who specialize in managing and investing retirement savings. Only 10 percent of workers' contributions accumulate in their individual retirement accounts. The remaining 3 percent pays the fund managers' fees and the premiums on group level disability and life insurance policies that the fund managers are required by law to purchase for their contributors. Workers who contribute into an individual retirement account for at least 20 years are guaranteed a minimum annuity benefit from the government should their accumulated savings fall short of a determined amount. Thus, contributors are not only saving for their retirement, but also accumulating rights toward a publicly-provided minimum benefit as well as securing coverage against risks to household income from disability and sudden death.[4]

Recall that we do not simply assume that the mandate requiring employees to participate in the pension system acts like a ration. Rather, we present it as a hypothesis to be tested. Enterprises in the growing, unregulated sectors in developing economies, almost by definition, do not contribute to pension systems on behalf of their employees (ILO, 1997). Thus, job type and pension system participation may be co-determined, making it necessary

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[3] Most countries that have undertaken structural reform of public social security systems, have retained or restructured a public "first pillar" with some sort of distributive, safety-net function, and added a private "second pillar" of individual retirement savings accounts, funded with mandatory, defined contributions. Finally, most have establishing the rules of a voluntary "third pillar" of regulated tax incentives and pension plans established between employers and employees.

[4] For a detailed account of social security reform in Chile, the structure of the new pension system and the impact of reforms, see Holzmann (1997), and Edwards and Edwards (2000). For a discussion of the incentive effects expected from a transition to individual retirement accounts, see World Bank (1994) and Holzmann et. al. (2000).

to establish whether employees sort between formal and informal jobs knowing that this will determine whether they will accumulate rights to a pension and, thus, with reference to their risk and time preferences. Similarly, we do not assume that the self employed are truly unrationed. In the case of the self employed, we are less concerned with the operations of the labor market than with credit market imperfections. These may dissuade some self employed from accumulating rights to a pension even though their lifetime budget constraint and preferences indicate that they should.

III. Methodological Framework

A. Hypotheses

Let $\mathbf{t}$ be an agent's rate of time preference and $\mathbf{r}$ his rate of risk aversion. Further, let the self-employed be identified by the subscript $\mathbf{s}$ and employees by the subscript $\mathbf{e}$. Finally, let contributors to pension funds be identified by the subscript $\mathbf{c}$ and non-contributors by the subscript $\mathbf{n}$. Now, our set of three questions can be translated into the series of testable hypotheses presented below.

	Question	Time preferences		Risk aversion	
		Null	**Alternative**	**Null**	**Alternative**
1.	Are salaried/waged employees and the self employed distinct?	H_0: $\mathbf{t_s} = \mathbf{t_e}$	H_1: $\mathbf{t_s} \neq \mathbf{t_e}$	H_0: $\mathbf{r_s} = \mathbf{r_e}$	H_1: $\mathbf{r_s} \neq \mathbf{r_e}$ H_1: $\mathbf{r_s} < \mathbf{r_e}$
2.	Are salaried/waged employees rationed?	H_0: $\mathbf{t_{ec}} = \mathbf{t_{en}}$	H_1: $\mathbf{t_{ec}} \neq \mathbf{t_{en}}$ H_1: $\mathbf{t_{ec}} < \mathbf{t_{en}}$	H_0: $\mathbf{r_{ec}} = \mathbf{r_{en}}$	H_1: $\mathbf{r_{ec}} \neq \mathbf{r_{en}}$ H_1: $\mathbf{r_{ec}} > \mathbf{r_{en}}$
3.	Are the self employed unrationed?	H_0: $\mathbf{t_{sc}} = \mathbf{t_{sn}}$	H_1: $\mathbf{t_{sc}} \neq \mathbf{t_{sn}}$ H_1: $\mathbf{t_{sc}} < \mathbf{t_{sn}}$	H_0: $\mathbf{r_{sc}} = \mathbf{r_{sn}}$	H_1: $\mathbf{r_{sc}} \neq \mathbf{r_{sn}}$ H_1: $\mathbf{r_{sc}} > \mathbf{r_{sn}}$
4.	Are salaried/waged employees and self employed contributors distinct?	H_0: $\mathbf{t_{sc}} = \mathbf{t_{ec}}$	H_1: $\mathbf{t_{sc}} \neq \mathbf{t_{ec}}$ H_1: $\mathbf{t_{sc}} < \mathbf{t_{ec}}$	H_0: $\mathbf{r_{sc}} = \mathbf{r_{ec}}$	H_1: $\mathbf{r_{sc}} \neq \mathbf{r_{ec}}$ H_1: $\mathbf{r_{sc}} > \mathbf{r_{ec}}$

Our two null hypotheses relating to the first question state that employees on the one hand and the self-employed on the other are the same. One alternative hypothesis, that they are not the same, is presented for time preferences and two alternative hypotheses, that they are not the same and that the self-employed are less risk averse, are presented for risk preferences.

To check that employees are rationed and the self-employed unrationed, as we expect under the partial mandate, we look at whether each agent type sorts into contributors and non-contributors with respect to preferences. In each of the four resulting sets of hypotheses the null is that contributors and non-contributors are the same. Then, for the hypotheses relating to time preferences two alternatives are presented. One states that contributors and non-contributors are different and the other that the former are more patient.

For the hypotheses relating to risk preferences the two alternatives are that contributors and non-contributors are different and that the former are more risk averse. Unrationed

contributors will be more risk averse than non-contributors if the formal pension system is the only available insurance against poverty in old age. In the case of Chile this is probably a simplification, but the hypothesis provides us with a basis for further discussion below.

Finally, we add a fourth question and corresponding set of hypotheses. If employees are rationed and the self-employed are unrationed, we would expect the contributors from the two groups to be distinct with respect to their salient preferences. Thus, our fourth set of null hypotheses states that employees and self-employed contributors are indistinct. Corresponding to each null are two alternative hypotheses, the first stating that the two types of contributor are distinct and the second that self-employed contributors are respectively patient and more risk averse.

B. Data Collection and Methodology

In order to test the hypotheses listed above, we require data on the time and risk preferences of employees and self-employed contributors and non-contributors to the pension system in Chile. A carefully designed field experiment similar to the laboratory-run experiment of Schubert, Brown, Gysler and Brachinger (1999) generates our data on risk preferences. For time preferences, we adopted an approach developed by Donkers and van Soest (1999) that involves asking questions about a series of hypothetical situations.[5]

Economic experiments are traditionally conducted in university laboratories with small samples of graduate students, as in Poterba (1988), Kotlikoff, Samuelson and Johnson (1988), and Schubert, *et al.* (1999). In order to obtain data from a sample more relevant to our questions, we took the experiment and hypothetical questions to a representative sample of economically active respondents.[6] Our sample was drawn from the pool of respondents to the PRIESO 2000 survey in Greater Metropolitan Santiago (urban, peri-urban, and rural communities), and stratified according to sector (self employment, or wage and salaried employment) status. We selected 115 employees and 115 self-employed from the PRIESO 2000 sample to participate in the experiment. In the interval between the PRIESO 2000 and the field experiment, 23 of the selected self-employed became employees. Thus, our final sample contained 138 employees and 92 self-employed. Just under 60 percent of the employees and just over 20 percent of the self-employed were contributing to a pension system at the time of the experiment.

