The effects of social security privatization on consumption, saving and welfare: evidence from Peru

by

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Abstract

This thesis is an empirical study of the privatization of social security in Peru, with a particular emphasis on consumption, saving and welfare. The first chapter provides a general description of the reform and positions it as a valuable study case. The second chapter evaluates the effect of the privatization on the well-being of the elderly and their dependents immediately after the reform, when social security was moving from a steady state to the other. It concludes that the effect was positive, although the larger impact was experienced neither by the poorest households nor by the oldest households. The third chapter, instead of evaluating the reform, uses the variability provided by the reform to analyze an old economic question: to what extent pension saving crowds out voluntary saving. It finds that for every dollar of insurance provided by the pension system, voluntary savings decrease by 70 cents to one dollar. I now turn to describe each chapter in detail.

The first chapter describes the Peruvian social security privatization, which includes the introduction of the funded system in 1992 and the consequent modifications in the pre-existing pay-as-you-go systems. I argue that this reform is a valuable study case for a number of reasons. First, the reform was a source of a large and heterogeneous variation on both current and expected pension benefits. Contrarily, reforms within pay-as-you-go systems usually imply a general (positive or negative) effect on pension benefits. Second, the segmentation of the Peruvian labor market, in terms of a formal and informal sector, provides a valuable control group: individuals working in the informal sector, which are not covered by social security before and after the reform. Third, although official data is neither complete nor fully reliable, excellent micro-data is available from the Living Standards Measurement Study (LSMS) survey, which was developed by the World Bank. The data neatly capture the periods before and after the reform. Hence, this chapter provides the basis for the empirical analyses of the subsequent chapters of the thesis.

The second chapter estimates the effect of the Peruvian social security privatization on well-being of the elderly and their dependents during the transition period. Rather than comparing the pay-as-you-go and the funded systems in steady state, I examine the privatization effect for the generation that received pension benefits when those that sustained the pay-as-you-go migrated to the funded system. Using four repeated cross-sections of the LSMS, I estimate a difference-in-differences for consumption, where the treatment group is composed by households covered by social security (in this chapter, coverage is defined as the reception of pension benefits) and the control group is composed by households not covered. The

results show that consumption rose significantly by 17.81% for the average covered household after privatization. A closer examination describes the characteristics of the privatization effect. First, it increases with the education level of the household head. Second, quantile regressions show that it increases with consumption. Third, the larger effect was not experienced by the households with the oldest heads, but by those with heads between 50 and 60 years old. Finally, the dynamics of the effect shows that it did not respond to the purpose of the reforms of the pay-as-you-go systems, which was cutting pension benefits indeed.

The third chapter estimates the crowding out of pension wealth on voluntary saving using the Peruvian social security privatization as a natural experiment. Using three repeated cross-sections of the LSMS, I regress the household voluntary saving rate on an estimate of household pension wealth. I instrument pension wealth, using a Heckman selection model as the first stage, using occupation and industry of the primary earning in the household. The identifying variation for the crowding out of voluntary savings by pension savings comes from two sources: 1) the segmentation of the Peruvian labor market, which divides the sample in households covered and uncovered by social security (in this chapter, coverage is defined as the enrolment to social security); and 2) the dissimilar effects the reform had on covered households in accordance to income and age. The results confirm the basic predictions of the life cycle model. Pension wealth has a negative effect on voluntary savings and the size of this effect increases with age. The offset is estimated to be between 70% and 100%. These results are substantially more precise than those in previous studies because of variation coming from the large scale of the Peruvian social security reform.

Contents

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Chapter 1

Social security privatization in Peru

1.1 Description of the reform

1.1.1 The prior systems

The Peruvian pension system was created in the early seventies out of the unification of dispersed pre-existing schemes. A two-plan model was adopted, with two purely public pension systems operated on a pay-as-you-go basis. One system[1] had no restriction on membership and covered all private-sector workers and many civil servants (open pay-as-you-go), while the other system[2] was limited to special groups of civil servants (closed pay-as-you-go).

The open system required a minimum number of contribution years to be eligible to receive pension benefits (15 for men and 12.5 for women) and a minimum retirement age (60 for males and 55 for females). Pension benefits were determined ex-ante through a legal formula that yields pensions proportional to an average of final salaries. The system also included a minimum pension and a maximum pension, which had the purpose of introducing income redistribution.

The closed system required a minimum number of contribution years to receive pension benefits (15 years for males and 12.5 years for females), but did not demand a minimum retirement age. Pension benefits were equal to the wage received in the last position the retiree held, and benefits were adjusted whenever this wage was adjusted. Thus, the purpose of this system was providing generous pension benefits to selected groups of civil servants.

The open and closed systems both suffered from political manipulation, inappropriate management and corruption problems. In the open system, the redistributive purpose was compromised. In the

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[1] National Pension System, created by Law 19990 in 1973.
[2] Cédula Viva System, created by Law 20530 in 1974.

closed system, a number of laws included new groups of civil servants (in spite of its closed nature) and relaxed the accessibility conditions to pension benefits. These changes, which were introduced in political cronyism, made pension debt to become a large item in the government budget.

1.1.2   The funded system

The Alberto Fujimori administration (1990-2000) lunched into radical and wide-ranging liberal reforms. The implemented liberal reforms were not presented by Fujimori during the political campaign, but rather criticized by him as the core of his political strategy against the liberal candidate Mario Vargas Llosa. The World Bank (WB) and the International Monetary Fund (IMF) played an important role in the turn of Fujimori to market-friendly policies, including social security privatization (see Bowen, 2000). These institutions proposed this privatization and actively promoted it, providing project lending and supplying technical assistance (see World Bank, 1994 and 2004).

The introduced funded system does not require a minimum number of contribution years to be eligible to receive pension benefits, but only a minimum retirement age (65 for males and females). The private funded system[3] is a scheme of individual savings accounts, with defined contributions and managed by private pension fund administrators. Pension benefits are the result of individual saving and the return on those savings. Additionally to these resources, individuals switching from the pay-as-you-go to the funded system are entitled to recognition bonds if they have made a minimum number of past contributions (Appendix A provides the pension formula). Hence, Peru was the second country to privatize social security, a reform conducted by 28 countries in the last years.

As opposed to other countries that phased out the pay-as-you-go system or that created a unified multiple pillars system, the Peruvian funded system coexists with the open pay-as-you-go[4]. Newcomers in the labor force are able to select their preferred system between the open pay-as-you-go and funded system, while current workers are allowed to stay in the pay-as-you-go systems and to switch to the funded system[5]. Pensioners have no incentives to switch to the funded system, given its capitalization nature.

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[3] Private Pension System, created by Law Decree N°25897 in 1993.

[4] Mesa-Lago (2001) divided structural reforms in Latin America into three main groups: 1) the substitutive model, where the former public system is closed down and substituted with a private system based on individual fully funded (Chile, Bolivia, El Salvador and Mexico); 2) the mixed model, where a complementary fully funded component is introduced within a reformed public system (Argentina and Uruguay); and c) parallel model, where the public system is not closed but reformed and becomes an alternative option to a private system based on individual fully funded (Peru and Colombia).

[5] However, the right to choose is partially constrained because it was forbidden to switch back from the funded system to the pay-as-you-go system.

1.1.3 The transition

The introduction of the funded system in Peru, as all privatization processes, started a transition period. After privatization, individuals that sustained the pay-as-you-go system migrate to the funded system, so that the individual accounts of the funded system are financed from revenue previously devoted to the collective fund of the pay-as-you-go system. Since there are no internal resources to continue paying the benefits promised to retirees and older workers that remain under the pay-as-you-go system, the gap is covered by resources external to the pension system, such as foreign debt. The transition period ends when no more resources external to social security are needed to respect the accrued rights of the elderly.

The lack of internal resources to respect pension benefits that characterizes the transition, as well as the own problems of the two pay-as-you-go systems, made the reform not intended to be revenue-neutral. In fact it was an objective of the legislative changes to restrict the generosity of the pay-as-you-go systems, as well as to provide more redistributive pension benefits. The sequence of modifications to accomplish these goals was the following:

- Open pay-as-you-go system (1992)[6]. It made less flexible the accessibility conditions to pension benefits and changed the legal formula. Prior to the reform, males with 15 years of contribution or females with 13 were eligible for pension. The reform restricted pension access to individuals with 20 years of contribution, regardless of gender. Additionally, the legal formula was changed to make pensions depend on a different average of final salaries (Appendix A provides the pension formula both before and after the reform).

- Open pay-as-you-go (1995)[7]. It introduced minor corrective measures to strengthen the competitiveness of the funded system with respect to the pay-as-you-go system. The contribution rate and retirement age of the latter were taken to equal levels with the former. Originally, the contribution rate was 11% of income in the pay-as-you-go system, while it was approximately 13% in the funded system. After this law, the contribution rate was fixed in 13% for the pay-as-you-go system (from 1997 on) and approximately 12% for the funded system. Originally, the retirement ages were 60 for males and 55 for females in the pay-as-you-go system, while it was 65 for males and females in the funded system. The legal modification made equal the retirement age of both systems to 65, regardless of gender.

- Closed pay-as-you-go (1996 and 1997)[8]. It introduced three major modifications to purge the

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[6] The reform was introduced by Law Decree N°25967.

[7] The reform was introduced by Law N°26504.

[8] The reform was introduced by Decree Law 817 and Law 26835.

pensions obtained illegally and to cut the generous pension benefits (see Ministerio de Economía y Finanzas - Peru, 2004). First, enrolments to the closed pay-as-you-go were declared null if they had infringed the legal framework. Second, a specialized government agency was given power to recognize pension rights and to audit existing benefits. Third, a maximum pension was introduced equal to the wage of a congressman.

The reform of the two pay-as-you-go systems did not accomplish the same degree of success. While the changes in the open pay-as-you-go system could effectively cut pension benefits and provide more homogeneous pension benefits, the changes in the closed pay-as-you-go system were seriously restricted by Peru's Constitutional Court, which invoked the Theory of Accrued Rights. First, the court settled that pension benefits could not be reviewed if they were provided for more than ten years, thus protecting irregular enrolments. Second, the court ruled out the new power of the specialized government agency, favoring the disorder associated to the multiple management units[9]. Third, the court established that the maximum pension could not be applied retroactively, despite of the financial and actuarial deficit of the closed pay-as-you-go. Although the government reacted by preparing other legal devices, the closed-pay-as-you-go could not be actually reformed until 2004.

1.2 The Peruvian reform as a study case

1.2.1 A source of exogenous variability

The reform had a large effect on both current pension benefits of retired workers and expected pension benefits of active workers. This effect is not easy to observe directly from the legislative changes described in Section 1.1 because the reform implied three different changes: 1) the funded system introduced pension benefits whose computation directly depends on contributions capitalization; 2) the reform within the open pay-as-you-go system cut its generous benefits; and 3) the reform within the closed pay-as-you-go system failed to do the same. In order to see the size of the effect of these changes on pension benefits, Table 1.1 anticipates some summary statistics of the subsequent chapters. On one hand, Chapter 2 will show that the mean of consumption for households with at least one member receiving pension benefits rose from 19395 in 1991 to 25128 in 1994 (Peruvian monetary units in real terms of 2004). Then, Chapter 2 will show that a half of this improvement can be attributed to social security. On the other hand, Chapter 3 will construct a pension wealth variable (that is, the discounted value of expected pension benefits) and will show that the mean for households with at least one active worker enrolled to social security decreased from 37742 in 1991 to 20945 in 1994 (Peruvian monetary units in real terms of 2004).

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[9] A government agency estimated that there were 806 different governmental offices providing benefits by 1996.

Table 1.1: Effects of social security privatization on pension benefits

Variable	1991	1994	1997	2000
Average household consumption*	19395	25128	27218	25657
Average household pension wealth**	37742	20945	23569	

* Urban households with at least one retired worker receiving pension benefits.

** Urban households with at least one active worker enrolled to social security.

The effect of reform on pension benefits was not only large, but also highly heterogeneous. The reform implied three different changes: 1) the funded system provides pension benefits that depends on income positively and on age negatively; 2) the reform within the open pay-as-you-go system corrected the redistribution mechanism by providing pensions relatively monotone on income and age; and 3) the reform within the closed pay-as-you-go system failed to do the same, so that pension benefits kept on being regressive. The subsequent chapters will confirm that privatization changed the redistribution patterns of social security. On one hand, Chapter 2 will show that the privatization effect within households with at least one member receiving pension benefits increases with income: households with higher education levels and higher consumption levels benefited significantly more from the reform. On the other hand, Chapter 3 will use the estimated pension wealth variable to show that the marginal effect of income on pension wealth and the marginal effect of age on pension wealth depend on the pension system the household belongs to (see Figure 3-1).

The Peruvian social security privatization was unexpected, which is sustained by three facts. First, the Peruvian reform was not motivated by projected aging problems compromising its structural sustainability, but it was rather an attempt to protect the system from political manipulation and corruption problems. The evidence does not seem to support the aging motive for pension reforms in developing countries, where the higher fertility rates and the shorter life expectancies make this problem significantly less severe. In developing countries, where reforms have implied going from a public pay-as-you-go system to a private funded system, the main benefits seem to be perceived in the translation of the pension system management, from the public to the private sector[10]. Second, the creation of the funded system corresponded to a general Peruvian policy shift toward market-friendly policies, which were not part of Fujimori's campaign platform. Third, the specific design of the reform was recommended by international financial institutions whose diagnostic was not based specifically on the Peruvian pay-as-you-system situation[11].

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[10] Consistently with this view, the pay-as-you-go system is maintained in countries where corruption problems in the public sector are moderated, but it is replaced with the funded system in countries where they are severe. See Smetters (2005) for a discussion on this subject.

[11] Rofman (2007) says "Peru's political climate under the new Alberto Fujimori administration was strongly pro-privatization. With support from the multilateral financing agencies, the new government implemented pension reform, creating a single-pillar funded scheme".

Even if individuals were expecting solvency problems in the pay-as-you-go system, the Peruvian reform is a valuable natural experiment. Peru was the first country that privatized social security following the recommendations of the IMF and the WB. The reform was based on a rarely known model introduced twelve years ago by Chile, under a completely different international framework. If households were expecting a pension reform, they should have anticipated a reform within the pay-as-you-go systems and not the introduction of a new system. In particular, it is unlikely that they had known who would win and who would lose with this reform, and specially by how much. Assuming that households were expecting a uniform decrease in pension benefits (as generated by most of the reforms within pay-as-you-go systems), the variability provided by the particular Peruvian reform would still be worthy.

1.2.2 Segmentation of the Peruvian labor market

One important problem of Peruvian social security has historically been low coverage rates. Membership to pension systems is legally mandatory for wage workers and voluntary for self-employees. However, the size of the Peruvian informal segment put a large fraction of the labor force outside pension systems. Rofman (2007) points out that in 2002, from a labor force of almost 13 million, only 3.4 million workers were enrolled in any of the three main systems.

Low coverage rates have not been increased by the reform. The root of the problem is that low coverage is not only related with the design of pension systems, but fundamentally with the fragmentation of the Peruvian economy. In fact, individuals uncovered by social security are also outside other established schemes like tax payments, health programs, regulation on minimum wages and job security legislation. Consistently with this view, Morón and Carranza (2005) point out that because Peru has a large informal sector, the target market of pension systems is very narrow.

Although the segmentation of the Peruvian labor market constitutes an important social problem, it also provides a valuable control group. The reform affected the universe of social security subscribers (those that stayed in the pay-as-you-go systems and those that switched to the funded system), but it did not affect the large informal sector. Since there is a group of individuals and households not covered by social security before and after the reform, it is possible to control for other changes in consumption-saving behaviour over the same period.

Notice that the word "coverage" refers to different concepts regarding the scope of analysis. In Chapter 2, which focuses on current pension benefits, coverage is defined as the reception of these benefits by one household member. Chapter 2 will show that 19.9% of the households in the analyzed survey are covered in this first sense. In Chapter 3, which focuses on expected pension benefits, coverage is defined as the enrolment to any pension system by one household member. Chapter 3 will show that

33.4% of the households in the analyzed survey are covered in this second sense.

Table 1.2 compares summary descriptive statistics for covered and uncovered households, using the explained different definitions. Regarding coverage as the reception of pension benefits, there are some important insights. First, the mean of age of household head is larger for the treatment group (63) than for the control group (46) because the former has pensioners among their members. Second, the number of household members are almost the same for the treatment group (4.93) and the control group (5.12), revealing that pensioners tend to live in composite living arrangements. Regarding coverage as the enrolment to pension system, there is one important difference: educational attainment. Covered households are relativelly more educated than uncovered households.

Table 1.2: Mean characteristics of urban households covered and uncovered by social security

Variable	Reception of pension benefits		Enrolment to pension system	
	Uncovered	Covered	Uncovered	Covered
Age	46.29	63.29	49.29	48.13
	(13.45)	(12.51)	(15.41)	(12.96)
Gender (Female=1)	0.18	0.23	0.21	0.14
	(0.39)	(0.42)	(0.41)	(0.35)
Educational attainment:				
None	0.04	0.03	0.06	0.02
	(0.21)	(0.17)	(0.23)	(0.14)
Primary school	0.32	0.33	0.37	0.22
	(0.47)	(0.47)	(0.48)	(0.42)
High school	0.41	0.33	0.41	0.37
	(0.49)	(0.47)	(0.49)	(0.48)
Technical institute	0.08	0.09	0.06	0.12
	(0.27)	(0.29)	(0.23)	(0.33)
University	0.15	0.22	0.11	0.26
	(0.35)	(0.41)	(0.31)	(0.44)
Family size	5.12	4.93	4.99	5.43
	(2.21)	(2.52)	(2.32)	(2.23)
N	7327	1679	4434	1958

Notes: The calculations for the first two columns are from the LSMS Peru 1991, 1994, 1997 and 2000.
The calculations for the last two columns are from the LSMS Peru 1991, 1994 and 1997.
The standard errors are in parentheses. All numbers are weighted.

1.2.3 Relevant pension systems by scope of analysis

Unfortunately, official data on the number of social security participants before the reform is not available and official data on the number of participants after the reform is neither complete nor fully reliable. However, the available data after the reform provides important information for empirical research: an analysis on active workers should primarily focus on the evolution of the open pay-as-you-go and funded systems, while an analysis on retired workers (at least during the first years after the reform) should

primarily focus on the evolution of the open and closed pay-as-you go systems.

The previous statement is based on the official number of active and retired workers by pension system. Panel A of Figure 1-1 shows the evolution of the number of active workers by pension system. It shows a rapid enrolment to the funded system in contrast to a slow enrolment to the open pay-as-you-go system, which lost several participants in the previous years (as it was just said, there is no official data on this drop). It also shows the insignificant number of active workers subscribed to the closed pay-as-you-go system in accordance to its close nature (there is official data only for 1997 and 2003). Panel B of Figure 1-1 shows the evolution of the number of retired workers by pension system. It highlights the importance of both the open and the closed pay-as-you-go systems in the provision of pension benefits during the period immediately after the reform, as well as the new and slow participation of those receiving pension benefits from the funded system.

Figure 1-1: Number of active and retired workers by social security system
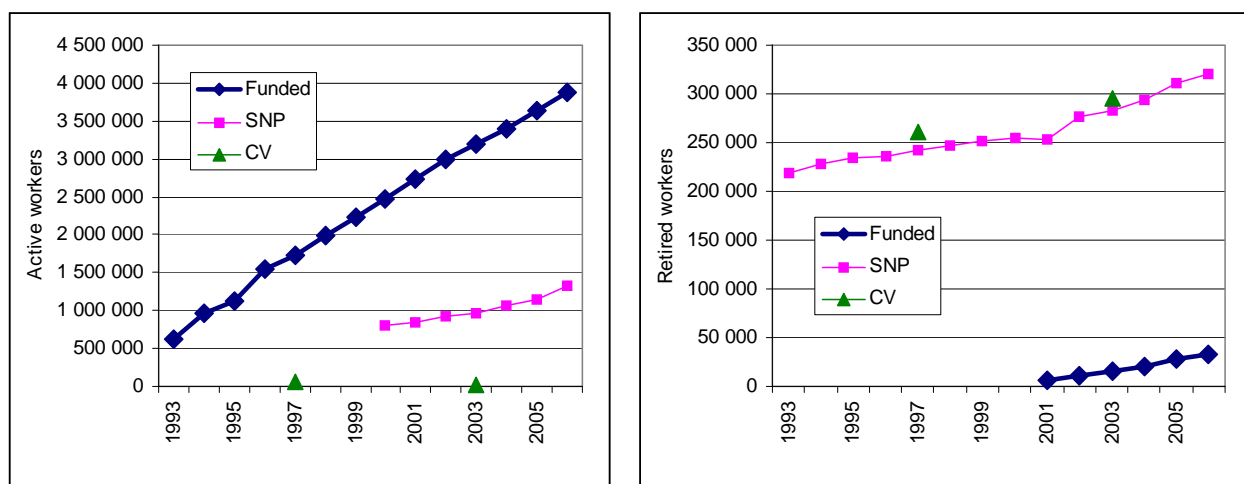
The different speeds of pension systems' change between active and retired workers come from the different incentives they face. On one hand, active workers opt for the open system that maximizes their pension wealth. The reformed open pay-as-you-go system offers pension benefits relatively monotone on income and age. The new funded system, given its capitalization nature, provides pension benefits that positively depend on income and negatively depend on age. Hence, individuals face different incentives to enrol to each pension system depending on their income and age: relatively old and poor individuals stay in the open pay-as-you-go, while relatively young and rich individuals switch to the funded system. Moreover, this last group has incentives to switch expeditiously in order to avoid losing resources in the common pay-as-you-go fund and to fully get the returns of the funded system. On the other hand,

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however, retired workers clearly do not have incentives to switch to the funded system and workers close to retirement have positive incentives to switch only if a significantly high wage compensate for the short period of capitalization.

1.3   World Bank data

Empirical papers on microeconomic subjects (consumption, savings, labor supply, living arrangements) based on social security privatization experiences are difficult to find. This lack of evidence is partly due to the absence of good data for the countries that have implemented the reform, since most of them are developing countries. In Chile, for instance, social security was privatized in 1981 and a good pre-reform household survey is not available.

The Peruvian social security privatization stands as an outstanding study case. The reform was implemented in 1992, having been the first after the Chilean experience. Although official data on social security is neither complete nor fully reliable, excellent micro-data on consumption and saving is available from the Living Standards Measurement Study (LSMS) survey[12]. The LSMS surveys were developed by the WB to provide policy-relevant data on the welfare and living standards of households in a number of developing countries. In Peru, six LSMS surveys have been conducted and they capture the periods before, during and after the pension reform[13].

The Peruvian LSMS survey has not been conducted on a regular basis and their geographic coverage has varied by year: the 1985-1986 survey covered the entire country, the 1990 survey covered only Metropolitan Lima, the 1991 survey covered 70% of the country's population (it excluded some rural areas), and the 1994, 1997 and 2000 surveys covered again the entire country. However, the dissimilar geographic coverage is not a problem to the purposes of social security research because all the exclusions are from rural areas and the scope of the analysis on social security is exclusively urban.

The Peruvian LSMS survey consists of a series of cross-sections. There is information on 1706 urban households in the 1991 survey, 2303 urban households in the 1994 survey, 2387 urban households in the 1997 survey and 2610 urban households in the 2000 survey. The LSMS survey contains a subset of panel observations. However, households that have been interviewed in more than one survey year are only a few. For instance, there are only 1448 households where interviews were conducted in the 1991, 1994 and 1997 surveys (both from urban and rural sectors). This thesis uses the LSMS survey only as a series of cross-sections.

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[12]See Grosh and Glewwe (1995) for a guide to LSMS surveys and their data sets.

[13]In Peru, the LSMS survey is referred to as the *Encuesta Nacional de Hogares sobre Medición de Niveles de Vida (ENNIV)*.

The unit of observation of the ENNIV survey is the household[14] for consumption, housing, micro-enterprises activities and agro-pastoral practices, while the individual for the education, health, labour, fecundity and migration sections.

The Peruvian LSMS survey provides variables for household income and consumption, which have been computed through the sum of monetary values, properly annualized and adjusted for changes in prices. Household income is defined as household annual disposable income. It is the sum of each member's earnings from wage employment and self-employment, estimated value of goods produced and consumed by the household, incomes from property rent, regular payments received by the household (pensions, dividends, transfers from family members) and irregular payments received (lottery winnings, inheritances). Household consumption is defined as household annual consumption, including spending on durable and non-durable goods. It is the sum of foods consumed, clothing purchased and received in-kind from employer, housing expenses, household maintenance expenses, expenses for health care and medicine, expenses for transportation and communications, education and entertainment expenses, other goods and services and value of transfers (monetary or in-kind) given to non-household members[15].

The quality of the data collected is generally good. The questionnaires and methodologies of collecting and processing the information have not suffered important modifications, such that any possible bias in the construction of indicators is constant over time. Moreover, there is no evidence of any particular bias, neither in the computation of income level nor in the estimation of aggregated consumption. Deaton (1997) notes that LSMS surveys income and expenditure data are of generally good quality.

In order to observe to what extent the data from the LSMS survey is consistent with the macroeconomic conditions in Peru, Figure 1-2 contrasts aggregate data from the national accounts (which goes from 1990 to 2001) and data from four LSMS surveys (1991, 1994, 1997 and 2000). The Gross Domestic Product and the sum of private consumption and private investment are measured in the primary axis, while the median of urban household income and the median urban household consumption are measured in the secondary axis. The four variables are expressed in Peruvian monetary units in real terms of 2004. The Gross Domestic Product and the sum of private consumption and private investment present the same pattern: Fujimori reforms have allowed sustained economic growth since 1993 except for a slump after 1997, when El Niño's impact on agriculture, the financial crisis in Asia and the instability in Brazilian markets undercut growth. The median of urban household income and the median urban household consumption match up with this evolution. Moreover, these last two variables show that the maximum difference between both variables is registered in 1997, which means that the maximum level of saving was registered after a number of years of economic growth.

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[14]Household is defined as the person or collection of persons, whether related or not, that habitually live in the same

Figure 1-2: Evolution of LSMS median income and consumption versus national accounts

Gross Domestic Product
Private consumption and investment
♦ Median household income
■ Median household consumption

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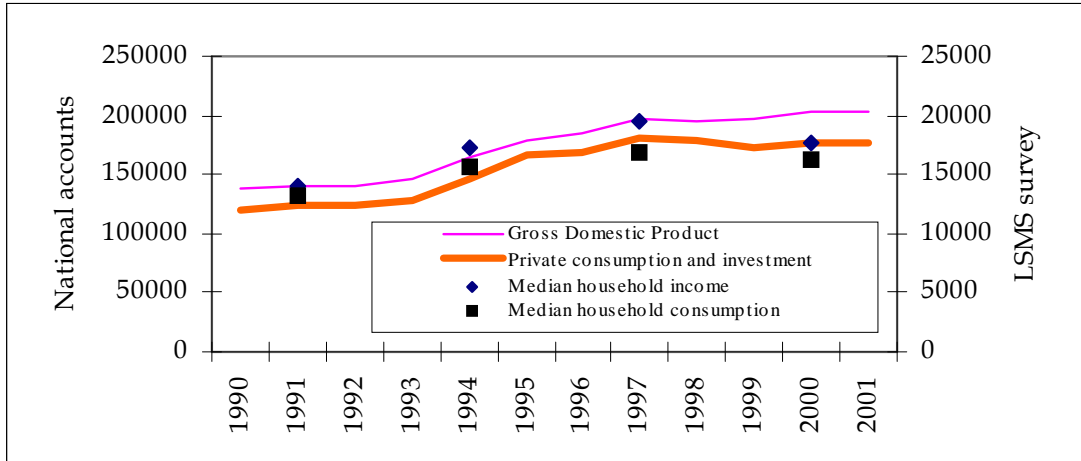
private dwelling, occupying it in part or in whole, and that tend to their life needs together.

[15] Appendix A.3 explains the composition of household consumption in more detail.

Chapter 2

What is the role of social security privatization in changing elderly welfare?

2.1 Introduction

Social security systems are designed to ensure material well-being for individuals retired from the labor market and their dependents. Many theoretical and practical approaches examine the question of how to design a system that satisfies this goal paying attention to potential collateral consequences on labor market efficiency, fiscal burden, national savings and deepness of financial markets. Debate about the optimal design has intensified during the past few years, which have witnessed social security privatization processes in almost 30 countries in the world. One criterion to evaluate efficiency must be in terms of the primary objective: to ensure material well-being for individuals retired from the labor market and their dependents.

Previous analyses have compared steady states of the pay-as-you-go system and the funded system in terms of the primary objective of social security and fundamentally in terms of their potential collateral consequences[1]. However, privatization processes include a crucial transition period, which arises when social security is moving from one steady state to the other. After privatization, individuals that sustained the pay-as-you-go system migrate to the funded system, so that resources external to social

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[1]The steady state pay-as-you-go system and the funded system are typically (almost) equivalent in terms of the primary objective by design (at least on average), but the consequence in each system for the potential collateral consequences are different.

security are necessary to respect the entitlements of individuals already retired and those close to retirement. The transition period, characterized by the lack of resources within the pay-as-you-go system to respect the accrued rights of the elderly, has an important potential effect on the primary objective of social security.

The purpose of this paper is to evaluate, specifically during the transition period, the effect of Peruvian social security privatization on the well-being of individuals retired from the labor market and their dependents. In other words, the paper examines whether the benefits outweigh the costs of the reform for the generation that experienced the transition, that is, the group of individuals receiving pension benefits (or about to do it) when the migration from the pay-as-you-go to the funded system took place. The study of the subject is important for going beyond the comparison of steady states (in a sense, the analysis takes for granted that moving from one steady state to the other was an optimal choice) and revealing the benefits or the costs for the transition generation in terms of the primary objective of social security.

The importance of the transition period has been emphasized by some papers that explore the theoretical conditions under which privatizing social security would increase general economic welfare. Feldstein (1995), Kotlikoff, Smetters and Walliser (1998), Feldstein and Samwick (1998) and Börsch-Supan (1998) develop models that concludes that the effect of privatization on welfare depends not only on the difference between the rate of increase of the payroll tax base and the return on real investments, but also on the additional taxes that future generations must pay to finance the interest on the extra national debt created for financing the transition period[2]. Although for simplicity these papers suppose that benefit entitlements are fully respected, whether this assumption holds is an empirical question not answered yet. This lack of evidence is partly due to the absence of good data for the countries that have implemented the reform, since most of them are developing countries. In Chile, for instance, social security was privatized in 1981 and a good pre-reform household survey is unavailable. This paper fills this gap by using the Peruvian privatization of 1993, which was the first after the Chilean experience.

This paper estimates the effect of social security privatization in Peru on consumption of the elderly and their dependents. The analysis focuses on consumption rather than income because economic theory suggests that the former is a better measure of welfare as it captures long-term income prospects, while the latter is likely to be disproportionately influenced by transitory fluctuations. The basic setup is a difference-in-differences for household consumption. The treatment group is composed by households covered by social security, where coverage is defined as the reception of retirement pension benefits. Thus, the treatment group includes households with at least one elder or one survivor receiving income

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[2]The papers identify the conditions under which social security privatization generates efficiency gains. The reform would raise economic welfare if, for instance, the marginal product of capital exceeds the rate of economic growth, the capital intensity of the economy is below the welfare maximizing level and the rate of economic growth is positive.

support from a pension system. The control group is composed of households not covered by social security, that is, all the other households available in the surveys. The paper compares the differences in consumption for these two groups before and after social security privatization.

The treatment is provided by the Peruvian social security privatization, which introduced a funded system in 1993 and modified the two pre-existing pay-as-you-go systems. The treatment is exogenous for three reasons. First, the Peruvian reform was not motivated by projected aging problems compromising its structural sustainability, but it was rather an attempt to protect the system from political manipulation and corruption problems. Second, the creation of the funded system corresponded to a general Peruvian policy shift toward market-friendly policies, which was not pre-announced to voters. Third, the specific design of the reform was recommended by international financial institutions whose diagnostic was not based specifically on the Peruvian pay-as-you-systems situation.

The control group consists of two different types of households: households that do not receive pension benefits because none of their members are retired (nor dependents of retired persons), and households whose retired members are not covered by social security because they worked in the informal sector. In the context of the difference-in-differences, this is a problem because the treatment and control group are required to be as similar as possible, which avoids differential trends or omitted variables with divergent effects. However, I argue this heterogeneous control group is an advantage, because it allows comparing the differences in consumption for covered households and households that are not affected at all by the reform, such as those not receiving pension benefits and those not contributing to social security (because they work in the informal sector). In any case, since the treatment and control groups are basically different along two dimensions, age and formality, the paper controls for the first and it provides a robustness check for the second.

A selection concern arises from the utilization of social security coverage to define groups of treatment and control arises. Since being covered or uncovered by social security is not a random event, the variables that determine who is covered by social security may be the same that determine consumption. In order to solve this concern, the set of controls include a number of variables that potentially explain coverage and consumption at the same time: age (and square), educational attainment, gender, household size (and square) and a dummy for composite living arrangements.

To measure consumption for various subgroups of the population, the paper uses four repeated cross-sections of the Peruvian LSMS (WB) for 1991, 1994, 1997 and 2000. The basic result shows that consumption rose significantly by 17.81% for the average covered household after social security privatization. Thus, the reform positively impacted on the well-being of covered households, regardless of the lack of internal resources that characterizes the pay-as-you-go systems during the transition.

The setup allows a closer examination of the effect of privatization. First, the interaction term is

multiplied by dummies for educational attainment: the effect increases with the education level of the household head. Second, the parameter is estimated using quantile regressions: the effect increases with consumption. These two extensions suggest a positive relation between the effect of privatization and permanent income during the transition. Third, the interaction term is multiplied by dummies for age groups: the larger effect was not experienced by the households with the oldest heads, but by those with heads between 50 and 60 years old. Finally, the interaction term is estimated using single year dummies rather than the post reform dummy in order to contrast the sequence of reforms and the dynamics of the effect. The sequence of reforms was the following: the prior social security was composed by an open system and a (highly generous) closed system[3]; the former was modified in 1992 and the latter was modified in 1996 and 1997. The purpose of these modifications was to cut pension benefits, consistently with the lack of resources that characterizes the transition. The dynamics of the effect shows that the reform of the open pay-as-you-go system had little effect in comparison to the generosity of the closed pay-as-you-go system, whose reform was late and only partial.

In sum, the empirical analysis shows that the Peruvian social security privatization had a positive effect on the well-being of covered households during the transition, which reveals that the government managed to raise external resources. However, a further examination shows that the larger impact was experienced neither by the poorest households nor by the households with the oldest heads. Moreover, the dynamics of the effect reveals that the purpose of the modifications of the pay-as-you-go systems was not accomplished. After these findings, the question arises as to whether the positive impact on well-being was an intended goal of the Peruvian government. An alternative explanation can be found in the intense legal defence of accrued rights developed by covered households during the transition.

The rest of the paper is organized as follows. Section 2.2 briefly describes the Peruvian social security privatization. Section 2.3 describes the methodology to measure the effect of social security privatization on household consumption. Section 2.4 describes the dataset. Section 2.5 presents the results of the paper and some extensions. Section 2.6 presents a number of robustness controls. Finally, Section 2.7 concludes.