In the experiment respondents were confronted with a series of gambles framed first as investment and then as insurance decisions. Illustrative examples of both frames of the risk aversion experiment are shown in Figure 1. Trained 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 regardless of how well it fared. The numerators explained the probabilities of Firm A's success, the pay-offs from Firm A in each state, and the fixed pay-off from Firm B.[7] The

[5] Barsky, Juster, Kimball and Shapiro (1997) use a similar approach in their analysis of pension savings and health benefits in the US.

[6] A detailed description of the study, and an example of the script and materials used (in English and Spanish), are available from the authors upon request.

[7] The initial pay-off for Firms A if successful was Ch$3,000 (3 thousand Chilean pesos). This is slightly

respondents were then asked to decide in which firm to invest. After registering their answer, the numerators would raise the amount of the secure pay-off, and ask the respondents to choose between the two firms again. As the amount of the secure pay-off grew, investing in Firm A looked less attractive to a risk averse respondent. In this way a certainty equivalent - that is the point at which respondents would no longer risk investing in Firm A - was elicited for each gamble. The probability of Firm A's failure was altered three times while keeping the state-specific pay-offs constant, and in the fourth investment gamble, the pay-offs were altered.

The insurance gambles were similarly conducted. Respondents were asked to imagine they were the owners of a share in a company listed on the stock market. They could choose to either purchase an insurance policy that would protect the value of their share from market turbulence, or not to take up the policy and face either a large or a small financial loss. After registering their decision, the numerators would slightly increase the cost of insuring and ask again whether they would insure. As the cost of insurance increased, the option to protect the share value would become less attractive to the respondent. The probabilities and pay-offs associated with the four insurance decisions exactly matched those of the four investment decisions. 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. Which of their decisions ultimately determined their earnings was picked at random at the end of the interview.

After the investment and insurance decisions, the respondents were asked a series of cascading hypothetical questions designed to measure their time preferences. In each hypothetical question, respondents were asked how they would prefer to receive their winnings from a national lottery draw. One of the four cascading hypothetical questions is shown here as an example.

a) Imagine that you win a cash prize in the national lottery and the prize is worth Ch$3,000,000. You can take your winnings at once if you want, but the lottery organizers ask if you would be prepared to wait a year before taking your prize.

   If they were offering you Ch$3,000,000 now or Ch$3,000,000 in a year's time, would you agree to wait?

b) What if they were to offer you more than Ch$3,000,000 if you were prepared to wait - what is the minimum amount of money they would have to offer you in order to get you to wait?

c) Would you accept Ch$ _____ in a year's time instead of Ch$3,000,000 now?

If the respondents agreed to wait after part (a) of the question, the numerators recorded their answer, and proceeded to the next hypothetical situation. If they did not agree to wait numerators recorded their answers and moved on to part (b), and then recorded the amount that the respondents would be willing to accept in order to wait. The numerators would then probe to find out whether the respondents would accept progressively lower amounts. In this way, the numerators would establish the smallest amount the respondents would agree

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higher than the average respondent's hourly income of Ch$2,282, or US$4.23 at the exchange rate prevailing in June, 2000, of Ch$538.61 : US$1.

to wait for, to the nearest Ch$25,000. The numerators recorded this final amount in each of the four hypothetical situations, and proceeded onto the last part of the interview.

Prior to receiving their pay-offs from the experiment, the respondents were asked a series of questions concerning their demographic characteristics, participation in the labor market, income, and finally their current contributory status in the pension system.

IV. Results

A. Individual Preferences and Treatment Effects

Every respondent in the experiment faced four hypothetical decisions relating to time preferences, and two answers were elicited for each, one spontaneous and the other probed. Thus, for each individual in our sample we have eight measures of time preference each taking the form of subjective discount rates.[8]

Figure 2 shows the frequency distributions of the spontaneous and probed subjective discount rates for each decision. Each row in Figure 2 corresponds to a different decision. In the first row we present the subjective discount rates corresponding to an initial amount of Ch$3,000,000 and a wait of one year. The second row shows the subjective discount rates corresponding to the current equivalent of Ch$3,000,000 in three months' time. The third row shows the subjective discount rates corresponding to the current equivalent of Ch$3,000,000 in one year's time. The fourth row shows the subjective discount rates corresponding to an initial amount of Ch$300,000 and a wait of a year. The left-hand column shows the spontaneous answers and the right-hand column the results of the interviewers' probing.

The interviewers' probing took the form of challenging the respondents as to whether they would accept lower amounts of money. Thus, in the decisions about delays, probing may lead to lower interest rates. In the decisions about current equivalents to amounts due in the future, probing may lead to higher subjective discount rates. The graphs in rows 1 and 4 correspond to delays and, as expected, we see the histograms shift left when probing is introduced. The graphs in rows 2 and 3 of Figure 2 correspond to speed-ups. In row 3, as expected, the histogram shifts right, while in row 2 there is no detectable shift.

The fixed and random effects regressions presented in Table 1 provide a formal analysis of the effects of variations in treatment. The fixed and random effects regressions in the first two columns of the table use only experimental treatment variables as explanatory variables. The treatment variables include a dummy that takes the value 1 if the subjective discount rate resulted from the numerators' probing and zero otherwise (*Probed*), a dummy that takes the value 1 if the treatment involved choosing a current equivalent to an amount of money in the future and a zero if it involved compensation for a delay (*Now*), a dummy that takes the

[8] Strictly speaking, our time preference measures are the internal rate of return for the household. A subjective discount rate is the interest rate at which a household would choose flat consumption. We do not use consumption data. Rather we elicited the effective interest rate households use to evaluate various patterns of pay-offs over time – the internal rate of return. For ease of interpretation, we have chosen to use the term "subjective discount rate".

value 1 if the choice involved a time period of three months and zero if it involved a year (*Shorter*), and a dummy that takes the value 1 if the decision involved Ch$300,000 and zero if it involved Ch$3,000,000 (*Smaller*). The random effects regression in the third column includes several respondent characteristics (income, age, years of education, sex, marital status, and location) as additional explanatory variables. This third model should not be interpreted as causal. Any significant results relating to the respondents' characteristics should be viewed as descriptive only.