2.2 Social security privatization in Peru

This section recaps from Chapter 1 what is strictly necessary to carry out the empirical analysis presented in this chapter.

Peruvian social security was privatized in 1993. Prior to the reform, two purely public pension sys-

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[3]An open pension system has no restriction on membership, while a closed pension system is either limited to certain employees or blocked to new members.

tems operated on a pay-as-you-go basis. One system had no restriction on membership and covered all private-sector workers and many civil servants (open pay-as-you-go), while the other system was limited to special groups of civil servants (closed pay-as-you-go). These two systems suffered from political manipulation, inappropriate management and corruption problems. The Alberto Fujimori administration (1990-2000) lunched into radical and wide-ranging liberal reforms, including social security privatization. The private funded system introduced a scheme of individual savings accounts, with defined contributions and managed by private pension fund administrators. After the reform, newcomers in the labor force are able to select their preferred system between the open pay-as-you-go and funded system, while current workers are allowed to stay in the two pay-as-you-go systems or to switch to the funded system[4].

The introduction of the funded system in Peru, as all privatization processes, started a transition period. This transition arises when social security is moving from one steady state to the other. After privatization, individuals that sustained the pay-as-you-go system migrate to the funded system, so that the individual accounts of the funded system are financed from revenue previously devoted to the collective fund of the pay-as-you-go system. Since there are no internal resources to continue paying the benefits promised to retirees and older workers that remain under the pay-as-you-go system, the gap is covered by resources external to the pension system, such as foreign debt. The transition period ends when no more resources external to social security are needed to respect the accrued rights of the elderly and social security reach the new steady state.

The lack of internal resources to respect pension benefits that characterizes the transition, as well as the own problems of the two pay-as-you-go systems, made the reform not intended to be revenue-neutral. In fact it was an intended objective of the reform to restrict the generosity of the pay-as-you-go systems, as well as to provide more redistributive pension benefits. The sequence of modifications to accomplish these goals was the following. The first reform modified the open pay-as-you-go system in 1992. Since pension benefits are determined ex-ante through a legal formula that yields pensions proportional to an average of final salaries (including minimum and maximum pensions), the reform changed this legal formula to decrease the average of final salaries and to provide more homogeneous pension benefits. The second reform modified the closed pay-as-you-go system in 1996 and 1997. This system was highly generous as pension benefits were equal to the wage received in the last position the retiree held and they were adjusted whenever this wage was adjusted. The reforms purged pension benefits obtained illegally and introduced a maximum pension equal to the wage of a congressman (Section 1.1 explains the sequence of legal modifications to accomplish these goals in more detail).

The reform of the pay-as-you-go systems did not fully accomplish their intended purposes. In par-

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[4]As opposed to other countries that have phased out the pay-as-you-go system or that have created a unified multiple pillars system, the Peruvian funded system coexists with the reformed open pay-as-you-go. See Mesa-Lago (2001).

ticular, the reform of the closed system was late and seriously restricted by Peru's Constitutional Court which invoked the Theory of Accrued Rights. The fact that this reform was just in 1996 and 1997 is important for the purposes of the paper. The open pay-as-you-go system was reformed in 1992, but the closed pay-as-you-go system kept on providing pension benefits linked to the last position the retiree held. In other words, while the open system provided more modest and more redistributive pension benefits, the closed system did exactly the opposite at least until 1996. The fact that this reform was restricted by legal means is also important for the purposes of the paper. It is not clear to what extent this reform could undo the generosity of their pension benefits. Then, the final outcome of social security privatization on elderly well-being during the transition is mostly an empirical question.

Finally, it is important to mention that low coverage rates have historically characterized Peruvian social security, which is a problem that the reform has been unable to solve. Legally, membership to pension systems is mandatory for wage workers, while voluntary for self-employees. However, because of the large size of the Peruvian informal segment, numerous workers never enrol in pension systems or, having enrolled, do not contribute enough to get a pension at retirement[5]. Hence, a large fraction of the Peruvian labor force does not receive pension benefits at retirement. This low coverage is strongly related with the fragmentation of the Peruvian labor market in terms of a formal sector and an informal sector. Wage workers that do not contribute to social security are also outside other established schemes like tax payments, health programs, regulation on minimum wages and job security legislation. Hence, although the design of pension systems plays a role, it is far from being the main determinant.

2.3   Method

The paper estimates the effect of social security privatization in Peru on consumption of the elderly and their dependents. The analysis focuses on consumption rather than income because economic theory suggests that the former serves as a better proxy for the material well-being of the household than the latter. First, consumption is less susceptible to temporary fluctuations due to transitory events (for instance, layoffs or changes in family status), which usually do not reflect changes in well-being. Second, consumption reflects in-kind transfers that income fails to capture sometimes. Meyer and Sullivan (2001 and 2003) discuss these and other conceptual and reporting reasons to prefer consumption rather than income to measure material well-being.

An important concern evaluating the effect of the Peruvian social security privatization on house-

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[5] In the pay-as-you-go systems, receiving a pension legally requires a minimum number of contribution years. In the funded system, receiving a pension does not legally require a minimum number of contribution years, but receiving a recognition bond does. Additionally, in this system, accumulating a small fund does not yield to a pension stream but to a lump sum payment.

hold consumption is how to disentangle the effect of this reform from the effect of changes in omitted variables. Macroeconomic factors, such as economic growth and inflation rates, may cause changes in consumption across time. Any other institutional reform, parallel to social security privatization, may provide alternative explanations for consumption changes. These two examples of omitted variables are quite relevant because Peruvian macroeconomic conditions changed during the nineties and because the Peruvian social security privatization was among a group of radical and wide-ranging liberal reforms lunched by Alberto Fujimori administration, as it was mentioned in Section 2.2.

The basic setup to isolate the effect of social security privatization is a difference-in-differences. The empirical analysis estimates a regression model of the following form:

$$C_{ht} = \alpha_0 + \alpha_1 \cdot covered_{ht} + \alpha_2 \cdot post_{ht} + \beta \cdot covered_{ht} \cdot post_{ht} + X_{ht} \cdot \gamma + \mu_{ht} \tag{2.1}$$

where C_{ht} represents consumption for household h at time t, $covered_{ht}$ equals unity for households covered by social security, $post_{ht}$ equals unity for households at the post policy change periods, X_{ht} are the control variables, and μ_{ht} is the error term. The coefficient β measures the effect of social security privatization on household consumption.

The basic setup is the following. The treatment group is composed by households covered by social security. To the purposes of this paper, coverage is defined as the reception of pension benefits from social security. Thus, the treatment group includes households with at least one elder or one survivor receiving income support from a pension system (examples of survivors are spouses and single daughters of dead retirees). The control group is composed of households not covered by social security, so that it includes all the other households available in the survey. The paper compares the difference in consumption for these two groups before and after social security privatization, getting rid of changes in consumption across time caused by factors not related with social security and eliminating pre-reform differences in consumption between covered and uncovered households.

In the context of Peru, this setup provides a particularly attractive control group because of the segmentation of the labor market in terms of a formal and informal sector. Firstly, the control group is composed by households whose members are all relatively young. These members can be contributing to social security or not, which depends on whether they are working in the formal sector or not. Secondly, the control group is composed by households with elders (or potential survivors) that are not receiving income support from a pension system because they did work in the informal sector. Hence, while previous empirical analyses on the elderly typically use young households as control group, the segmentation of the Peruvian labor market allows the addition of two important subgroups: households with young members not contributing to social security and households with old members (and potential

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survivors) not receiving pension benefits. The inclusion of these two subgroups improves the difference-in-differences estimator because they are not directly affected by the reforms. In particular, they are not affected by changes in pension benefits, social security contributions or payroll taxes. Nevertheless, it can be argued that the inclusion of households from the informal sector is a weakness of the setup since the difference-in-differences requires a homogeneous control group that is similar as possible to the treatment group. Section 2.6 discusses this last argument and shows that the results are robust to alternative setups.

Two selection concerns arise from the utilization of social security coverage to define groups of treatment and control. First, to the extent that being covered or uncovered by social security is not a random event, the variables that determine who is covered by social security may be the same that determine consumption. In order to solve this concern, the set of controls include a number of variables that potentially explain coverage and consumption at the same time (the selected control variables are provided later, together with an explanation on why the assignment is not random). Second, a group of elders could have decided to embrace or to opt out of social security after privatization, so that changes in mean consumption may result from changes in the characteristics of households in one of the two groups. However, this problem is not of particular importance given that privatization did not change enrolment incentives for the elderly: switching from uncovered to covered is almost impossible because getting pension benefits depends on past contribution, while switching from covered to uncovered (that is, giving up to pension benefits) is not a desirable option. In any case, the set of controls also checks for changes in the characteristics of households within groups[6].

The treatment is provided by the Peruvian social security privatization. This treatment is exogenous because it was not the governmental response to variables associated with past or expected future consumption outcomes, and because it was unexpected. Two arguments may compromise the validity of these statements. On one hand, it can be argued that social security privatization was motivated by the lack of resources to keep on paying the pay-as-you-go pensions due to a small tax collection. Endogeneity would arise to the extent that tax collection is a function of consumption. On the other hand, it can be argued that the reform was expected given the financial problems of the pay-as-you-go systems and that, consequently, households adjusted their consumption patterns before the reform. However, three facts sustain that the Peruvian social security privatization was an exogenous and unexpected reform. First, the Peruvian reform was an attempt to protect the system from political manipulation and corruption problems, so that it was not motivated by projected aging problems. Second, the creation of the funded system was part of a general Peruvian policy shift toward market-friendly policies, which was not

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[6] Privatization did change enrolment incentives for young individuals, which could have decided to embrace or to opt out of social security after privatization. Endogeneity may arise in a long term analysis that let these young individuals to get retired (with or without pension benefits). This paper, however, focuses exclusively on the transition period.

announced in Fujimori's campaign platform. Third, the specific design of the reform was recommended by international financial institutions whose diagnostic was not based specifically on the Peruvian pay-as-you-systems situation (Section 1.2 goes further on the Peruvian social security privatization as a source of exogenous variability).

The setup controls for a number of variables, included in X_{ht}, to improve the efficiency of the estimate of β by reducing the residual variance and fundamentally to avoid possible endogeneity problems. As it has been mentioned, being covered by social security is not a random event. In particular, a household receives pension benefits if a retired member contributed to social security during his working life (or if there is a survivor of this person), which determined different characteristics between the treatment and control groups. The first control variable is age (and the square) because households in the treatment group are probably older than households in the control group, given the presence of retirees. The second control variable is educational attainment of the household head (indeed a number of dummies for educational levels) because more educated households have a larger probability of being in the formal sector and therefore a larger probability of being covered by social security. The third control variable is the gender of the household head because males may have a different attitude toward social security than females. The fourth control variable is the number of members (and the square) because family size may also determine a different attitude toward social security. The final control variable is a dummy for composite living arrangements because having more than one income recipient increases the probability of being in the formal sector and therefore the probability of being covered by social security.

Finally, it is important to recognize that the paper examines the effect of privatization on household consumption after a number of potential minor behavioral responses. The main behavioral response to modifications in pension benefits is changing consumption for two reasons: first, labor market retirement makes labor income to be null so that pension benefits become a crucial consumption determinant; second, labor market retirement put leisure time away from the group of decision variables in the utility function. However, elderly may respond along a number of other behavioral dimensions (post-retirement labor supply, early retirement decisions and living arrangements) that may change the final effect on consumption[7]. Moreover, elders can live with their offspring (especially in developing countries), so that a modification in pension benefits could induce other household members to change labor income. Thus, the paper estimates the net effect.

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[7]For instance, while normally a decrease in pension benefits would reduce consumption, the final result may change if it also induces to increase post-retirement labor supply, to postpone retirement decisions or to substitute independent for shared living arrangements. Each of these three reactions would increase income, which would compensate the reduction that follows the assumed decrease in pension benefits.

2.4 Micro-data

The empirical analysis uses micro-data from four cross-sections of the Peruvian LSMS that capture periods before, during and after social security privatization. From the six LSMS surveys that have been conducted in Peru, this paper uses the surveys that are closest to the institutional reforms of 1992, 1993, 1996 and 1997, which are the surveys conducted in 1991, 1994, 1997 and 2000 (see Section 1.3 for information on the Peruvian LSMS survey).

An important variable for the empirical analysis is household consumption. Household consumption, a variable provided by LSMS survey, includes spending on durable goods (see Section 1.3 for an explanation on the composition and computation of this variable). The LSMS survey also includes a variable that contains the weight of each observation. Hence, statistics and estimations throughout the empirical analysis come from weighted data. Household consumption and all other monetary variables are set in real terms of June 2004 throughout the empirical analyses.

The unit of observation for the empirical analysis is the household because consumption is available at the household level only. Moreover, information on the reception of retirement pension benefits is also only available at that level.

The empirical analysis is conducted only on urban sectors. Peruvian social security has historically excluded individuals in rural areas, so they remain outside any legal program. The orientation towards self-consumption and the informality of their economic activities put them away from the scope of pension schemes. After this exclusion, there is available information on 9006 households from which 1679 are covered by social security (that is, households that receive retirement pension benefits) and 7327 are uncovered by social security. There are 1706 households in the 1991 survey, 2303 in the 1994 survey, 2387 in the 1997 survey, and 2610 in the 2000 survey.

The empirical analysis is somehow limited by the omission of three important aspects in the surveys. First, the questionnaires do not identify the household member that receives the retirement pension, which can be a retiree or a survivor. Thus, it is not possible to analyze the different demographic profile of the participants directly. Second, the questionnaires do not ask for the system that provides pension benefits (open pay-as-you-go, closed pay-as-you-go or funded system). Hence, it is not possible to analyze whether there is a differential effect of the three systems over consumption. Third, the questionnaires do not collect the purchase values and dates of durable goods so that their "use value" cannot be estimated. Thus, constructing a consumption variable that includes the service flow from durables is not possible.

Table 2.1 provides descriptive statistics for covered and uncovered households, revealing interesting patterns. First, although the mean of age of household head is larger for the treatment group (63) than for the control group (46), the difference is not particularly big. In order to explain why, the groups composition is described again: while the treatment group has households with one elder or one

survivor receiving pension benefits, the control group has households whose members are all relatively young and households with elders that are not receiving pension benefits. Thus, while the presence of young households in the control group increases the difference, three facts decreases it: 1) the presence of not too old retirees in the treatment group because of the low retirement ages and the flexible early retirement mechanisms; 2) the presence of survivors in the treatment group, such as spouses and single daughters of dead retirees[8]; and 3) the presence of elders that are not receiving pension benefits in the control group. Second, the mean of the dummy for composite households is larger for the treatment group (0.69) than for the control group (0.35), revealing that most pensioners tend to live with others. Third, the number of household members are almost the same for the treatment group (4.93) and the control group (5.12), confirming that pensioners tend to live in composite living arrangements. In sum, the treatment group is far from being a homogenous group composed by household with only elders among their members. In fact, the treatment group includes many composite households (which means they have young individuals among their members) and even households without elders.

Table 2.1: Mean characteristics of households covered and uncovered by social security

Variable	Treatment group	Control group
Age	63.29	46.29
	(12.51)	(13.45)
Gender (Female=1)	0.23	0.18
	(0.42)	(0.39)
Educational attainment:		
None	0.03	0.04
	(0.17)	(0.21)
Primary school	0.33	0.32
	(0.47)	(0.47)
High school	0.33	0.41
	(0.47)	(0.49)
Technical institute	0.09	0.08
	(0.29)	(0.27)
University	0.22	0.15
	(0.41)	(0.35)
Family size	4.93	5.12
	(2.52)	(2.21)
Composite household	0.69	0.35
	(0.46)	(0.48)
N	1679	7327

Notes: The calculations are from the LSMS Peru 1991, 1994, 1997 and 2000. The standard errors are in parentheses. All numbers are weighted.

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[8]Single daughters of dead retirees have negative incentives to get married and constitute an important group of pensioners. Unfortunately, as just mentioned, questionnaires do not identify them.

2.5 Results

Table 2.2 presents a difference-in-differences table for household consumption, where the pre-reform period is 1991 and the post-reform period is 1994, 1997 and 2000. Consumption for covered households increased 6570 monetary units[9] from the pre-reform to the post-reform period, while consumption for uncovered households only increased 3786 monetary units during the same period. Then, it can be preliminarily concluded that social security privatization caused an increase of 2784 monetary units in mean consumption for covered households, that is, an increase of 14.35% with respect to the prior situation. This result neither conditions on differences in household demographic nor controls for how demographics change over time.

Table 2.2: Mean household consumption

	Pre treatment	Post treatment	Difference
Control group	15498	19284	3786
Treatment group	19395	25965	6570
Difference	3897	6681	2784

Notes: The calculations are from the LSMS Peru 1991, 1994, 1997
and 2000. All numbers are weighted.

Table 2.3 reports OLS estimates for Equation 2.1 showing how relative consumption for covered households changed during the sample period. The coefficient β on the interaction term $covered_{ht} \cdot post_{ht}$ from this regression can be interpreted as the change in consumption for covered households from 1991 to 1994, 1997 and 2000, relative to the change in consumption for uncovered households in the same period. Consumption rose significantly 3453 monetary units (p-value: 0.000) for the average covered household after social security privatization, which means an increase of 17.81% with respect to the prior situation. This result, larger than the directly obtained from the difference-in-differences table, conditions on differences in household demographic and controls for how demographics change over time. Then, Table 2.3 confirms the positive effect of the Peruvian social security privatization on the consumption level of households receiving pension benefits during the transition. Despite the lack of internal resources that characterizes the pay-as-you-go systems during this period, the Peruvian government managed to raise external resources to increase the well-being of covered households.

The OLS estimates provide collateral information. First, for reasons other than social security privatization (macroeconomic factors or institutional reforms), consumption rose by 3314 monetary units (p-value: 0.000) for the average household. Second, while Table 2.2 shows an important difference in mean consumption between the treatment and control groups, Table 2.3 reports that the coefficient on the dummy variable for being covered by social security is not significant (p-value: 0.379). The above

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[9] Recall from Section 2.4 that price indices are used to set the four surveys in real terms of June 2004.

means that differences in consumption between covered and uncovered households are well explained by the control variables. Finally, the relations between consumption and the control variables are revealed. They are all highly significant (p-value: 0.000) with the exception of gender and the square of household size. The age of the household head and its square allows observing the humped shape predicted by life cycle theory. The educational attainment of the household head, which is a measure of permanent income, has a positive effect on consumption consistently with life cycle theory. The number of members is found to have a positive effect on household consumption. The dummy variable equal to one for composite households recovers economies of scale and transfers between families within a household.

Table 2.3: OLS regression of consumption: effect of privatization

Variable	OLS	Variable	OLS
Covered*post	3453.4	Educational attainment:	
	(960.9)	Primary school	3971.2
Covered	-736.3		(429.6)
	(836.4)	High school	9078.7
Post	3314.4		(491.1)
	(338.8)	Technical institute	13956.6
Age	588.7		(720.2)
	(62.5)	University	23755.5
Age (square)	-4.3		(846.3)
	(0.6)	Composite household	3075.4
Gender (Female=1)	-724.2		(378.2)
	(356.2)	Intercept	-17153.6
Family size	1128.9		(1675.6)
	(243.8)		
Family size (square)	-16.7		
	(18.4)	N	9006

Notes: The standard errors are in parentheses.
The estimation is weighted.

A first extension from the basic setup allows the evaluation of differential treatment effects by education levels. In order to do so, the double interaction $covered_{ht} \cdot post_{ht}$ of Equation 2.1 is replaced by triple interactions of $covered_{ht}$, $post_{ht}$ and the dummies for educational attainment[10]. Figure 2-1 reports OLS estimates of the coefficients for this extension, as well as the standard errors in parentheses (Table B.1 of Appendix B.1 presents full results). The figure shows that the higher the education level, the larger the positive effect of the reform during the transition. In particular, consumption rose 1106 monetary units (p-value: 0.416) for the average household that has a head with no education, 2117 monetary units for primary school (p-value: 0.027), 2788 monetary units for high school (p-value: 0.009), 3136 monetary units for technical career (p-value: 0.093) and 4635 monetary units for university career (p-value: 0.025).

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[10]The dummy $post_{ht}$ is also interacted by the dummies for educational attainment in order to allow for different macroeconomic effects by education levels.

This result suggests that the effect of social security privatization increases with permanent income.

Figure 2-1: OLS regression of consumption: effect of privatization by education level
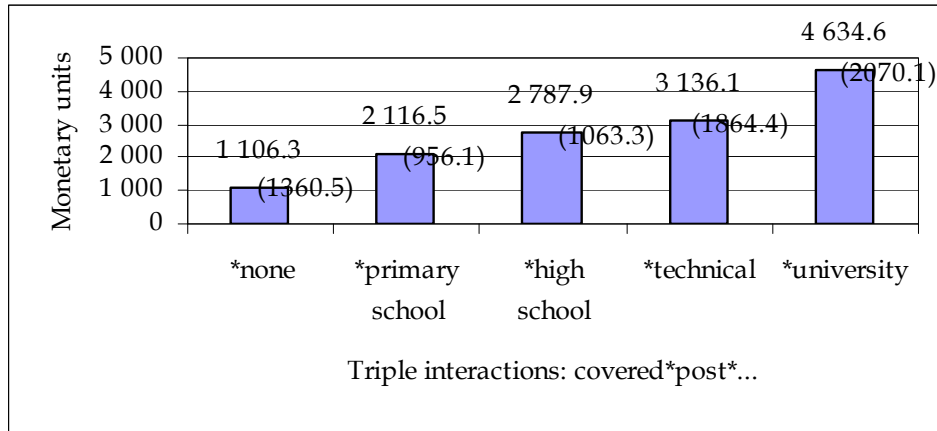
A second extension goes further on the previous statement by letting social security privatization effect to vary at different points in the consumption distribution. Equation 2.1 is estimated using quantile regressions. Figure 2-2 reports estimates for this extension (Table B.2 of Appendix B.1 presents full results). The figure shows that the privatization effect increases with consumption: consumption rose by 1724 monetary units (p-value: 0.000) for those at the 25th percentile, 2978 monetary units (p-value: 0.000) for those at the 50th percentile and 4689 monetary units (p-value: 0.002) for those at the 75th percentile. These results also suggest a positive relation between the effect of social security privatization and permanent income.

Figure 2-2: Simultaneous-quantile regression: effect of privatization
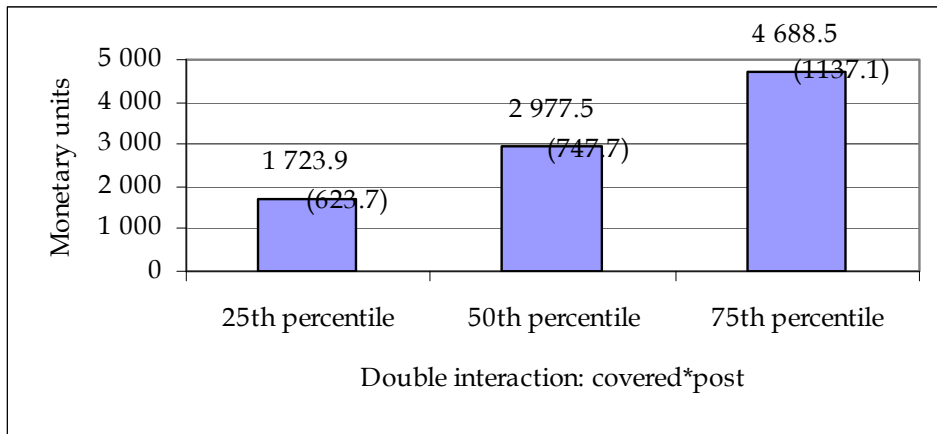
In order to confirm formally that the effect of social security privatization during the transition increases with permanent income, a statistical test evaluates whether the set of coefficients are equal at the three quantiles estimated. The statistic $F(2, 8992)$ is 6.25, so that the null is rejected at any sensible level of significance (p-value: 0.0019). Additionally, the equality of the coefficients is tested in pairs. The statistics $F(1, 8992)$, shown in Table 2.4, confirm that the effect differs among quantiles. In sum, the results show that the external resources raised by the Peruvian government were not focused on the poorest segments; contrarily, the effect of social security privatization during the transition increases with permanent income.

Table 2.4: Quantile regression of consumption: F-tests for equal coefficients

Coefficient	50th percentile	75th percentile
25th percentile	5.03	11.44
	(0.0250)	(0.0007)
50th percentile		4.14
		(0.0419)

Notes: The statistics are $F(1, 8992)$.
Levels of significance in parentheses.

The interpretation of the first and second extensions is straightforward. Section 2.2 explained that the Peruvian social security privatization accomplished conflicting results reforming the pre-existing public systems: in the open pay-as-you-go, the reform provided more redistributive pension benefits; in the closed pay-as-you-go, the reform was late and failed to break the link between pension benefits and current wage of the last position the retiree held. The empirical results show that the latter effect prevailed over the former effect. In other words, pension benefits of the unsuccessfully reformed closed pay-as-you-go system (which was highly regressive) prevailed over pension benefits of the successfully reformed open pay-as-you-go.

A third extension explores whether the effect of social security privatization during the transition depends on the age of the pensioner. Since the data does not identify this household member, which can be a retiree or a survivor, the analysis uses the age of the household head as a proxy. The double interaction $covered_{ht} \cdot post_{ht}$ of Equation 2.1 is replaced by triple interactions of $covered_{ht}$, $post_{ht}$ and dummies for age groups[11]. The age groups are defined as follows: 1) less than 50 years old, where the pensioner is likely a survivor; 2) from 50 to 60, where the pensioner is either a survivor or a retiree benefited by the low retirement ages or the flexible early retirement mechanisms; and 3) more than 60 years old, where the pensioner is either a survivor or a retiree, but definitely old. Figure 2-3 reports OLS estimates for this extension (Table B.3 of Appendix B.1 presents full results). The figure shows

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[11] The dummy $post_{ht}$ is also interacted by the age group dummies in order to allow for different macroeconomic effects by age groups.

that the larger effect was not experienced by the elderly, but by the other groups. While consumption rose 2489 monetary units (p-value: 0.023) for households with old heads, it rose 4239 monetary units for households with middle-aged heads (p-value: 0.012) and 2535 monetary units for households with young heads (p-value: 0.072). This result suggests that the external resources raised by the Peruvian government were not focused on the elderly, but on younger groups.

Figure 2-3: OLS regression of consumption: effect of privatization by age groups
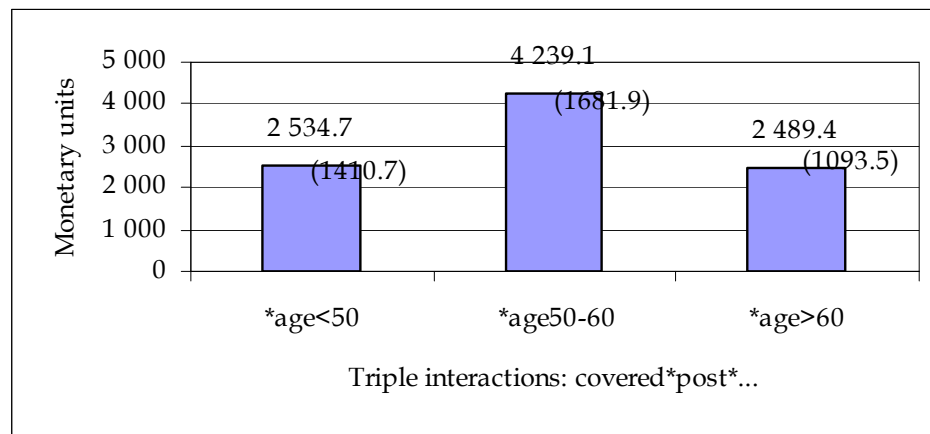
A final extension from the basic setup allows the evaluation of the goal of the legislative changes along the transition. As explained in Section 2.2, it was an objective of the reform to restrict the generosity of the pay-as-you-go systems, which were expected to become unaffordable after the foreseen migration to the funded system. In order to contrast the sequence of reforms (recall the open pay-as-you-go was modified in 1992 and the closed pay-as-you-go was partially modified in 1996 and 1997) and the dynamics of the effect of social security privatization, the interaction term $covered_{ht} \cdot post_{ht}$ of Equation 2.1 is estimated using single year dummies rather than the post reform dummy. The interaction of covered household indicator with the 1991 dummy is excluded so that the figure represents changes in consumption since 1991[12]. Figure 2-4 plots the coefficients (Table B.4 of Appendix B.1 presents full results). Consumption for the average covered household rose 3670 monetary units between 1991 and 1994, revealing that the generosity of the unreformed closed pay-as-you-go prevailed over the reform of the open pay-as-you-go in 1992. Then, consumption rose 315 monetary units between 1994 and 1997 (3985-3670), when the reform of the closed pay-as-you-go in 1996 and 1997 was taking place. Finally, consumption decreased 1112 monetary units from 1997 to 2000 (3985-2873), showing that the reform of

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[12]Consistently with this procedure, single year dummies are used instead of the post reform dummy. The 1991 dummy is excluded.

the closed pay-as-you-go in 1996 and 1997 had a modest effect. Hence, the reform failed to restrict the generosity of the pay-as-you-go systems during the transition, at least considering the prior situation.

Figure 2-4: OLS regression of consumption: effect of privatization by year
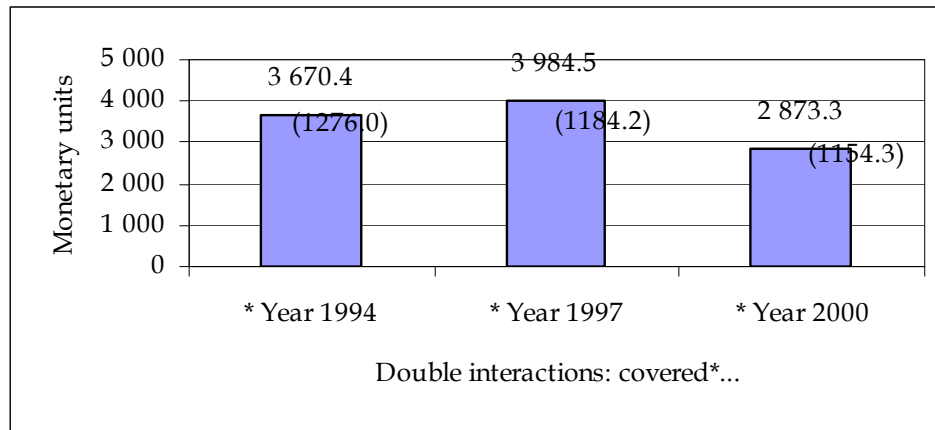
In sum, a further examination of the positive effect of social security privatization reveals that the larger impact was experienced neither by the poorest households nor by the households with the oldest heads. Additionally, the dynamics of the effect shows that the reform of the open pay-as-you-go system had little effect in comparison to the generosity of the closed pay-as-you-go system, whose reform was late and partial. These findings question whether the positive impact on welfare was an intended goal of the Peruvian government. An alternative explanation can be found in the intense legal defence of accrued rights developed by covered households during the transition.

2.6   Robustness of the results

One potential concern with the proposed setup is the utilization of consumption as measure of well-being. Although Section 2.3 presents a number of reasons to prefer consumption over income, the paper also examines income to verify that the results are not sensitive to the selected measure of well-being. Table 2.5 presents the results. Income rose 4051 (p-value: 0.076) for the average covered household after social security privatization, which means an increase of 15.47% with respect to the prior situation. This results are consistent with the previous analysis, since consumption rose 3453 (p-value: 0.000) for the average covered household. The extensions applied to consumption are also applied to income (these results are not reported). Although the results for income are usually less significant than those for consumption, they reveal exactly the same patterns in all the cases.

Table 2.5: OLS regression of income: effect of privatization

Variable	OLS	Variable	OLS
Covered*post	4051.4	Educational attainment:	
	(2286.0)	Primary school	5037.0
Covered	-637.5		(682.1)
	(2269.0)	High school	11602.6
Post	3496.3		(814.2)
	(730.5)	Technical institute	18052.2
Age	1024.1		(1113.8)
	(95.8)	University	34770.9
Age (square)	-7.7		(1585.5)
	(0.9)	Composite household	6560.9
Gender (Female=1)	-2214.7		(659.7)
	(568.8)	Intercept	-30850.4
Family size	1175.2		(2685.1)
	(414.2)		
Family size (square)	12.3		
	(29.8)	N	9006

Notes: The standard errors are in parentheses.
The estimation is weighted.

A second concern with the proposed setup is the heterogeneity of the control group, which is composed by all households available in the surveys. The control group in the context of Peru, as mentioned in Section 2.3, includes not only young households contributing to social security (as previous research has typically done), but also households with young members not contributing to social security and households with old members (and potential survivors) not receiving pension benefits. It has been claimed that the inclusion of these two subgroups improves the difference-in-differences estimator because they are not directly affected by the reform. However, the inclusion of households from the informal sector may also be a problem since the difference-in-differences requires a homogeneous control group that is similar as possible to the treatment group. In particular, the difference-in-differences requires that, in the absence of the treatment, the average outcome for the treated would have experienced the same variation as the average outcome for the untreated. This assumption could be compromised in the context of Peru if households covered by social security were mostly inserted to the formal sector. In such a case, macroeconomic factors and other institutional reforms with differential effects on households from the formal and informal sector would lead to biased estimators. In other words, given the presence of informal households among the control group, the estimations could be affected by differential trends in treatment and control groups and to omitted variables that change in different ways for treatment and control groups.

In order to examine the previous concern, a first task is finding a criterion to divide households in terms of formality. This paper uses a survey question that asks whether any household member paid

direct taxes (income, payroll, property) during the last twelve months. The selected criterion leads to 5180 households in the informal sector and 3826 in the formal sector. More importantly, the percentage of informal households is 49% among the treated and 60% among the untreated[13]. Although the difference of proportions is not important, it can still bias the estimation. In order to completely disregard the potential bias, Equation 2.1 is estimated separately for households from the formal and informal sector. If the effect attributed to social security privatization came indeed from different evolutions of consumption for the formal and informal sector, both estimations would lead to non significant coefficients. Table 2.6 repeats the baseline results of Table 2.3 and presents the estimates of Equation 2.1 for the two groups. The effect of social security privatization is significant in both groups: 2727 monetary units for the informal sector (p-value: 0.007) and 3548 monetary units for the formal sector (p-value: 0.021). Hence, the results are robust to potential differential trends in treatment and control groups caused by formality issues, as well as to potential omitted variables related to formality that change in different ways for treatment and control groups.

Table 2.6: OLS regression of consumption: effect of privatization by formality status

Variable	All	Informal sector	Formal sector
Covered*post	3453.4	2724.6	3547.7
	(960.9)	(1013.9)	(1541.9)
Covered	-736.3	-477.7	-811.0
	(836.4)	(924.1)	(1276.9)
Post	3314.4	2332.4	5235.9
	(338.8)	(433.0)	(536.5)
Other controls:	Educational attainment, age		
	(and square), gender, family size		
	(and square), composite and intercept		
N	9006	5180	3826

Notes: The standard errors are in parentheses.
The estimation is weighted.