In the decisions about delays the probing led to a significant fall in the subjective discount rate of 10 percentage points, while in the decisions about speed-ups it led to no significant increase.[9] Both the graphs and the regressions also show that the respondents chose significantly (0.1 percent level) lower subjective discount rates when paying for a speed-up rather than being compensated for a delay, marginally but still significantly (5 percent level) higher subjective discount rates when considering shorter periods of time, and significantly (0.1 percent level) higher subjective discount rates when considering smaller amounts. Note that less than 11 percent of the variation in the subjective discount rates is accounted for by the treatment variables and respondent fixed effects. This suggests that there is considerable noise in our time preference data. The respondent characteristics improve the fit of the random effects model only marginally. Consistent with Olson and Bailey (1981), Lawrence (1991), and Becker and Mulligan (1997), higher incomes are associated with greater patience (10 percent level). None of the other respondent characteristics are significant.

As described in the previous section, each respondent faced eight risky decisions. Thus, for each individual we have eight incentive compatible measures of risk aversion. These measures each take the form of a certainty equivalent. A higher certainty equivalent corresponds to a lower level of risk aversion.

Figure 3 shows the frequency distributions of the certainty equivalents for each decision. Each row in Figure 3 corresponds to a different gamble. The risky option in the first row is Ch$3000 with a probability of 1/6 and Ch$1000 with a probability 5/6. The risky option in the second row is Ch$3000 with a probability of 1/2 and Ch$1000 with a probability 1/2. In the third row it is Ch$3000 with a probability of 5/6 and Ch$1000 with a probability 1/6 and in the fourth row it is Ch$5000 with a probability of 1/2 and Ch$2000 with a probability 1/2. Thus the expected value of the risky option increases as we move down the page. The left-hand column corresponds to the investment frame and the right-hand column to the insurance frame.

As one would expect, the distributions of certainty equivalents shift right as the expected value of the risky option increases. Our respondents required higher certainty equivalents for risks with higher expected values. In addition, the distributions shift to the right as we move from the investment to the insurance frame. Our respondents required higher certainty equivalents, i.e., appear less risk averse when the gambles were framed as insurance decisions.

[9] The sum of the coefficients on *Probed* and *Probed*Now* is not significantly different from zero at the 10 percent level. Restricting the effect of probing to be the same for the two delay-related decisions and the same for the two speed-up-related questions was accepted by the data.

These results are confirmed by the fixed and random effects regressions in Table 2. All the regressions contain four treatment variables. *Gamble2*, *Gamble3*, and *Gamble4* are dummies that each take the value 1 for the gamble in the corresponding row of Table 2 and zero otherwise. *Insurance* is a dummy that takes the value 1 for the insurance frame and zero otherwise. The certainty equivalents vary significantly (0.1 percent level) from one gamble to another and increase with expected value. Further, the certainty equivalents are significantly (0.1 percent level) greater in the insurance frame.[10] Note that just over 40 percent of the variation in the certainty equivalents is accounted for by the treatment variables and respondent fixed effects. In the third column we introduce respondents' characteristics into the random effects model. Once again, this third regression should not be interpreted as a causal model. Any significant results relating to the respondents' characteristics should be viewed as descriptive only. The respondent characteristics improve the fit of the random effects model only marginally - only education has a significant (5 percent level) coefficient.

B. Individual Preferences, Self-Employment, and Pension Contributions: Comparisons of Means and Non-Parametric Tests

The focus of analysis involves a comparison across employment categories and between contributors and non-contributors to the pension system. For this we need a single proxy for each of the preference parameters of interest. The fixed effects regressions presented above could be used to construct such measures. However, a careful comparison of the 'within', 'between', and 'overall' R-squared goodness-of-fit measures, suggests that the fixed effects may not be well defined. This being the case, we choose the one measure among the other eight for each parameter that most often yields significant results in the analyses that follow. The justification for this selection criterion is that several of the conclusions we present below depend on the power rather than the significance of the statistical tests we apply. The chosen measures are, for time preferences, the discount rate for a delay of twelve months on three million Chilean Pesos and, for risk preferences, the certainty equivalent relating to the fourth insurance decision.

According to the first of these measures, the mean subjective discount rate for our sample is 43 percent. This compares well with both the micro-finance industry rates (32.9 to 39.3 percent per annum) and the ceiling on the retail-lending rate imposed by the banking industry regulator, 46.7 percent per annum, that prevailed at the time of the study.[11] In Table 3, we present the mean subjective discount rates for four sub-samples of our respondents, non-contributing employees, contributing employees, non-contributing self-employed, and contributing self-employed, and for various unions of these sub-samples. The table also contains the results of a series of two- and one-tailed tests that correspond to the hypotheses presented in Section III. The mean subjective discount rate varies only marginally and not significantly between employees and the self-employed. The rate varies somewhat but not significantly between waged and salaried non-contributors and contributors, whereas self-employed contributors have a considerably and significantly (2

[10] The null hypothesis that moving from the investment to the insurance frame had the same effect in all gambles was accepted at the 40 percent level.

[11] The ceiling rate is referred to as the " interes maximo convencional" and can be found on the regulator's web page, *www.sbif.cl*

percent level on a two-tailed test, 1 percent level on a one-tailed test) lower subjective discount rate than self-employed non-contributors. The mean subjective discount rate for the contributing self-employed is also significantly below that of contributing employees (14 percent level on a two-tailed test, 7 percent level on a one-tailed test).

The frequency distributions of subjective discount rates for our various sub-samples are presented in Figures 4 and 5. They suggest that the normality assumption underlying the t-test may not be valid and that the power of the test may be compromised as a result. The graphs in Figure 4 do, however, indicate no clear distinction in time preferences between the two agent types, while those in Figure 5 clearly reveal the difference between contributors and non-contributors among the self-employed – the former appear more patient than the latter. In contrast, there appears to be no difference between contributors and non-contributors among employees. Some additional support for these observations and the t-test results is provided by a series of Epps-Singleton (1986) non-parametric tests presented in Table 4. These indicate that there is no significant difference between the self-employed and employees with respect to their distributions of time preferences; that there is no significant difference between contributing and non-contributing employees; that contributing and non-contributing self-employed are significantly different (9 percent significance level); but that self-employed and employee contributors are not significantly different.

In Table 5 we present the mean certainty equivalent measures of risk preferences for our four sub-samples of respondents and relevant unions of those sub-samples. The pattern of risk preferences that emerges is strikingly similar to that observed when considering time preferences. The mean certainty equivalent varies only marginally and not significantly between employees and the self-employed. It also varies only marginally and not significantly between contributors and non-contributors. The only group with a significantly different mean certainty equivalent is the contributing self-employed. Their mean certainty equivalent is significantly *above* that of both contributing employees (3 percent level on a two-tailed test, 1 percent level on a one-tailed test) and non-contributing self-employed (1 percent level on a two-tailed test, 1 percent level on a one-tailed test).