A third concern with the proposed setup is the assignation to the control group of households with old members not receiving pension benefits. An alternative strategy is assigning them to the treatment group, so that the treatment group would be composed by "households with elders among their members" and the control group by "households with no elders among their members". This strategy, conducted for different case studies, was not selected for three reasons: 1) it includes untreated households (households with elders not covered by social security) in the treatment group, so that the effect of privatization is underestimated; 2) it includes treated households (household with young survivors) in the control group,

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[13] A retiree must have been inserted to the formal sector during his working life to receive pension benefits. However, he can be currently avoiding tax payment.

so that the effect of privatization is double underestimated; and 3) it requires to establish an arbitrary critical age to define who an elder is. In any case, the exercise is useful to know how consumption changed for the average household with elders among their members after privatization, that is, whether the consumption increase was enough to raise the average. The results, reported in Table 2.7, show that consumption rose 2147 monetary units (p-value: 0.001) for the average household with elders among their members (the selected critical age is 50 years old). This increase, consistently with the expected underestimation, is less than the consumption raise of 3453 monetary units for the average covered household.

Table 2.7: OLS regression of consumption: effect of privatization

Variable	OLS	Variable	OLS
Elderly*post	2146.8	Educational attainment:	
	(648.0)	Primary school	4204.0
Elderly	-1709.2		(429.4)
	(656.4)	High school	9540.7
Post	2804.3		(483.7)
	(451.8)	Technical institute	14591.8
Age	580.7		(718.9)
	(63.9)	University	24385.1
Age (square)	-4.0		(832.8)
	(0.6)	Composite household	3313.3
Gender (Female=1)	-723.0		(431.0)
	(361.3)	Intercept	-17234.0
Family size	1095.7		(1680.2)
	(249.0)		
Family size (square)	-14.6		
	(18.8)	N	9006

Notes: The standard errors are in parentheses.
The estimation is weighted.

2.7 Conclusions

This paper evaluates the effect of Peruvian social security privatization on the well-being of individuals retired from the labor market and their dependents during the transition period. The basic setup is a difference-in-differences for household consumption. The treatment group is households covered by social security (coverage is defined as the reception of retirement pension benefits) and the control group is households not covered by social security. The paper compares the difference in consumption for these two groups before and after social security privatization.

Using four repeated cross-sections of the Peruvian LSMS, the paper finds a positive effect of Peruvian social security privatization during the transition period: consumption rose 17.81% for the average

covered household. This results contrasts with the scarcity of internal resources that characterize the pay-as-you-go systems during the transition. A number of extensions reveal some characteristics of the positive effect. First, it increases with the education level of the household head and the consumption level of the household, suggesting a positive relation with permanent income. Second, the larger effect was experienced by the households with heads between 50 and 60 years old and not by the households with the oldest heads. Finally, the dynamics of the effect reveals that pension benefits could not be cut by the legal modifications as expected.

Whether the positive impact on well-being was an intended goal of the Peruvian government is a question that arises from these results. It is possible that the positive impact was the result of the intense legal defence of accrued rights of covered households during the transition. The paper provides an important policy lesson for countries evaluating pension reforms: social security privatization involves not only introducing a funded system, but also facing a costly transition period that requires a comprehensive plan to raise external resources and to assign them following some criteria.

Chapter 3

Does pension saving crowd out voluntary saving?

3.1 Introduction

The simplest version of the life cycle model predicts that a change in pension wealth is completely offset by modifications of opposite sign in voluntary saving, where the offset is distributed over the lifespan remaining after the pension change. These predictions are intuitively convincing, as individuals desire to avoid drastic changes in consumption patters after retirement, when income dwindles down. However, previous empirical evidence does not provide conclusive results, which is due to a number of reasons. First, it is difficult to estimate pension wealth. Second, pension wealth seldom shows exogenous variation to measure its impact on voluntary saving. Third, the econometric estimation of this impact is complicated because unobserved variables may explain both voluntary saving and pension wealth. This paper analyses the crowding out effect of pension wealth on voluntary saving for Peru at a micro level, using its social security privatization as a natural experiment. The large scale of this reform favor results substantially more precise than those in previous studies. In particular, the results confirm three predictions of the life cycle model at the one-percent significance level: there is crowding out of voluntary saving, the size of the reaction increases with age, and the offset is almost complete. The study of the subject is not only important for contrasting the previous theoretical statements on saving behavior, but also for discussing public policy issues, like the effect of a pension reform on national savings. A pension reform that modifies expectations about future benefits has an effect on voluntary saving, to the extent that the crowding out actually exists. The changes in voluntary savings impact on national savings, which results in a number of consequences in capital markets and economic growth.

The paper regresses household voluntary saving rate on household pension wealth, using three cross sections of the Peruvian LSMS (WB). The surveys capture periods before, during and after the Peruvian social security privatization, which modified the pre-existing pay-as-you-go and introduced a parallel funded system. Since the variable is not available, the paper computes pension wealth for individuals that declare being covered by social security, with different methodologies for those in the pay-as-you-go system and those in the funded system (pension wealth is zero for individuals that declare being uncovered by social security). The parameter of interest is estimated using the time series variation provided by privatization and the cross sectional variation provided by two different sources. The first is related with the segmentation of the Peruvian labor market (formal and informal sectors), which implies the existence of a group covered by social security (whose pension wealth is greater than zero) and another group uncovered by social security (whose pension wealth is equal to zero). The second source of cross sectional variation is the heterogeneous effect that the reform had among members of the group covered by social security. In particular, the individual effect was determined by income and age.

The utilization of pension wealth as an explanatory variable generates two endogeneity problems. First, the unobserved variables that explain the variables used to estimate pension wealth may be the same unobserved variables that explain voluntary saving. Second, to the extent that being covered or uncovered by social security is not a random event, the unobserved variables that determine who is covered by social security may be the same that determine voluntary saving. The paper proposes an instrumental variable approach to solve these concerns, where the first stage regression is a Heckman model with an outcome equation for pension wealth and a selection equation for being covered by social security. Hence, the predicted variable for the second stage regression is the product between the probability of being covered by social security and the expected value of pension wealth conditional on being covered by social security. The identifying assumption is that the marginal effect of income and the marginal effect of age on pension wealth depend on the pension system the household belongs to (pay-as-you-go or funded), but that the marginal effect of income and the marginal effect of age on voluntary saving do not.

The results confirm the predictions of the life cycle model: the null hypothesis that there is no crowding out of voluntary savings is rejected at the one-percent level. The paper additionally incorporates nonlinearities in the regression to take a closer look at the crowding out. First, dummies for age groups are interacted with the predicted pension wealth variable (that is, the coefficient of interest is modelled as a step function of age). The results show that the absolute value of the coefficients roughly increases with age, in accordance to life cycle theory. Second, the theoretical responses predicted by a simple life cycle model are imposed next to the predicted pension wealth variable, in such a way that the associated coefficient is interpreted as a measure of the offset completeness. The results show that this

last coefficient is significant at a one-percent level and close to the minus one predicted by theory.

The main contribution of the paper is that confirms important conclusions of the life cycle model at a high significance level. The clearness and significance of the results are related with the advantages of the Peruvian pension reform as a natural experiment. First, pension wealth experiences much more variability from a social security privatization than from a reform within a pay-as-you-go system. Since the methodology for computation of pensions dramatically changes, it is even possible either to win or to lose with the privatization. Second, while previous papers have worked with one or two sources of variation (see Section 3.2), this paper works with three: the time series variation provided by the reform, the cross sectional variation provided by the sample division in terms of households covered and uncovered by social security, and the cross sectional variation provided by the differential effects the reform had on households covered by social security. Finally, the coexistence of the pay-as-you-go and the funded system, a special feature of the Peruvian reform, allows the development of an instrumental variable approach that exploits that the marginal effect of income and the marginal effect of age on pension wealth are different in accordance to the system the household belongs to. Hence, the instruments clearly fulfil the relevance condition.

The rest of the paper is organized as follows. Section 3.2 presents a brief overview of previous literature. Section 3.3 provides a simple version of the life cycle model to interpret the results throughout the paper. Section 3.4 briefly describes the Peruvian social security privatization and provides some arguments to sustain its exogeneity. Section 3.5 describes the dataset and how the scope of the study is defined. It also presents the methodology for the construction of the pension wealth variable, as well as the results. Section 3.6 describes the methodology to measure the substitutability between voluntary savings and pension wealth. Section 3.7 presents the results of the paper. Section 3.8 tests non linearities from the basic specification. Finally, Section 3.9 provides the conclusions and discusses the policy implications.

3.2 Literature

A brief summary of the literature clarifies the contribution of the paper. Previous studies on the subject at a micro level have followed either of two alternative approaches[1]. A first group of papers has worked with single cross sections. Feldstein and Pellechio (1979) and King and Dicks-Mireaux (1982) were two of the first. Working with data for the United States and Canada respectively, they found negative

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[1] The empirical papers on the subject have preferred working with micro data instead of time series, taking a direct microeconomic perspective and avoiding aggregation problems. However, there is some important empirical research with time series. Feldstein (1974), who performed the earliest empirical research on the subject, worked with time-series for the United States. He found a largely negative association between aggregate saving rates and pension wealth.

relations between pension wealth and non-pension wealth. Gale (1998) made an important contribution to the literature by stressing that the saving response to changes in pension wealth depends on the age of the individual. He imposed the responses predicted by a simple life cycle model (whose absolute values increase with age) next to the pension wealth variable. The significance of the associated coefficient was implicitly taken as a proof of the positive relation between the saving responses and age, while its size (supposedly between zero and minus one) was interpreted as the substitutability between voluntary savings and pension wealth.

A second group of papers has worked with repeated cross sections, in such a way that the parameter of interest is estimated using both time series and cross sectional variation. In order to avoid the endogeneity associated to the utilization of pension wealth as an explanatory variable, Attanasio and Brugiavini (2003) and Attanasio and Rohwedder (2003) significantly added to the literature by developing instrumental variable approaches that exploited the differential effect of reforms within pay-as-you-go systems on different pension wealth groups. Working with data for Italy and the United Kingdom respectively and imposing structure on the data like Gale (1998), they found convincing evidence that the crowding out effect exist for some specific groups (Italians between 35 and 45 years old, and British over 32 years old subscribed to the State Earnings-Related Pension Scheme).

While the previous groups of papers were based on pay-as-you-go systems, Quintanilla (2007) recently analysed the crowding out for Chile, the first country implementing a social security privatization. She worked with a single (post reform) cross section and dealt with the endogeneity problem by developing an instrumental variable approach that exploited the degree of choice Chileans had when deciding staying in the old system or opting out to the new system. The identifying assumption is that the group of individuals able to choose between the pay-as-you-go and funded systems could get higher pension wealth in average, while the same group did not get higher non-pension wealth for a reason over and above the pension wealth effect. Imposing structure on the data, she found an offset equal to -0.41 significant at the five percent level and another equal to -0.66 significant at the ten percent level, using two different instruments. In the Chilean case, unfortunately the lack of appropriate household surveys before the early privatization impedes the utilization of time series variation in the estimation.

3.3   Theoretical framework

The theoretical framework is a simple version of the life cycle model, quite similar to Gale (1998) and posterior authors. An individual maximizes the discounted lifetime utility within a discrete time framework, with the year as the time unit. The within-period utility function is isoelastic (constant risk aversion) for simplicity. The lifetime budget constraint assumes that the individual works during the

initial periods of his life and then retires, receiving a pension until passing away. Labor supply, income and pension streams are assumed to be exogenous. Retirement age and maximum attainable age are given. Formally, a generic individual solves the following maximization problem:

$$\max_{\{C_t\}} \sum_{t=1}^{T} \frac{C_t^{1-\rho}}{1-\rho} \cdot \delta^t \quad \text{subject to} \quad \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} \leq \sum_{t=1}^{R-1} \frac{E_t}{(1+r)^t} + \sum_{t=R}^{T} \frac{P_t}{(1+r)^t}$$

where t indexes age, C is consumption, E is cash earning, P is pension benefit, ρ is the coefficient of relative risk aversion ($\frac{1}{\rho}$ is the elasticity of intertemporal substitution), δ is the discount factor, r is the real interest rate, R is the retirement age and T is life span. The solution of this problem is the following:

$$C_t = \frac{[\delta \cdot (1+r)]^{\frac{t}{\rho}}}{\sum_{t=1}^{T} \delta^{\frac{t}{\rho}} \cdot (1+r)^{\frac{t}{\rho}-t}} \cdot \left(E^T + P^T\right) \quad \text{for all } t$$

$$\text{where } E^T = \sum_{t=1}^{R-1} \frac{E_t}{(1+r)^t} \quad \text{and} \quad P^T = \sum_{t=R}^{T} \frac{P_t}{(1+r)^t}$$

The stream $\{C_t\}$ provides the optimal levels of consumption during life. However, these levels change if an unanticipated modification in earnings or pensions is introduced. A modification in E^T or P^T shifts the budget constraint and forces the individual to reoptimize the problem. The new budget constraint, updated to the change period, must include the resources saved during past periods. The following formula provides the general solution for an individual of age t that experiences an unanticipated change in earnings or pensions in period tr:

$$C_{t,tr} = \frac{[\delta \cdot (1+r)]^{\frac{t-tr+1}{\rho}}}{\sum_{t=1}^{T-tr+1} \delta^{\frac{t}{\rho}} \cdot (1+r)^{\frac{t}{\rho}-t}} \cdot \left[(1+r)^{tr-1} \cdot E^T - \sum_{t=1}^{tr-1} C_t + (1+r)^{tr-1} \cdot P^T\right] \quad \text{where } t \geq tr \quad (3.1)$$

Voluntary saving rate can be expressed as a function of pension wealth by using Equation 3.1. In order to do so, the following two definitions are introduced:

$$s_t \equiv \frac{E_t - C_t}{E_t} \tag{3.2}$$

$$PW_t \equiv (1+r)^t \cdot P^T \tag{3.3}$$

where s_t is voluntary saving rate and PW_t is pension wealth. The function is obtained by using 3.3 to insert PW_t instead of P^T into Equation 3.1 and by inserting the resulting expression for consumption into Equation 3.2.

The derivative of voluntary saving with respect to pension wealth can be obtained by simple differentiation:

$$\frac{\partial s_t}{\partial PW_{tr}} = -\frac{1}{E_t} \cdot \frac{\delta^{\frac{t-tr+1}{\rho}} \cdot (1+r)^{\frac{t-tr+1}{\rho} - (t-tr+1)}}{\sum\limits_{t=1}^{T-tr+1} \delta^{\frac{t}{\rho}} \cdot (1+r)^{\frac{t}{\rho}-t}} \quad \text{where } t \geq tr$$

where this expression can be simplified by defining $\eta \equiv \delta^{\frac{1}{\rho}} \cdot (1+r)^{\frac{1}{\rho}-1}$ and by using the geometric progression formula. Thus,

$$\frac{\partial s_t}{\partial PW_{tr}} = -\frac{1}{E_t} \cdot \Phi\left[t, tr\right] \tag{3.4}$$

$$\text{where } \Phi\left[t, tr\right] \equiv \frac{1-\eta}{1-\eta^{T-tr+1}} \cdot \eta^{t-tr}$$

Equation 3.4 provides information on the crowding out that is crucial to the purposes of this paper. First, the negative sign means that a change in pension wealth is offset by an oppose modification in voluntary savings. Second, the equation provides an expression $\Phi\left[t, tr\right]$, hereafter called structural factor, which shows that the reaction for a change in pension wealth is not linear but dependent on how old the individual is at the reform period and how long the reform occurred before the period of observation. On the one hand, the closer the individual is to the maximum attainable age when the reform takes place (that is, the smaller $T - tr + 1$), the larger the structural factor is[2]. This outcome is related with the fact that younger individuals have a longer horizon to distribute the effect of an unexpected change in pension wealth, while older individuals hurry to change their saving pattern. On the other hand, the more distant to the analyzed period the reform is (that is, the larger $t - tr$), the smaller the structural factor. This outcome involves that the effect of a pension reform is high in the period that is immediately subsequent and that this effect persists but dwindles down as time goes by. Finally, the

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[2] The analysis assumes $\eta < 1$. This would be the case if a log utility was assumed (because $\rho = 1$ implies $\eta = \beta$).

model predicts a complete offset, which means that a pension wealth modification induces to a series of changes in voluntary saving (distributed from the reform period to the retirement age) whose sum equals the pension wealth modification[3]. This outcome implies perfect substitutability between pension and non pension wealth.

The empirical contrast of the previous conclusions can face problems from both inside and outside this simple theoretical framework. In the framework of the model, the adjustment factors are sensitive to the assumed parameters. For instance, a higher discount factor ($\uparrow \delta$), a higher elasticity of intertemporal substitution ($\downarrow \rho$), a longer life span ($\uparrow T$) or a higher discount factor ($\uparrow r$) will result in a general decrease in the adjustment factors. Moreover, the fact that the movements are not parallel further complicates any exact forecast. However, the crowding out existence and the positive relation between the size of the reaction and age remain under any sensible set of parameters. Outside the framework of the model, a number of issues may complicate the conclusions and specially the offset completeness. Liquidity constraints, bequest motives, implicit family arrangements, initial wealth and other issues may remove the relation between current voluntary savings and pension wealth. This would produce a true offset different from 100 percent and may compromise the level of the adjustment factors as predicted by this simple model.

3.4   Social security privatization in Peru

This section recaps from Chapter 1 what is strictly necessary to carry out the empirical analysis presented in this chapter.

Prior to the reform, a purely public pension systems operated on a pay-as-you-go basis was available for active workers (open pay-as-you-go)[4]. The system requires a minimum number of contribution years to be eligible to receive a pension, as well as a minimum retirement age. Benefits are determined ex-ante through a legal formula that yields pensions proportional to an average of final salaries. The system also includes a minimum pension and a maximum pension, which have the purpose of introducing income redistribution. This pension regime suffered from political manipulation, inappropriate management and corruption problems, which affected its redistributive purpose and compromised its economic independence.

Peruvian social security was privatized in 1993. The Alberto Fujimori administration (1990-2000)

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[3] This comes from the fact that $\sum_{t=tr}^{R} \Phi[t, tr] = 1$.

[4] Indeed, there were two purely public pension systems: one system had no restriction on membership and covered all private-sector workers and many civil servants, while the other system was limited to special groups of civil servants. However, since only a few active workers were enrolled to the closed pay-as-you-go, the description of the prior system exclusively focuses on the open pay-as-you-go. See Subsection 1.2.3 for more information on this.

lunched into radical and wide-ranging liberal reforms. The implemented liberal reforms were not presented by Fujimori during the political campaign, but rather criticized by him as the core of his political strategy against the liberal candidate Mario Vargas Llosa. The WB and the IMF played an important role in the turn of Fujimori to market-friendly policies, including social security privatization. These institutions proposed this privatization and actively promoted it, providing project lending and supplying technical assistance.

The introduced funded system does not require a minimum number of contribution years to be eligible to receive pension benefits, but only a minimum retirement age. The private funded system is a scheme of individual savings accounts, with defined contributions and managed by private pension fund administrators. Pension benefits are the result of individual saving and the return on those savings. Additionally to these resources, individuals switching from the pay-as-you-go to the funded system are entitled to recognition bonds if they have made a minimum number of past contributions.

As opposed to other countries that have phased out the pay-as-you-go system or that have created a unified multiple pillars system, the Peruvian funded system coexists with the reformed pay-as-you-go. Newcomers in the labor force are able to select their preferred system, while current workers are allowed to stay in the pay-as-you-go system and to switch to the funded system[5]. As both systems present roughly the same contribution rates and retirement ages, it can be asserted that workers choose between the pay-as-you-go and the funded by maximizing their pension wealth.

After privatization, individuals that sustained the pay-as-you-go system migrate to the funded system, so that the individual accounts of the funded system are financed from revenue previously devoted to the collective fund of the pay-as-you-go system. The lack of internal resources to respect pension benefits and the own problems of the two pay-as-you-go system, made the reform not intended to be revenue-neutral. In fact it was a objective of the reform to restrict the generosity of the pay-as-you-go system, as well as to provide more redistributive pension benefits (Section 1.1 explains the sequence of legal modifications to accomplish these goals).

The effect of the introduction of a funded system and the reorganization of the pay-as-you-go system on pension wealth is not easy to disentangle. Section 3.5.2 estimates the variable expected pension wealth for individuals in surveys before, during and after this reform, providing evidence on the following statements: 1) the reform within the pay-as-you-go system cut its generous benefits and corrected the redistribution mechanism by providing pensions relatively monotone on income and age; and 2) the introduced parallel funded system provides pensions whose computation directly depends on contributions capitalization; hence, pensions positively depend on income and negatively depend on age.

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[5] However, the right to choose is partially constrained because it was forbidden to switch back from the funded system to the pay-as-you-go system.

As individuals are able either to stay in the pay-as-you-go system or to switch to the funded system, they choose the system that maximizes their pension wealth. Hence, the reform did not have a uniform effect on pension wealth, but a huge heterogeneous effect. Moreover, the reform affected the universe of social security subscribers (those that stayed in the pay-as-you-go system and those that switched to the funded system).

Peruvian social security has a number of important features. Subscription to both pension systems continues for life, in such a way that unemployment does not imply falling out of the system. However, unemployment may affect the future pension level. In the pay-as-you-go system, obtaining a pension is subject to the accomplishment of a number of years contributing to the system. In the funded system, there are no accessibility conditions, but the pension is a direct function of the contributions made to the system during working life. Additionally, the recognition bond is subject to a minimum number of contributions.

Low coverage rates have historically characterized Peruvian social security, which has been a problem that the reform has been unable to solve. Legally, membership to pension systems is mandatory for wage workers, while voluntary for self-employees. However, the size of the Peruvian informal segment put a large fraction of the labor force outside pension systems. In fact, individuals uncovered by social security are also outside other established schemes like tax payments, health programs, regulation on minimum wages and job security legislation. Hence, the low coverage rate is not only related with the design of pension systems, but fundamentally with the fragmentation of the Peruvian economy.

The Peruvian social security privatization was unexpected, which is sustained by three facts. First, the Peruvian reform was not motivated by projected aging problems compromising its structural sustainability, but it was rather an attempt to protect the system from political manipulation and corruption problems. Second, the creation of the funded system corresponded to a general Peruvian policy shift toward market-friendly policies, which were not part of Fujimori's campaign platform. Third, the specific design of the reform was recommended by international financial institutions whose diagnostic was not based specifically on the Peruvian pay-as-you-system situation (Section 1.2 goes further on the Peruvian social security privatization as a source of exogenous variability).

3.5 Micro-data

3.5.1 Data description

The micro data used for the empirical analysis is three cross sections from the LSMS of Peru. From the six LSMS waves that have been conducted in Peru, this paper uses the surveys conducted in 1991, 1994 and 1997, which neatly capture the periods before, during and after the pension reforms.

An important variable for the empirical analysis is household voluntary saving rate, defined as the difference between household disposable income (net of taxes and mandatory social security contributions) and household consumption, divided over household disposable income. Household income is the sum of each member's earnings from wage employment and self-employment, as well as other wide-range sources of income (goods produced and consumed by the household, property rent, regular and irregular payments received). Household consumption includes spending on durable goods. Although the ideal definition of consumption should include the service flow from durables, the 1991 and 1994 surveys lack of information on the stock of durables to compute it (specifically, date of purchase and useful life). Notice that the paper works with the flow of voluntary saving, as opposed to using the stock of voluntary saving. While the former measure is able to recover the immediate response to a change pension wealth, the latter measure is accumulated over long periods and consequently its level can be related to a wide variety of previous events.

Another important variable is household pension wealth, defined as the discounted value of pensions that household members will receive in the future[6]. The LSMS does not provide information on pension wealth so that the paper computes it. The method considers that individual pension wealth is zero for those that declare being uncovered by social security and an individual-specific positive value for those that declare being covered by social security. The method for computing these values depends on whether the individual declares being enrolled to the pay-as-you-go system or to the funded system, as well as on the specific year of observation. Section 3.5.2 and specially Appendix C.1 explains this method in detail. Finally, individual pension wealth is aggregated in order to obtain household pension wealth.

The LSMS survey includes a variable that contains the weight of each observation. Hence, statistics and estimations throughout the empirical analysis come from weighted data. Household income, household consumption and all other monetary variables are set in real terms of June 2004 throughout the empirical analyses.

The unit of observation for the empirical analysis is the household because consumption (from which voluntary saving rate is constructed) is provided at the household level only. Hence, although enrolment to pension systems is an individual feature, the analysis considers this enrolment at a household basis. In particular, a household is taken as covered by social security if the head, the spouse or both are covered by it. Moreover, households with a son, daughter or other relative older than 25 years old covered by social security are also considered inside this group[7]. Additionally, the analysis considers that a household is in the pay-as-you-go system or in the funded system according to the enrolment of

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[6]Unlike in the works by Attanasio and Brugiavini (2003) and Attanasio and Rohwedder (2003), the pension wealth variable does not discount contributions to the pension system.

[7]Other filters have been applied, such as 40 years old, with no change on the results of the paper.

its members. Although household members may be enrolled to different systems, the data shows that these cases are only 45.

The scope of the empirical analysis is based on three criteria. First, the analysis is conducted exclusively for urban sectors. The orientation towards self-consumption of rural households and the informality of their economic activities put them away from the scope of pension schemes and any legal program. Second, the analysis is conducted for households whose head is at an economically active age, where the lower limit is 25 years old and the upper limit is given by the retirement age in force. This is because the aim of the paper is examining the effect of changes in future pensions. Finally, the analysis excludes households that have reported too negative saving rates. The climate of political violence, especially in 1991, made some households distrustful at the moment of the survey. On one hand, some households in the highest income sectors may have underestimated their income because of fearing a government tax review or a leak of information with delinquents. On the other hand, some households in the poorest income sectors may also have given distorted responses, fearing losing the governmental aid. In order to exclude households that supposedly misreported their income, a number of alternative arbitrary limits have been used. Finally, a -100% limit was chosen, excluding 207 additional households[8].

Table 3.1 shows the number of households under the scope of analysis. The final sample is composed of 4900 households, comprising 1182 from 1991, 1797 from 1994 and 1921 from 1997. Table 3.1 provides information on social security coverage too. As it has been explained, a large number of households are uncovered by social security due to the fragmentation of the Peruvian labor market.

Table 3.1 also shows the summary statistics. On one hand, the average voluntary saving rate has increased from 5.4% in 1991 to 10.4% in 1997. Notice that the increase of this rate has been larger for households covered by social security (from 6.5% to 13.6% or 13.8%) than for households uncovered by social security (from 4.6% to 9.0%). On the other hand, the average pension wealth has decreased from 15485 local monetary units in 1991 to 7110 local monetary units in 1997. Although these aggregated changes suggest a negative relation between voluntary saving and pension wealth, only an analysis on an individual basis can confirm it. In effect, the treated group indeed experienced all types of effects following the reform. While some individuals may see their pension wealth going down, others may see the pension wealth increasing. Next section will go further on this important characteristic of the Peruvian social security reform.

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[8] The results remain basically the same with other filters, such as –150% or -200%.

Table 3.1: Summary statistics of main variables

Year	Covered		Uncovered	Total
	Pay-as-you-go	Funded		
Number of observed households				
1991	494	0	688	1182
1994	411	110	1276	1797
1997	279	266	1376	1921
Mean of household voluntary saving rate				
1991	6.5	-	4.6	5.4
1994	8.1	10.1	6.3	6.9
1997	13.6	13.8	9.0	10.4
Mean of household pension wealth				
1991	37742	-	0	15485
1994	17305	29479	0	6449
1997	15211	30802	0	7110

3.5.2 Pension wealth

This section summarizes the procedure for the computation of pension wealth, while Appendix C.1 explains it in detail. Pension wealth is zero for individuals that declare being uncovered by social security and a positive value for individuals that declare being covered by social security. This last positive value is computed for each individual by the following stages:

1. Estimation of lifetime earnings profiles. These profiles are required and unavailable so that the paper estimates them. First, observed current earnings of each individual are imputed as a pivot point of his lifetime earnings profile. Second, the other points are computed by applying to this point a set of increase rates that corresponds to the group the individual belong to, which is done backward and forward (the next paragraph explains the computation of these increase rates). Finally, each profile is delimited from the first year in the labor market (six plus years of schooling) and the last year in the labor market (retirement age).

The sets of increase rates are computed following a simple econometric procedure. The data is the same three cross sections of the LSMS, but having the individual as the unit of analysis. The methodology estimates a Mincer (1974) equation, with sample selection, for log monthly earnings from wage employment. The estimated coefficients are used to simulate lifetime earnings profiles for several groups, by sweeping the occupational experience variable backward and forward. The groups are defined by the other five explanatory variables: years of schooling, gender, year of observation, number of household members and number of household income recipients. The outcome is group lifetime earning profiles that are used to compute group sets of variation rates

(i.e., the quotient of the income of one period divided by its lag).

2. Estimation of lifetime profiles for the probability of being working. These profiles are computed by using the coefficients of the selection equation of the previously estimated Mincer model. The lifetime profiles for the probability of being working are computed by sweeping the occupational experience variable backward and forward. The exercise can be done for different groups, where these groups are defined by the other explanatory variables. Finally, each profile is delimited from the first to the last year in the labor market. Hence, each individual receives the lifetime profile corresponding to the group he belongs to.

3. Pension estimation. The previous estimated lifetime profiles allow the estimation of the pension of each individual. For those enrolled to the pay-as-you-go system, the procedure implies checking the eligibility condition and computing the pension by applying the legal formula that corresponds to the observation year. For those enrolled to the funded system, the procedure implies computing the result of individual saving and the return on those savings at the retirement age, as well as the eventual recognition bond.

4. Individual and household pension wealth. Individual pension wealth is estimated as the discounted value of future pensions at the retirement period. The parameters for such estimation are real interest rate, probabilities of surviving in different periods conditional on having survived until one specific period, and maximum attainable age. Finally, in order to get household pension wealth, individual pension wealth is discounted to the period of analysis and aggregated by household.

The estimated pension wealth variable allows observing the heterogeneous effect of the reform. Figure 3-1 presents the average pension wealth of individuals enrolled to the five different pension systems: pay-as-you-go 1991, pay-as-you-go 1994, funded 1994, pay-as-you-go 1997 and funded 1997. The figure shows this average individual pension wealth by income quintiles and by age groups, in such a way that it is possible to see preliminarily how the reform affected pension wealth and how it changed the redistribution patterns of social security in terms of income and age.

Panel A of Figure 3-1 shows average individual pension wealth by income quintiles. In the original pay-as-you-go of 1991, average pension wealth is monotone in the first four income quintiles and significantly increases in the last quintile. Section 3.4 mentioned that the reform looked for cutting the generous benefits of the pay-as-you-go system and regaining the redistributional purpose of the system. Panel A shows that average pension wealth in the reformed pay-as-you-go systems is smaller in all income quintiles and that this average is relatively monotone in all income quintiles (especially in 1997). Section 3.4 also mentioned that the reform introduced a parallel funded system where pensions depend on contributions and the associated return. Panel A shows that, consistently with its capitalization

Figure 3-1: Average individual pension wealth in monetary units of June 2004
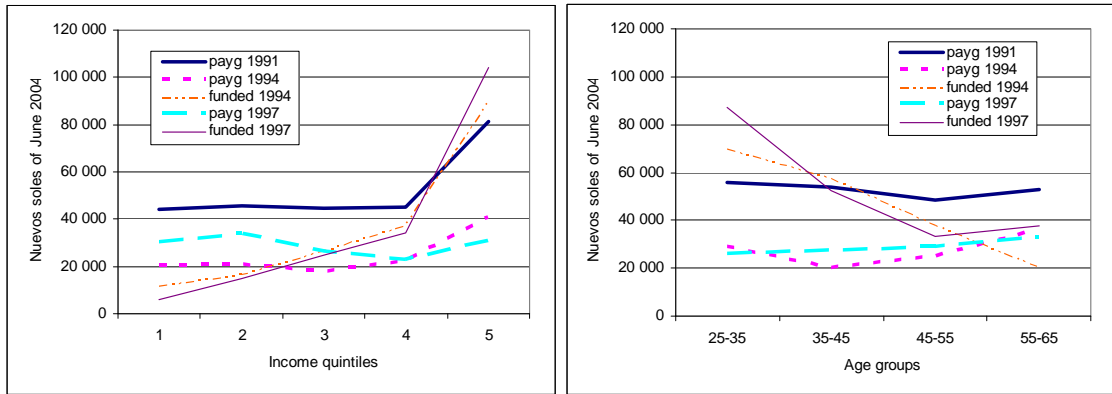
nature, there is a clear positive relation between income and pension wealth in the funded system. The average pension wealth of the funded system is smaller than the average pension wealth of the original pay-as-you-go system in the first four income quintiles, but larger in the last income quintile.

Hence, the change in pension wealth for each individual depended on his particular income level and his pension system choice. Individuals in the lowest income percentiles were negatively affected, although the impact was smaller for individuals that remained in the reformed pay-as-you-go system. However, for a given level of income, the impact was smaller for individuals that switched to the new funded system. Moreover, individuals of the highest income percentile that switched to the funded system experienced, in average, an increase in their pension wealth.

Panel B of Figure 3-1 shows average individual pension wealth by age groups. It shows that the original pay-as-you-go system presented a slight negative relation between age and pension, which means that it favored young individuals. The reformed pay-as-you-go system reduced the pension levels and, contrarily to the previous situation, presented a slightly positive relation between age and pension. The funded system introduced a clearly negative relation between age and pension, which is related with its capitalization nature. However, as the funded system included recognition bonds for old individuals that switched from the pay-as-you-go system, the negative relation was somewhat broken for the last age group.

Hence, the change in pension wealth for each individual depended on his particular age and his pension system. Roughly speaking, youngest individuals experienced a decrease in their pension wealth if they remained in the pay-as-you-go system, but an increase if they switched to the funded system. Middle aged and old individuals, however, experienced a different negative effect.

In sum, the estimated pension wealth variable shows that the reform changed the redistribution patterns of social security. In particular, the marginal effect of income on pension wealth and the marginal effect of age on pension wealth depend on the pension system the household belongs to (pay-as-you-go 1991, pay-as-you-go 1994, funded 1994, pay-as-you-go 1997 and funded 1997).

The previous analysis is only preliminary. A number of things are operating in the shown averages (age varies across income quintiles and income varies across age groups), in such a way that the changes in the redistribution patterns are not fully demonstrated. However, the econometric analysis is going to confirm the evidence provided trough this simple statistical analysis.

Finally, it is important to recognize that pension wealth is constructed from a number of reasonable but arbitrary assumptions. However, because the estimation strategy relies on an instrumental variable approach, the exact level of pension wealth is not crucial, but the fact that the selected instruments recover how social security privatization differently affected households. While introducing the instrumental variable technique, the paper will explain why this is the case. Hence, the computation of pension wealth does not seek to predict the exact level of the variable, but rather to provide a practical variable that allows the estimation and the interpretation of coefficients in terms of monetary units

3.6 Method

The effect of pension wealth on voluntary saving is found through the following specification:

$$SR_{ht} = \alpha \cdot socsec_{ht} + \beta \cdot PW_{ht} + X_{ht} \cdot \theta + \mu_{ht} \tag{3.5}$$

where SR_{ht} is the voluntary saving rate of household h observed at year t, $socsec_{ht}$ equals unity for households covered by social security and zero for households uncovered by social security, PW_{ht} is household pension wealth, X_{ht} is a set of control variables (see below), and μ_{ht} represents the unobservables that affect voluntary saving. The parameter of interest is β, which measures the effect of pension wealth on voluntary saving.