The frequency distributions of our measure of risk preferences for the various sub-samples of respondents are presented in Figures 6 and 7. These give us no reason to doubt the results of the t-tests, although, once again, the validity of the normality assumption is called into question. This notwithstanding, the Epps-Singleton test results presented in Table 6 fully concur with the t-test results: there is no significant difference between the self-employed and employees with respect to their distributions of risk preferences; there is no significant difference between contributing and non-contributing employees; contributing and non-contributing self-employed are significantly different (1 percent level); and self-employed and employee contributors are significantly different (4 percent level).

C. Individual Preferences, Self-Employment, and Contribution to the Pension System: Controlling for Other Factors

Before drawing any conclusions we need to check that the significant variations in preferences across sub-samples are not spurious and that, where no significant variation is observed, this is not due to uncontrolled variation relating to other factors. Above, we

identified significant relationships between time preferences and income on the one hand, and risk preferences and education on the other. We need to control for these relationships in our current analysis in order that we may be sure of the extent to which agents are sorting into different employment categories and into contributors and non-contributors according to preferences. Table 7 contains three probit regressions. The regression in the first column takes a dummy variable indicating whether an individual is self-employed or not as the dependent variable. The other two regressions take a dummy variable indicating whether an individual is contributing to a pension scheme or not as the dependent variable. In the second column the sample is restricted to the self-employed, while in the third it is restricted to waged and salaried employees. As before, these regressions should not be treated as causal models but as controlled or conditional correlations.

In the first column we see that after controlling for income, education, age, location, sex, and marital status, there remains no evidence of a variation in preferences between the self-employed and waged and salaried employees. The p-values relating to time and risk preferences in this regression are 0.58 and 0.41 respectively. The regression in the second column indicates that after controlling for income, education, age, location, sex, and marital status, the evidence of a significant variation in preferences between self-employed contributors and non-contributors remains. The p-values relating to time and risk preferences in this regression are 0.08 and 0.07 respectively. The regression also indicates that it is the more patient, more risk tolerant self-employed who contribute. Finally, the regression in the third column indicates that, while other factors such as education and sex vary between employee contributors and non-contributors, preferences do not. The p-values relating to time and risk preferences in this regression are 0.33 and 0.92 respectively.

V. Summary and Conclusions

Our aim in this paper has been to show how, by directly measuring preferences using field experiments and questions relating to hypothetical situations, we might establish which agents are free to reveal their preferences and which are not. This information could be of value to the designers of parsimonious but effective welfare monitoring programmes for policy interventions. We demonstrated the proposed techniques by exploring three questions relating to the decision to save and invest for retirement in the Chilean pension system of privately managed individual accounts. Those questions were (1) are employees and the self-employed distinct in terms of preferences, (2) are employees truly rationed in the sense that whether they contribute to a pension system is not determined by their preferences, and (3) are the self employed unrationed in the sense that whether they contribute to a pension system or not *is* determined by their preferences?

Our findings suggest that the answer to first question is 'no'. There is no significant difference in mean risk and time preferences between the self-employed and waged employees. Potentially more powerful non-parametric tests that take account of the full distributions of preferences confirm this result, as does a regression analysis in which we also control for other factors such as income, education, age, sex and marital status.

Our findings suggest that the answer to the second question should be 'yes'. There is no significant difference in mean risk and time preferences between contributing and non-contributing waged employees and, once again, this result is confirmed by potentially more powerful non-parametric tests and a regression analysis in which we control for the other factors listed above.

Finally, our findings suggest that the answer to the third question should also be 'yes'. Mean risk and time preferences do vary significantly between the contributing and non-contributing self-employed. Once again, this result is confirmed by the non-parametric tests and a regression analysis in which we control for other factors. Consistent with theory, it is the more patient self-employed who choose to contribute to the pension system. However, in conflict with the assumption that the formal pension system is the only source of insurance against poverty in old age, self-employed contributors are significantly more tolerant of risk than the non-contributing self-employed.

This last finding suggests that the Chilean pension system may be viewed with some trepidation by its pool of potential clients. This may be because those who are more risk averse prefer to rely on alternative, traditional, family-based forms of social security or may be deterred by the financial risks associated with the capital markets in which retirement savings are invested under the reformed system.

Alternatively, these potential clients may be poorly informed about the system and the performance of the private fund managers who, despite the substantial variability in real annual returns shown in Figure 8, have earned a real average annual return of 11 percent for participants since the inception of the system (SAFP, 1999). Bearing in mind that risk aversion declines with education, the participation of the economically active who are free to choose could be enhanced by a campaign carefully designed to raise awareness, allay fears, and inform people of the benefits of saving for retirement in the formal pension system. Finally, our findings motivate a closer look at the informal strategies the self-employed may be using to insure against poverty when they lose the ability to work with old age.

The Chilean study effectively demonstrates the value of measuring preferences directly and analyzing the resulting data in conjunction with simple survey data. We have shown that our findings are robust to different methods of analysis and to the inclusion of additional variables as controls. This notwithstanding, there is a need for caution. Two out of three of our conclusions are dependent on the power, rather than the significance of the statistical tests we apply. With a larger sample size, significant variation between agent types might be observed where currently it is not. We are confident that, even if a larger study found some variation in preferences between contributing and non-contributing waged employees, it would conclude that the self-employed are better able to reveal their preferences and are, thus, a much more interesting focus for a monitoring exercise. However, the slightest hint of variation in preferences between waged employees and the self-employed would cast doubt on the appropriateness of a study focused exclusively on the self-employed, as it would warn against drawing of inferences about the welfare of the former from the behaviour of the latter.