The parameter of interest is estimated using the time series variation provided by privatization and the cross sectional variation provided by two different sources. The first is related with the segmentation of the Peruvian labor market (formal and informal sectors), which implies the existence of a group covered by social security (whose pension wealth is greater than zero) and another group uncovered by social security (whose pension wealth is equal to zero). The second source of cross sectional variation is the heterogeneous effect that the reform had among members of the group covered by social security. In particular, the individual effect was determined by income and age.

The direct OLS estimation of Equation 3.5 may yield biased and inconsistent estimates of the crowding out for two endogeneity problems. First, the unobserved variables that explain the variables used to estimate pension wealth may be the same unobserved variables that explain voluntary saving. Second, to the extent that being covered or uncovered by social security is not a random event, the unobserved variables that determine who is covered by social security may be the same variables that determine voluntary saving. In order to properly identify the crowding out, the paper proposes an instrumental variable approach where the first stage regression is a Heckman model with an outcome equation for pension wealth and a selection equation for being covered by social security. Formally,

$$PW_{ht} = X_{ht} \cdot \Omega_x + Y_{ht} \cdot \Omega_y + \varepsilon_{ht}^{out} \tag{3.6}$$
$$\text{where } PW_{ht} \geq 0 \text{ if } socsec_{ht} = 1$$
$$\text{and} \quad PW_{ht} = 0 \text{ if } socsec_{ht} = 0$$

$$socsec_{ht}^* = X_{ht} \cdot \Phi_x + Z_{ht} \cdot \Phi_z + \varepsilon_{ht}^{sel} \tag{3.7}$$
$$\text{where } socsec_{ht} = 1 \text{ if } socsec_{ht}^* > 0$$
$$\text{and } socsec_{ht} = 0 \text{ if } socsec_{ht}^* \leq 0$$

where X_{ht} is the same set of control variables included in the second stage regression, Y_{ht} is the set of instrumental variables of the outcome equation (see below) and ε_{ht}^{out} represents the unobservables that affect pension wealth. Additionally, Z_{ht} is the set of instrumental variables of the selection equation (see below) and ε_{ht}^{sel} represents the unobservables that affect social security enrolment.

Assuming that $\varepsilon_{ht}^{out} \sim N(0,1)$, $\varepsilon_{ht}^{sel} \sim N(0,1)$ and $corr\left(\varepsilon_{ht}^{out}, \varepsilon_{ht}^{sel}\right) = \rho$, the Heckman model is estimated using maximum likelihood (see Heckman (1979)). This procedure provides consistent, asymptotically efficient estimates for all the parameters even if $\rho \neq 0$. The first stage equation provides the following two variables for the second stage equation.

$$\begin{aligned}\widehat{socsec}_{ht} &= \Pr\left(socsec_{ht} = 1\right) \\ \widehat{PW}_{ht} &= E\left(PW_{ht} / socsec_{ht} = 1\right) \cdot \Pr\left(socsec_{ht} = 1\right)\end{aligned}$$

where $\widehat{socsec_{ht}}$ is the predicted probability of being covered by social security (used instead of the $socsec_{ht}$ variable) and $\widehat{PW_{ht}}$ is the predicted pension wealth variable (used instead of the PW_{ht} variable). This last predicted variable is the product between the probability of being covered by social security and the expected value of pension wealth conditional on being covered by social security.

The described methodology uses a number of variables. The $socsec_{ht}$ variable is included in Equation 3.5 because households covered by social security possibly have different saving propensities than uncovered households. As the former work in the formal sector, they probably have access to more attractive saving mechanisms (mutual funds, stocks) and to more formal credit mechanisms (banks and microfinance institutions). While the former access is associated to a larger saving propensity, the latter access is related to a smaller one. Thus, the coefficient reveals the prevailing effect. Table 3.2 presents the variables included in the vectors X_{ht}, Y_{ht} and Z_{ht}.

Table 3.2: List of control and instrumental variables

Vectors and variables names	Variables list
$\mathbf{X}_{ht}$	
Year dummies	$year94$, $year97$ ($year91$ excluded)
Household income	$income$
Years of education of household head	$schooling$
Age of household head and square	age, $age2$
Gender of household head (female=1)	$female$
Number of dependents and square	$depend$, $depend2$
Number of income recipients	$earners$
$\mathbf{X}'_{ht}$	
Double interactions for income	$income \cdot year94$, $income \cdot year97$
Double interactions for age	$headage \cdot year94$, $headage \cdot year97$
$\mathbf{Y}_{ht}$	
Triple interactions for income	$income \cdot year94 \cdot payg$, $income \cdot year94 \cdot funded$,
	$income \cdot year97 \cdot payg$, $income \cdot year97 \cdot funded$
Triple interactions for age	$headage \cdot year94 \cdot payg$, $headage \cdot year94 \cdot funded$,
	$headage \cdot year97 \cdot payg$, $headage \cdot year97 \cdot funded$
$\mathbf{Z}_{ht}$	
Occupational groups	$whitecollar$, $services$ ($bluecollar$ excluded)
Economic sectors	$extractive$, $industry$, $construction$,
	$commerce$ ($services$ excluded)

The control variables included in the vector X_{ht} improve efficiency and avoid possible omitted variable biases for the coefficient of interest. Year dummies are included to let voluntary saving vary over time for factors such as economic growth, unemployment and inflation rates. Household income and years of education are measures of current and permanent income, respectively; while the former has a theoretical positive effect, the latter has a theoretical negative effect. The age of the household head and its square are included to observe part of the humped shape predicted by life cycle theory. The number of

dependents and its square are included because the variable may have a decreasing negative effect on household saving capacity. Finally, the number of income recipients is a measure of how composite a household is, which is related with economies of scale and transfers between families within a household.

The instrumental variables included in the vector Y_{ht} exploit that the marginal effect of income on pension wealth and the marginal effect of age on pension wealth depend on the pension system the household belongs to (pay-as-you-go 1991, pay-as-you-go 1994, funded 1994, pay-as-you-go 1997 and funded 1997). The triple interactions of income, year dummies and pension system attempt to capture the different marginal effects of income on pension wealth in each of these five scenarios, while the triple interactions for age, year dummies and pension system try to do the same with the different marginal effects of age. Hence, the instrumental variables exploit the fact that the Peruvian pension reform changed the redistribution patterns of social security with respect to income and age. The identifying assumption is that the marginal effect of income and the marginal effect of age on pension wealth depend on the pension system the household belongs to, but that the marginal effect of income and the marginal effect of age on voluntary saving do not.

The instrumental variables included in the vector Z_{ht} exploit the fact that enrolment to social security goes beyond the design of pension schemes and it is strongly related with formality issues. Households uncovered by social security are usually in the informal sector, that is, they are outside other established schemes like tax payments, health programs, regulation on minimum wages and job security legislation. As being formal or informal depends on the specific job position, the variables for occupational groups and economic sectors have an effect on social security coverage. The identifying assumption is that occupational groups and economic sectors do not have an effect on voluntary saving over and above the recovered by the probability of being covered by social security, the pension wealth variable and the several controls included in the second stage regression, such as income, age and years of education.

The methodology considers a set of additional control variables included in the vector X'_{ht}. The crucial identifying assumption until here is that the marginal effect of income and the marginal effect of age on voluntary saving do not depend on the pension system the household belongs to (pay-as-you-go 1991, pay-as-you-go 1994, funded 1994, pay-as-you-go 1997 and funded 1997), that is, that the triple interactions (income, year dummies and pension system; age, year dummies and pension system) do not play a role in the second stage regression. However, it can be argued that the marginal effect of income and the marginal effect of age on voluntary saving change across time. In order to handle this concern, the methodology somewhat relaxes the identifying assumption and progressively include as controls in the second stage regression double interactions of income and year dummies, double interactions of age and year dummies, and the full set of double interactions. The ultimate identifying assumption is that the marginal effect of income and the marginal effect of age on voluntary saving do not depend on

the nature of the pension system the household belongs to, that is, on whether the pension system is pay-as-you-go or funded.

3.7 Results

3.7.1 First stage results

The first stage results confirm the preliminary analysis of Subsection 3.5.2, in the sense that the reform changed the redistribution patterns of social security in terms of income and age. The results show, in particular, that the marginal effect of income and the marginal effect of age on pension wealth depend on the pension system the household belongs to (pay-as-you-go 1991, pay-as-you-go 1994, funded 1994, pay-as-you-go 1997, funded 1997). In order to see it, Table 3.3 reports a summary on the estimate of Equation 3.6 (it includes the variables $income$, age, $age2$ and the four triple interaction terms associated to 1997; the full estimates for Equation 3.6 and Equation 3.7 are presented in Appendix C.2). The results associated to the basic set of controls X_{ht} are commented here (first column); a similar interpretation can be drawn for the other set of controls. First, observe how the marginal effect of income on pension wealth varies across pension systems. In 1991, 100 additional monetary units of income meant 54.94 additional monetary units in the stock of pension wealth. In 1997, the same change in income meant only 2.68 more monetary units in pension wealth in the reformed pay-as-you-go system (54.94-52.27) and 81.03 more under the funded scheme (54.94+26.09). In other words, the original pay-as-you-go system gave higher pensions to those with higher income, while the reformed pay-as-you-go system regained its original redistributive purpose. The new funded scheme is highly proportional, as expected, because it provides pensions in direct function of personal income. Second, observe how the marginal effect of age on pension wealth also varies across pension systems. In 1991, one additional year in age meant an increase of $-1274 + 18 \cdot age$ monetary units in pension wealth. In 1997, the same additional year meant an increase of $-1386 + 18 \cdot age$ in pension wealth in the reformed pay-as-you-go (-1386=-1274-112), while a decrease of $-1748 + 18 \cdot age$ in the new funded scheme (-1748=-1274-474). In other words, from the point of view of the original pay-as-you-go, the reform favored young individuals, especially in the funded system.

Table 3.3: First stage model - Heckman selection model: summary of outcome equation for pension wealth

Explanatory variables	Regression 1	Regression 2	Regression 3	Regression 4
Household income	0.5494	0.5535	0.5604	0.5514
	(0.2136)	(0.2674)	(0.2287)	(0.2676)
Age	-1273.935	-1249.227	-1308.781	-1247.681
	(587.181)	(644.707)	(591.318)	(638.760)
Age (square)	17.898	17.722	18.629	17.982
	(6.654)	(7.347)	(6.750)	(7.148)
Income·Year 1997·pay-as-you-go	-0.5227	-0.5252	-0.5348	-0.6056
	(0.2263)	(0.1607)	(0.2419)	(0.2)
Income·Year 1997·funded	0.2609	0.2563	0.2502	0.1749
	(0.2236)	(0.2)	(0.2)	(0.22)
Age·Year1997·pay-as-you-go	-111.6533	-115.022	-67.04275	12.85854
	(193.2056)	(122.3102)	(274.3246)	(212.3352)
Age·Year 1997·funded	-474.0959	-476.2219	-430.543	-348.3518
	(201.5871)	(147.0918)	(274.2656)	(227.8387)
Other triple interactions	$income \cdot year94 \cdot payg$, $income \cdot year94 \cdot funded$,			
	$headage \cdot year94 \cdot payg$, $headage \cdot year94 \cdot funded$			
Controls	Years of schooling, gender, number of dependents (and square),			
	number of income recipients, year 1994, year 1997, intercept			
Additional controls	None	Income·Year 1994	Age·Year 1994	Full set
		Income·Year 1997	Age·Year 1997	

Notes: Number of observations equals 4900 households (3304 censored and 1596 uncensored).
Standard errors in parentheses.

The first stage results also confirm that the set of instrumental variables Y_{ht} and Z_{ht} satisfy the condition of instrument relevance. Table 3.4 provides the statistic chi2. The statistic chi2(8) testing the hypothesis that the coefficients associated to the eight triple interaction terms are all zero is greater than 67 in all of the alternative specifications, so that the null hypothesis is rejected at any level of significance: Prob > chi2(8) = 0.0000. Hence, it can be stated that the Peruvian structural pension reforms have changed how income and age affect pension wealth. The statistic chi2(6) testing the hypothesis that the coefficients associated to the dummies for occupational groups and economic sectors are all zero is greater than 52 in all of the alternative specifications, so that the null hypothesis is rejected at any level of significance: Prob > chi2(6) = 0.0000. This favors the statement that being covered by social security depends on the formality of the specific job position.

Table 3.4: Tests of instrument relevance in the first stage regression

Test	Regression 1	Regression 2	Regression 3	Regression 4
chi2(8) statistic	72.51	72.67	67.85	67.60
chi2(6) statistic	67.19	54.48	58.95	52.84

Notes: chi2(8) tests the hypothesis that the instruments of the outcome equation are not relevant and chi2(6) tests the hypothesis that the instruments of the selection equation are not relevant.

3.7.2 Second stage results

Table 3.5 reports on the IV estimate of Equation 3.5. The main result is that the estimated impact of pension wealth on voluntary saving is negative and highly significant across alternative specifications. The first column presents a specification with the basic set of controls X_{ht}, the second column includes double interactions of income and year dummies, the third column includes double interactions of age and year dummies and finally the forth column includes the full set of double interactions X'_{ht} (these four specifications correspond to different identification assumptions that will be explained intuitively at the end of this section). The estimated coefficient, significant at the one-percent level in all of the specifications, is either -0.0008 or -0.0010. This means that an increase of 1000 monetary units in the stock of pension wealth would subtract either 0.8% or 1.0% of the voluntary saving rate (point estimates). Hence, Table 3.5 show that pension wealth does crowd out voluntary saving.

The results also confirm the expected relations between voluntary saving rates and most of the control variables. The dummy for social security coverage reveals that, keeping constant other characteristics, expected voluntary saving rate for households covered by social security is higher than expected voluntary saving rate for household uncovered by social security. Household income has a positive sign, showing that changes in income perceived as temporary have little effect on consumption spending. Years of schooling (introduced to control for permanent income) has a negative sign, showing that changes in income perceived as permanent do increase consumption. The age of the household head and its square are not significant. The humped shape is not observable, probably because the analysis is conducted only for households whose heads are below the retirement age[9]. The dummy for gender of household head is not significant. The number of dependents and its square reveal that the variable has a negative effect on household saving capacity, which is not decreasing. The number of income recipients reveals that the merge of families generates economies of scale and favors monetary and time transfers. Finally, the year dummies do not have coefficients stable across specifications.

---

[9] Apart from linear and quadratic controls, dummies of age were considered. As the coefficients of these variables were not significant, the results are not included.

Table 3.5: Instrumental variable regression of household voluntary saving rate on pension wealth
Linear effect

Explanatory variables	Regression 1	Regression 2	Regression 3	Regression 4
Household pension wealth	-0.0008	-0.0010	-0.0008	-0.0010
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Covered by social security	24.5166	30.7378	25.4511	31.8162
	(7.1011)	(7.5775)	(7.1860)	(7.6971)
Household income	0.0008	0.0011	0.0009	0.0011
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Years of schooling	-0.9731	-1.0076	-1.0031	-1.0713
	(0.2294)	(0.2359)	(0.2320)	(0.2401)
Age	-0.6761	-0.7282	-0.6899	-0.7545
	(0.4529)	(0.4699)	(0.4550)	(0.4721)
Age (square)	0.0077	0.0084	0.0091	0.0096
	(0.0049)	(0.0051)	(0.0050)	(0.0052)
Gender	-1.5972	-1.9474	-1.4682	-1.7496
	(1.5544)	(1.5953)	(1.5632)	(1.6059)
Number of dependents	-1.9774	-2.2938	-1.9747	-2.3066
	(0.7703)	(0.7936)	(0.7749)	(0.8001)
Number of dependents (square) .	0.1081	0.1223	0.1054	0.1205
	(0.0833)	(0.0864)	(0.0839)	(0.0872)
Number of income recipients	4.5949	4.5952	4.5343	4.4354
	(0.6126)	(0.6276)	(0.6165)	(0.6343)
Year 1994	-6.5302	0.7700	-2.5014	0.3933
	(1.6371)	(2.5961)	(6.8822)	(7.1515)
Year 1997	-5.1431	-2.5846	3.1227	4.8128
	(1.7559)	(2.6163)	(6.8225)	(7.0595)
Income · Year 1994		-0.0004		-0.0004
		(0.0001)		(0.0001)
Income · Year 1997		-0.0002		-0.0002
		(0.0001)		(0.0001)
Age · Year 1994			-0.1087	-0.0326
			(0.1534)	(0.1601)
Age · Year 1997			-0.1971	-0.2001
			(0.1514)	(0.1587)
Intercept	13.0881	10.0955	11.0296	9.7441
	(10.2615)	(10.7309)	(10.9809)	(11.4313)

Notes: Predicted household pension wealth is the product between the probability of
being covered by social security and the expected value of pension wealth conditional
on being covered by social security. Number of observations equals 4900 households
(3304 censored and 1596 uncensored). Standard errors in parentheses.