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Table 1: Regression analysis of subjective discount rates from hypothetical questions relating to time preferences

	fixed effects		random effects		random effects	
	Coef.	**s.e.**	**Coef.**	**s.e.**	**Coef.**	**s.e.**
Constant	0.439	0.029 ***	0.439	0.033 ***	0.374	0.103 ***
Probed	-0.098	0.033 ***	-0.098	0.033 ***	-0.098	0.033 ***
Now	-0.298	0.041 ***	-0.298	0.041 ***	-0.297	0.041 ***
Shorter	0.074	0.033 **	0.074	0.033 **	0.074	0.033 **
Smaller	0.271	0.033 ***	0.271	0.033 ***	0.275	0.033 ***
Probed x Now	0.145	0.047 ***	0.145	0.047 ***	0.146	0.047 ***
Income					-0.070	0.039 *
Age					0.001	0.002
Yrs of ed.					0.005	0.006
Female					0.015	0.044
Rural					0.057	0.050
Married					0.012	0.044
R-sq:						
within	0.146		0.146		0.147	
between	$< 1.0e^{-4}$		$< 1.0e^{-4}$		0.023	
overall	0.107		0.107		0.114	
Observations	1840		1840		1832	
Individuals	230		230		229	

Probed	Dummy which takes the value 1 if the interviewer probed.
Now	Dummy which takes the value 1 if the question elicited a current equivalent of an amount of money available in the future and the value 0 if the questions deals with a delay.
Shorter	Dummy which takes the value 1 if the period of time in question is 3 months and the value 0 if the time period is one year
Smaller	Dummy which takes the value 1 if the questions relates to $300,000 and the value 0 if the questions relates to $3,000,000
Income	Total monthly income of individual in millions of Chilean Pesos adjusted in accordance with CEPAL (1999)
Age	Age in years of individual
Yrs of ed.	Number of years of formal education of individual
Female	Dummy which takes the value 1 for females
Rural	Dummy which takes the value 1 for respondent in a rural area
Married	Dummy which takes the value 1 for married respondents

Notes: *** - significant at the 1% level; ** - significant at the 5% level; * - significant at the 10% level.

Table 2: Regression analysis of certainty equivalents from risk tolerance experiments

	fixed effects			random effects			random effects		
	Coef.	**s.e.**		**Coef.**	**s.e.**		**Coef.**	**s.e.**	
Constant	1665.892	32.214	***	1667.527	41.576	***	1347.917	148.102	***
Gamble2	341.641	40.807	***	340.053	40.905	***	335.859	40.916	***
Gamble3	868.242	40.834	***	866.905	40.930	***	865.484	40.942	***
Gamble4	1638.310	40.871	***	1634.263	40.946	***	1625.817	40.958	***
Insurance	113.030	28.915	***	111.894	28.972	***	112.735	28.980	***
Income							32.187	56.788	
Age							1.810	2.436	
Yrs of ed.							19.531	8.642	**
Female							-33.409	64.704	
Rural							66.132	73.868	
Married							78.972	63.915	
R-sq:									
within	0.540			0.540			0.539		
between	0.003			0.003			0.021		
overall	0.416			0.416			0.426		
Observations	1800			1800			1792		
Individuals	229			229			228		

Gamble2	Dummy which takes the value 1 for decisions in which the risky option is $3000 with a probability of 1/2 and $1000 with a probability 1/2.
Gamble3	Dummy which takes the value 1 for decisions in which the risky option is $3000 with a probability of 5/6 and $1000 with a probability 1/6
Gamble4	Dummy which takes the value 1 for decisions in which the risky option is $5000 with a probability of 1/2 and $2000 with a probability 1/2.
Insurance	Dummy which takes the value 1 for decisions framed as insurance decisions.
Income	Total monthly income of individual in millions of Chilean Pesos adjusted in accordance with CEPAL (1999)
Age	Age in years of individual
Yrs of ed.	Number of years of formal education of individual
Female	Dummy which takes the value 1 for females
Rural	Dummy which takes the value 1 for respondent in a rural area
Married	Dummy which takes the value 1 for married respondents

Notes: *** - significant at the 1% level; ** - significant at the 5% level; * - significant at the 10% level.

Table 3: Comparison of time preferences between employees and self-employed who are and are not contributing to pension funds

	Non-contributing	Contributing	All
Employees	47%	39%	43%
	(57)	(81)	(138)
Self-employed	47%	27%	43%
	(72)	(20)	(92)
All	47%	37%	43%
	(129)	(101)	(230)

Tests of differences in means with equal variance not assumed
(two-tailed test P-values reported first, one-tailed test P-values in square brackets)

Hypotheses		**P-value**
1.	Ho: Waged/salaried employees and the self-employed have the same time preferences	98% [51%]
2.	Ho: Among waged/salaried employees, non-contributors and contributors have the same time preferences	29% [14%]
3.	Ho: Among the self-employed, non-contributors and contributors have the same time preferences	2% [1%]
4.	Ho: Among contributors waged/salaried employees and self-employed have the same time preferences	14% [7%]

Notes: Number of observations reported in curved brackets.

Table 4. Results of Epps-Singleton non-parametric tests for significant difference between samples w.r.t. the distribution of time preference

	Time Preference	
Hypotheses		***P-values (two-tailed test)***
1.	Ho: The time preferences of waged/salaried employees and the self-employed are identically distributed	11%
2.	Ho: The time preferences of waged/salaried employee non-contributors and contributors are identically distributed	50%
3.	Ho: The time preferences of self-employed non-contributors and contributors are identically distributed	9%
4.	Ho: The time preferences of waged/salaried employees and self-employed are identically distributed	11%

Table 5: Comparison of risk tolerance between employees and self-employed who are and are not contributing to pension funds

	Non-contributing	Contributing	All
Employees	3457.14	3450.00	3452.94
	(56)	(80)	(136)
Self-employed	3333.33	3860.00	3451.68
	(69)	(20)	(89)
All	3388.80	3532.00	3452.44
	(125)	(100)	(225)

Tests of differences in means with equal variance not assumed
(two-tailed test P-values reported first, one-tailed test P-values in square brackets)

Hypotheses		**P-value**
1.	Ho: Waged/salaried employees and the self-employed are equally risk averse	99% [50%]
2.	Ho: Among waged/salaried employees non-contributors and contributors are equally risk averse	96% [48%]
3.	Ho: Among the self-employed non-contributors and contributors are equally risk averse	1% [1%]
4.	Ho: Among contributors waged/salaried employees and self-employed are equally risk averse	3% [1%]

Notes: Number of observations reported in curved brackets.

Table 6: Results of Epps-Singleton non-parametric tests for significant difference between samples w.r.t. distribution of risk preferences

	Risk Aversion	
Hypotheses		***P-values (two tailed test)***
1.	Ho: The risk preferences of waged/salaried employees and the self-employed are identically distributed	56%
2.	Ho: The risk preferences of waged/salaried employees non-contributors and contributors are identically distributed	96%
3.	Ho: The risk preferences of self-employed non-contributors and contributors are identically distributed	1%
4.	Ho: The risk preferences of waged/salaried employees and self-employed identically distributed	4%

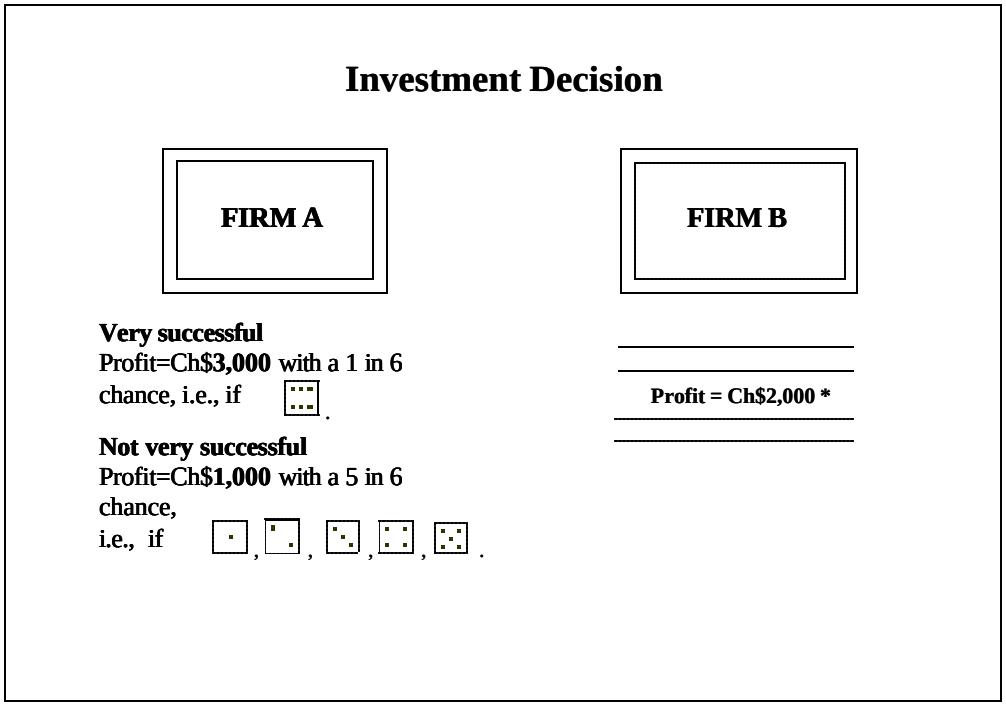
Table 7: Probability of Self Employment, Self Employed Contributor, Employed Contributor

Dependent Var.	Self Employed		Contributing Self Employed		Contributing Employee	
	Coef.	**s.e.**	**Coef.**	**s.e.**	**Coef.**	**s.e.**
Constant	-1.655	0.572***	-1.916	0.921	-1.412	0.835
Income	0.347	0.211*	0.334	0.217	0.740	0.611
Yrs of ed.	0.055	0.026**	0.052	0.044	0.142	0.039***
Age	0.025	0.008***	-0.024	0.016	0.012	0.011
Rural	0.231	0.224	-0.056	0.429	-0.086	0.313
Female	-0.434	0.195**	0.211	0.393	-0.614	0.247***
Married	0.172	0.191	0.501	0.413	0.345	0.245
Time pref	-0.113	0.206	-1.112	0.636*	-0.269	0.273
Risk pref	$-8.3e^{-05}$	$1.0e^{-04}$	$3.8e^{-04}$	$2.1e^{-04}$*	$-1.3e^{-05}$	$1.3e^{-04}$
Number of obs		225		88		136
Log likelihood		-135.861		-36.891		-76.361
Wald chi2(8)		28.810		16.780		27.920
Prob > chi2		0.000		0.032		0.001
Pseudo R2		0.100		0.218		0.171

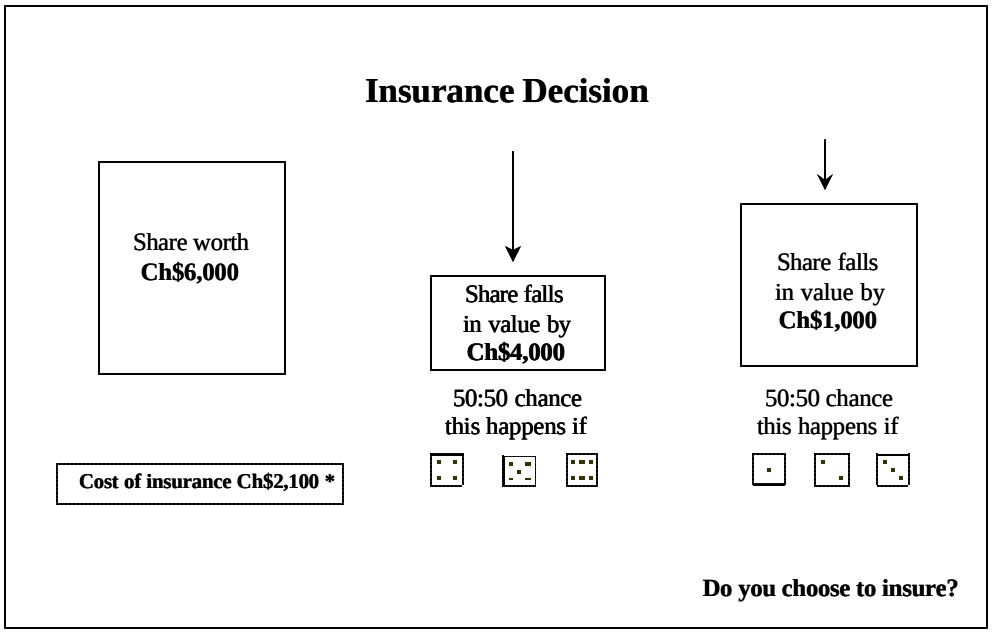
Income	Total monthly income of individual in millions of Chilean Pesos adjusted in accordance with CEPAL (1999)
Yrs of ed.	Number of years of formal education of individual
Age	Age in years of individual
Rural	Dummy which takes the value 1 for respondent in a rural area
Female	Dummy which takes the value 1 for females
Married	Dummy which takes the value 1 for married respondents
Time pref	Subjective discount rate (preferred measure)
Risk pref	Certainty equivalent (preferred measure)

Notes:
*** - significant at the 1% level; ** - significant at the 5% level; * - significant at the 10% level.
Standard errors are adjusted for heteroskedas ticity using White's (1980) estimate of covariance matrix

Figure 1: Decision card for risk aversion experiments – investment and insurance frames



* - The amount of profit varies over the course of the task



* - The cost of insurance varies over the course of the task.

Figure 2: Frequency Distributions for Subjective discount Rates for Time Preference Decisions

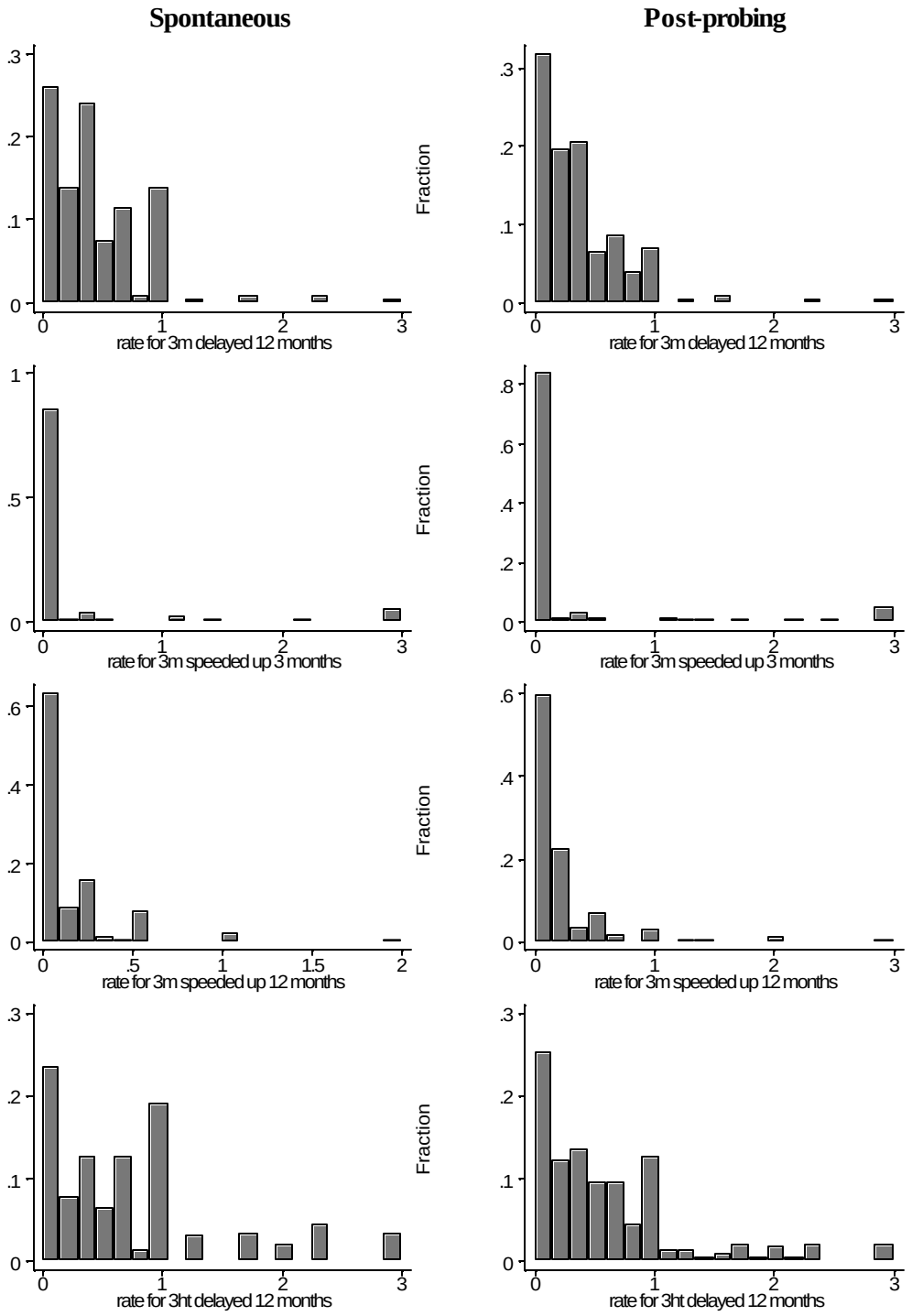


Figure 3: Frequency Distributions of Certainty Equivalents for Risky Decisions

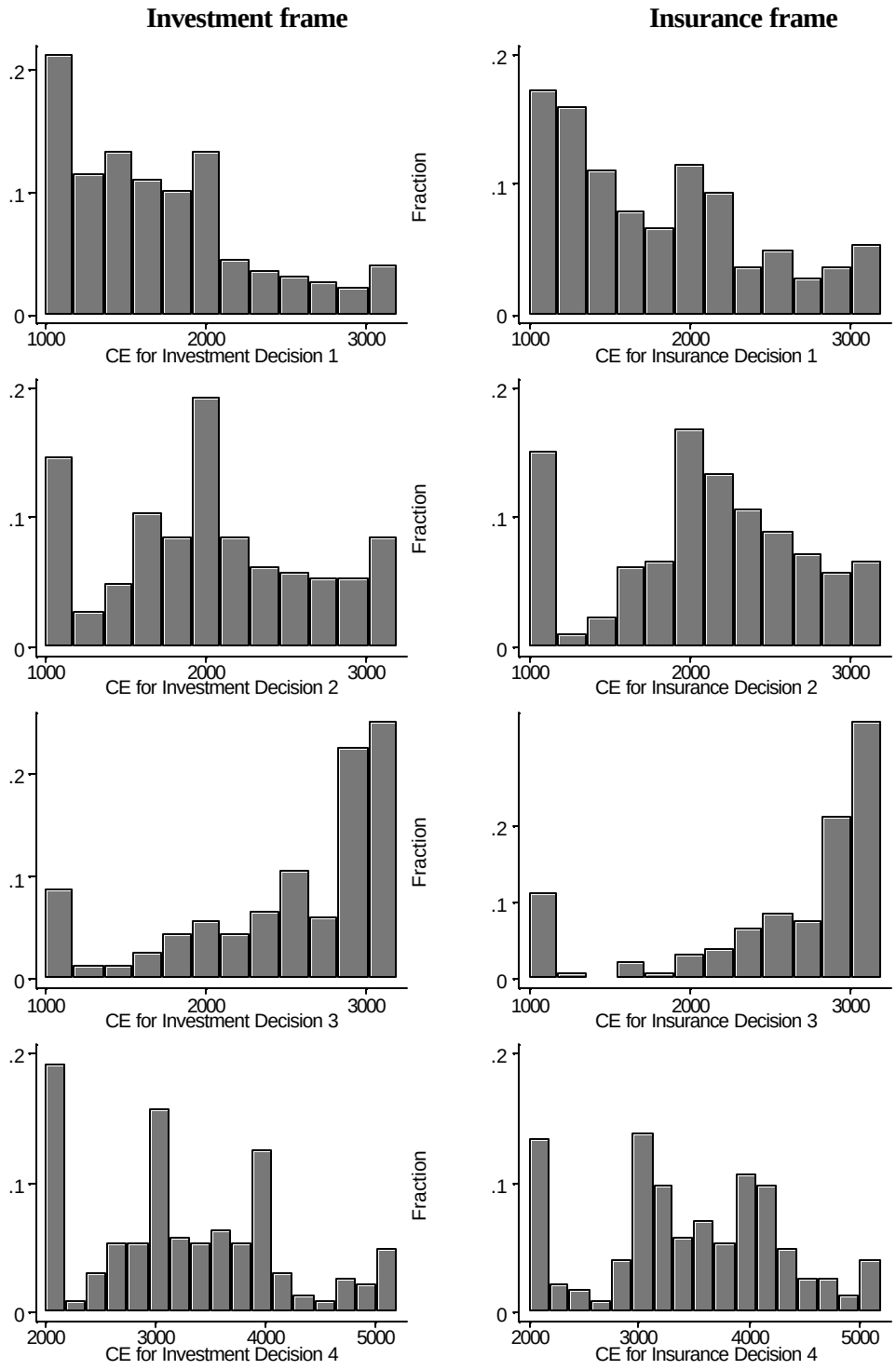


Figure 4: Individual Subjective Discount Rates for Employees and Self-employed

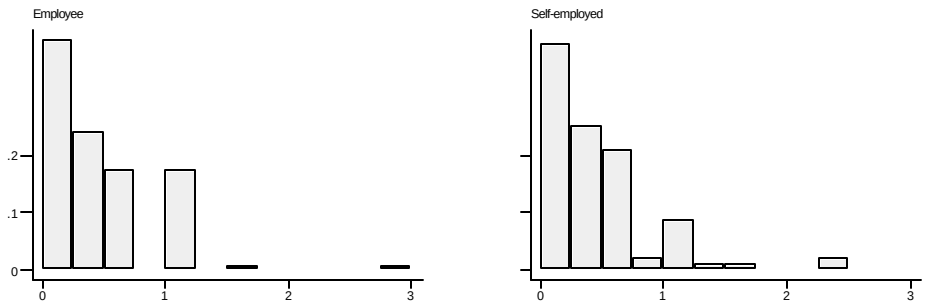


Figure 5: Comparison of Subjective Discount Rates between Employed and Self Employed, and Contributors and Non-contributors to Pension Funds

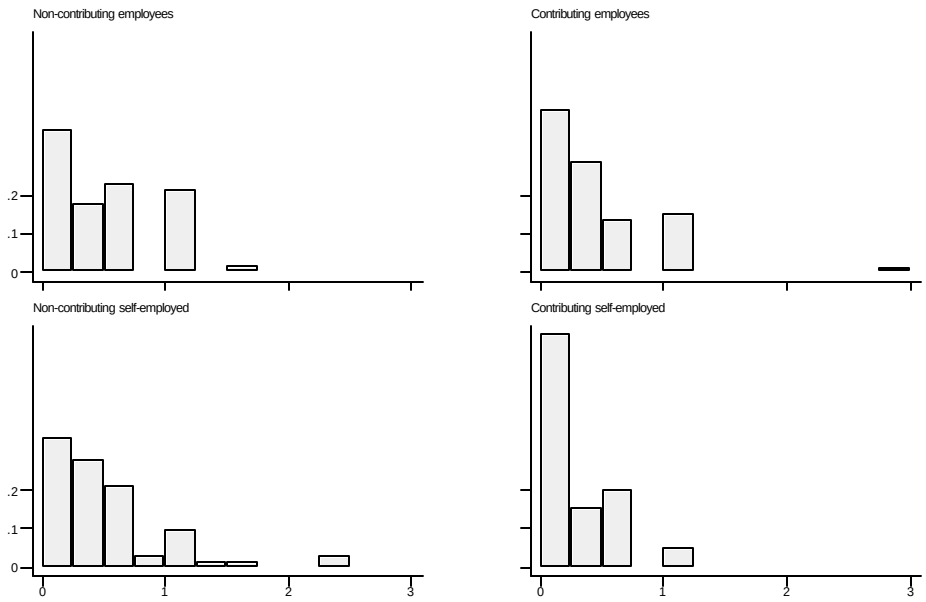


Figure 6: Individual Certainty Equivalents for Employees and the Self Employed

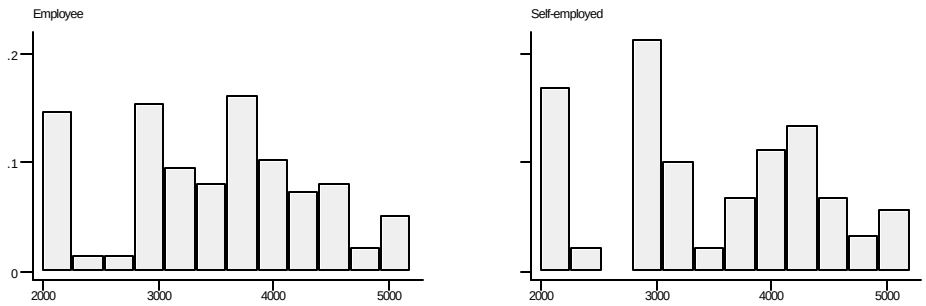


Figure 7: Comparison of Certainty Equivalents between Employed and Self Employed, and Contributors and Non-contributors to Pension Funds

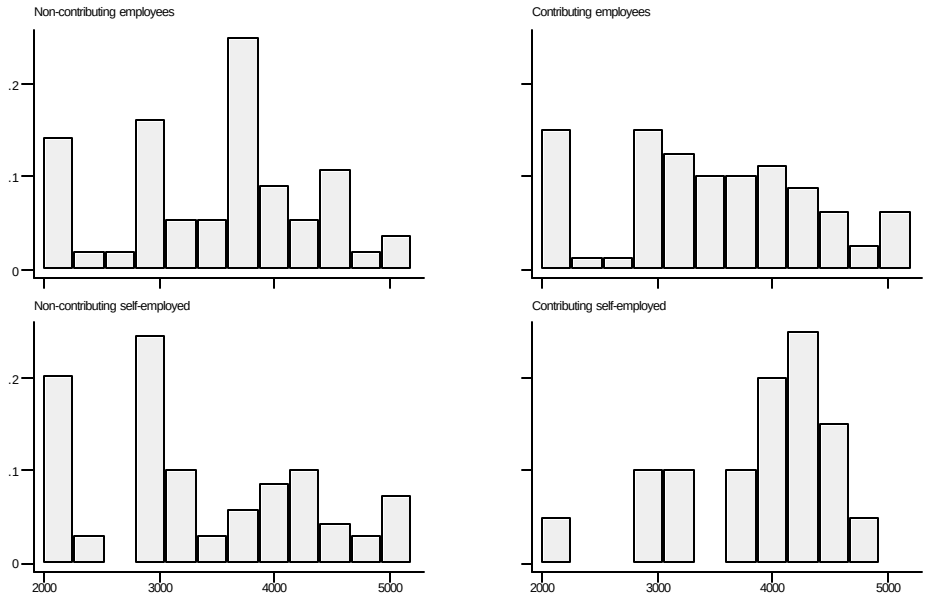


Figure 8: Real rate of return in Chilean pension system (AFP Industry Average), 1981 – 2000