The results are quite robust to different identifying assumptions. The variability that identifies the parameter of interest changes from one column to the other. The first column assumes that the marginal effect of income on voluntary saving and the marginal effect of age on voluntary saving were the same in pay-as-you-go 1991, pay-as-you-go 1994, funded 1994, pay-as-you-go 1997 and funded 1997. The second column allows the marginal effect of income on voluntary saving to vary over time. However, it assumes that this effect does not differ between the pay-as-you-go and the funded system. Additionally, it assumes that the marginal effect of age on voluntary saving is the same in the five scenarios. The third column, similarly, allows the marginal effect of age on saving to vary over time. This effect, again, cannot differ between the pay-as-you-go system and the funded system. Additionally, it assumes that the marginal effect of income on voluntary saving does not change. Finally, the fourth column allows both, the marginal effects of income and age on voluntary saving, to differ with years. The ultimate assumption is that these effects are not different in accordance to the nature of the pension system.

Finally, it is important to mention that the same methodology has been applied but exclusively on households covered by social security. Appendix C.3 presents the results, which are quite similar to these.

3.8   Extensions

3.8.1   Pension wealth as a step function of age groups

The first additional specification tests whether the individual reaction for a change in pension wealth, as the theoretical model of Section 3.3 predicts, is not linear but dependent on age. In order to have a possibility that the degree of substitutability between voluntary saving and pension wealth changes over the life cycle, Equation 3.5 is slightly modified to let the coefficient on pension wealth be dependent on age. The equation of interest is the following:

$$
\begin{aligned}
SR_{ht} \;=\; & \alpha \cdot socsec_{ht} + \beta_1 \cdot age25\_35 \cdot PW_{ht} + \beta_2 \cdot age35\_40 \cdot PW_{ht} + \beta_3 \cdot age40\_45 \cdot PW_{ht} \qquad (3.8) \\
& + \beta_4 \cdot age45\_50 \cdot PW_{ht} + \beta_5 \cdot age50\_55 \cdot PW_{ht} + \beta_6 \cdot age55\_60 \cdot PW_{ht} + \beta_7 \cdot age60\_65 \cdot PW_{ht} \\
& + X_{ht} \cdot \theta + \mu_{ht}
\end{aligned}
$$

where the new variables with respect to the previous equations are the dummies $age25\_35$, $age35\_40$, $age40\_45$, $age45\_50$, $age40\_45$, $age45\_50$, $age50\_55$, $age55\_60$ and $age60\_65$, equals unit for households whose head is aged between the defined ranges. The coefficients associated to the interactions of pension wealth and the group dummies (that is β_1, β_2, β_3, β_4, β_5, β_6, β_7) are expected to be negative

and to have an increasing absolute value with respect to the age of the household head.

Table 3.6 reports on the IV estimate of Equation 3.8. The estimates of the coefficients of pension wealth are negative and highly significant for all the age groups. Moreover, their absolute value roughly increases with the age of the household head. The model of Section 3.3 predicts that individual reaction for a change in pension wealth was not linear but dependent on his age. The estimations provide evidence that favors that conclusion. Intuitively, younger heads of household react moderately to an unexpected change in pension wealth and older heads of household hurry up to respond, which would be explained by the different time horizon to adjust wealth. Figure 3-2 describes the life cycle pattern of the estimated reaction. The figure shows the results for the specification with the basic set of controls, although the results are roughly the same across alternative specifications.

Table 3.6: Instrumental variable regression of household voluntary saving rate on pension wealth
Non linear effect: pension wealth is multiplied by dummies for age groups

Explanatory variables	Regression 1	Regression 2	Regression 3	Regression 4
Pension wealth·age25_35	-0.0006	-0.0008	-0.0007	-0.0008
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Pension wealth·age35_40	-0.0008	-0.0011	-0.0008	-0.0011
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Pension wealth·age40_45	-0.0007	-0.0008	-0.0007	-0.0009
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Pension wealth·age45_50	-0.0008	-0.0011	-0.0009	-0.0011
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Pension wealth·age50_55	-0.0009	-0.0011	-0.0009	-0.0011
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Pension wealth·age55_60	-0.0008	-0.0010	-0.0009	-0.0010
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Pension wealth·age60_65	-0.0012	-0.0011	-0.0012	-0.0012
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Covered by social security	21.8960	28.6442	22.7622	29.4511
	(7.1371)	(7.4878)	(7.2449)	(7.5928)
Controls	Household income, years of schooling, age (and square), gender, number of dependents (and square), number of income recipients, year 1994, year 1997, intercept			
Additional controls	None	Income·Year 1994 Income·Year 1997	Age·Year 1994 Age·Year 1997	Full set

Notes: Predicted household pension wealth is the product between the probability of being covered by social security and the expected value of pension wealth conditional on being covered by social security. Number of observations equals 4900 households (3304 censored and 1596 uncensored). Standard errors in parentheses.

Figure 3-2: Life cycle pattern of the estimated effect of pension wealth on voluntary saving rate
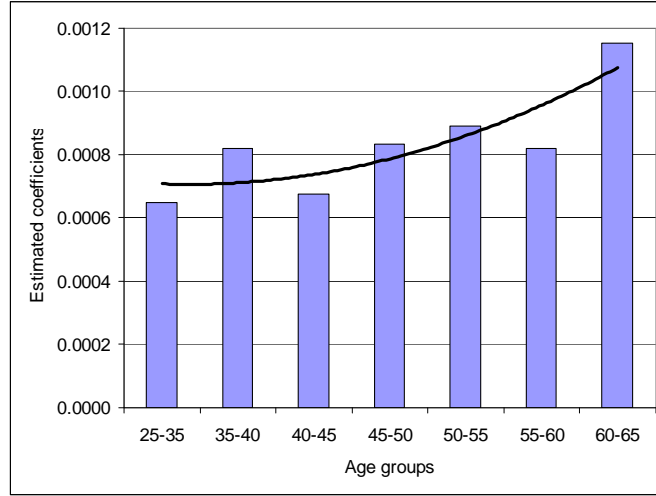
3.8.2 Life-cycle model structure on the data

The second additional specification tests up to what extent the offset between voluntary saving and pension wealth is perfect, as the theoretical model of Section 3.3 predicts. In order to quantify the offset, Equation 3.5 is modified to regress voluntary saving rates on the pension wealth variable divided by current income and multiplied by the adjustment factors (exactly as Equation 3.4 describes). The following equation includes the referred modification:

$$SR_{ht} = \alpha \cdot socsec_{ht} + \gamma \cdot \left[\Phi\left(t, tr\right) \cdot \frac{PW_{ht}}{income_{ht}} \right] + X_{ht} \cdot \theta + \mu_{ht} \qquad (3.9)$$

The plain application of the theoretical model of Section 3.3 in reality would imply that a change in expected pension wealth would be completely offset through modifications in saving rates. Mathematically, any change in the ratio of pension and current income would determine a change in the current saving rate equal to the structural factors $\Phi\left[t, tr\right]$ given by Equation 3.4. Theoretically, the estimated coefficient γ is expected to be minus one. Empirically, the absolute value of coefficient γ would quantify, in a range from zero to one, to what extent the offset is perfect. In order to apply Equation 3.9, the adjustment factors $\Phi\left[t, tr\right]$ are computed assuming $\delta = 0.98$, $\rho = 1$, $r = 0.03$ and $T = 65$.

Table 3.7 reports on the IV estimate of Equation 3.9. The estimates show an estimator γ that goes from -0.7 to -1.0, as predicted by the model of Section 3.3. The estimator is significant at the one-percent level across specifications. What is the interpretation of the coefficient γ in this framework?

The estimated coefficients mean that there is a general negative offset that goes from 70% to 100% between pension wealth and voluntary saving in Peru, assuming that the simple model of Section 3.3 and its calibration are valid to reveal households reactions.

Table 3.7: Instrumental variable regression of household voluntary saving rate on pension wealth
Non linear effect: pension wealth multiplied by theoretical response and divided by income

Explanatory variables	Regression 1	Regression 2	Regression 3	Regression 4
Adjusted pension wealth	-0.7288	-0.7085	-0.9574	-1.0107
	(0.1708)	(0.1682)	(0.2062)	(0.2224)
Covered by social security	1.2754	0.2651	3.0480	2.3864
	(5.9552)	(5.8873)	(6.0753)	(6.0412)
Controls	Household income, years of schooling, age (and square), gender,			
	number of dependents (and square), number of income recipients,			
	year 1994, year 1997, intercept			
Additional controls	None	Income·Year 1994	Age·Year 1994	Full set
		Income·Year 1997	Age·Year 1997	

Notes: Adjusted pension wealth is the product between predicted household pension
wealth and the structural factor (see Section 3.2), divided by income.
Number of observations equals 4900 households (3304 censored and 1596 uncensored)
Standard errors in parentheses.

How do these results compare with previous estimations? There are three papers that impose similar structures on micro data, in such a way that their results can be compared with these. Attanasio and Brugiavini (2003), who works with micro data from Italy, find a significant offset equal to -0.33 in one regression and offsets not significantly different from zero in other three alternative regressions[10]. They additionally estimate the offset for different age groups and find a significant offset close to minus one for households heads between 36 and 45 years old. Attanasio and Rohwedder (2003), who work with micro data for the United Kingdom, estimate the offsets for the two British systems. They only present results for different age groups. For the Basic State Pension, all the offsets are not significantly different from zero. For the State Earnings-Related Pension Scheme, they find a significant offset equal to -0.75 for the aged 54-64 group. They also find offsets equal to -0.55 and -0.65 for the aged 32-42 and 43-53 groups respectively, although the coefficients are only significant at the five-percent level. Quintanilla (2007), who works with micro data for Chile, finds an offset equal to -0.41 using one instrument and another equal to -0.66 using another instrument. The former is significant at the five-percent level and the latter is significant at the ten-percent level.

The offset for Peru is found significant at the one-percent level for the whole sample in all of the considered specifications. A possible explanation is that the Peruvian social security privatization has advantages as a natural experiment (see Section 1.2). The offset for Peru is also found larger than the

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[10] The four regressions correspond to two different specifications and to two different sample sizes.

offset obtained for Italy and United Kingdom. However, the size of the offset should not have to be seen as the main contribution of this paper, because it is indeed sensitive to the assumed parameters: the discount factor (δ), the elasticity of intertemporal substitution (ρ), the life span (T) and the discount factor (r). Hence, the significance of the negative sign and its robustness throughout specifications is more important, as previous research finds a significant negative relation only for specific age groups.

3.9   Conclusions

This paper uses three repeated cross-sections of the LSMS before and after the Peruvian social security privatization in order to examine the effect of an estimate of household pension wealth on household voluntary saving. The parameter of interest is estimated using the time series variation induced by the reform, as well as the cross sectional variation provided by two sources: the segmentation of the Peruvian labor market, which divides the sample in households covered and uncovered by social security; and the dissimilar effects the reform had on households with different income and different ages. The pension wealth variable is instrumented to control for potential endogeneity, exploiting that the Peruvian reform significantly changed the redistribution patterns of social security with respect to income and age.

The results confirm three important theoretical features related with saving behavior. First, a pension wealth change causes a modification of opposite sign in voluntary saving. The point estimate, significant at the one percent level, shows that an increase of 1000 monetary units in the stock of pension wealth subtracts either 0.8% or 1.0% of the average voluntary saving rate. Second, the negative relation is empirically confirmed at a one-percent level for different age groups. More importantly, as predicted by theory, the size of the reaction increases with age. This intuitively means that, while younger heads of household react moderately to an unexpected change in pension wealth, older hurry up to respond because of their shorter time horizon. Finally, the imposition of life cycle model structure on the data allows observing that the offset is between 70% and 100%. This means that a pension wealth modification induces to a series of changes in voluntary saving whose sum presumably equals a percentage between 70% and 100% of the pension wealth modification. This outcome implies almost perfect substitutability between pension and non pension wealth.

These results have important implications both for contrasting theoretical statements about saving behavior and for discussing some modern policy issues. On one hand, the paper confirms the most basic conclusions of the life cycle model, that is, that a change in pension wealth is completely offset by a modification of opposite sign in voluntary savings. This behavior is explained by a desire to avoid drastic changes in consumption patters after retirement. It also confirms that the size of the reaction positively depends on the age of the individual, which occurs because the offset is distributed over the lifespan

remaining after the pension change. On the other hand, the paper contributes to the discussion of the effects of pension reform on national savings. For instance, it is usually argued that a conversion from a pay-as-you-go system to a funded system is supposed to increase savings by forcing households to save a fixed share of labor income. However, it may also reduce savings due to crowding out voluntary savings. Thus, the crowding-out effect is important because it can reduce the effect of privatization on national savings to some extent.

Appendix A

Social security privatization in Peru

This section technically describes the pension benefits formulas of the open-pay-as-you-go system and the funded system. Since pension benefits in the closed pay-as-you-go system were simply equal to the wage received in the last position the retiree held, this system has no pension benefits formula.

A.1 Pension benefits formulas of the open pay-as-you-go

Prior to the reform, pension benefits were computed as the 50% of a "reference wage", plus an additional percentage (2.0% for males and 2.5% for females) for each contribution year additional to the minimum required. The reference wage was defined as the highest amount among of the average of the last 12, 36 and 60 months of contribution. Equation A.1 corresponds to the legal formula prior to the reform.

$$
\begin{aligned}
p_{payg} &= 0.50 \cdot rw + 0.020 \cdot rw \cdot (q - 15) \text{ for males} \\
p_{payg} &= 0.50 \cdot rw + 0.025 \cdot rw \cdot (q - 13) \text{ for females}
\end{aligned} \tag{A.1}
$$

where rw is the reference wage and q is the expected number of contribution years.

The reform of the open pay-as-you-go changed the pension formula: pension benefits were equal to 50% of the reference wage plus 4% for each additional year (this time, each year over 20). The reference wage was also defined differently: the average of the last 60 months for individuals with a number of years of contribution between 20 and 24, the average of the last 48 months for individuals with a number of years of contribution between 25 and 29; and the average of the last 36 months for individuals with more than 30 years of contribution. Equation A.2 corresponds to the legal framework after the reform. Finally, by other legal devices, the minimum pension was slightly increased in real terms, while

the maximum pension was slightly decreased in real terms. Both changes contributed to recover the redistributive purpose of the pay-as-you-go.

$$p_{payg} = 0.50 \cdot rw' + 0.04 \cdot rw' \cdot (q - 20) \text{ for males and females} \tag{A.2}$$

where rw' is the new reference wage.

A.2   Pension benefits formula of the funded system

Pension benefits of the funded scheme are a direct function of the resources accumulated in the Individual Capitalization Account (ICA) during working life. The following formula indicates the expected value of the ICA at the retirement age, which is 65 regardless of gender:

$$ICA = \left(\sum_{t=t_0}^{T} \frac{a_t \cdot e_t}{v_t} \right) \cdot v_T \tag{A.3}$$

where a_t is the contribution rate, e_t is the yearly employment wage and v_t is the value quote, which is the unit of measure of the pension fund. In addition, t_0 is the period of affiliation to the funded scheme and T is the period of retirement. Hence, the final level of the ICA is the sum of the quotes periodically bought with the contributions, multiplied by the value of the quote at the retirement age.

The pension of the funded system temporarily includes a recognition bond, a governmental transfer given in recognition for the past contributions made to the pre-existing pay-as-you-go system. Individuals switching from the pay-as-you-go to the funded system are entitled to these recognition bonds if they have made a minimum number of past contributions. The face value of the bonds is given by the following formula:

$$B = 0.1831 \cdot rw'' \cdot m \tag{A.4}$$

where rw'' is a kind of reference wage, computed as the average of the last twelve wages, and m is the number of months of contribution to the pay-as-you-go system. It is important to consider that the value of the bonds has an upper limit of S/.60000 of December 1992, which is periodically actualized by the Consumer Price Index.

Finally, the pension is a direct function of the sum of the ICA and the recognition bond at retirement age:

$$pension_{funded} = \frac{ICA + B}{URC} \tag{A.5}$$

A.3 Composition of household consumption

Aggregate value for household consumption is available as part of the Peru LSMS data files. This appendix, taken from official WB documentation, describes the composition of this aggregate. Total household expenditure on consumption goods is calculated as the sum of:

1. Foods consumed, including:

   - food, drink, and tobacco purchases;

   - estimated value of self-produced food, drink and tobacco;

   - estimated value of food received as in-kind payments from employer.

2. Clothing purchased and received in-kind from employer.

3. Housing expenses, including:

   - rent;

   - utilities and local property taxes;

   - other regular expenses.

4. Household maintenance expenses, including:

   - purchases of furniture and appliances;

   - purchases of products for household cleaning and repairs;

   - maid services;

   - estimated value of goods produced by own business and used for household consumption.

5. Expenses for health care and medicine.

6. Expenses for transportation and communications, including:

   - public transportation, gasoline, and mail;

   - maintenance and repair of vehicles;

   - long-distance travel;

- purchase of vehicle for personal use (automobile, motorcycle, bicycle);

- telephone service.

7. Education and entertainment expenses, including:

   - magazines and newspapers;

   - books, games, other entertainment items;

   - purchase of radio, television, camera, etc.

   - schooling: tuition, transport to school, meals, school supplies;

   - pre-school expenses.

8. Other goods and services, including:

   - meals purchased at restaurants;

   - goods for personal hygiene;

   - other products produced by home business and consumed by household.

9. Value of transfers (monetary or in-kind) given to non-household members.

Appendix B

What is the role of social security privatization in changing elderly welfare?

B.1 Extensions from the basic setup

Table B.1: OLS regression of consumption: effect of privatization by educational level

Variable	OLS	Variable	OLS
Covered*Post*None	1106.3	Post*Primary school	2399.2
	(1360.5)		(422.0)
Covered*Post*Primary school	2116.5	Post*High school	2567.0
	(956.1)		(470.6)
Covered*Post*High school	2787.9	Post*Technical	2792.1
	(1063.3)		(1533.3)
Covered*Post*Technical	3136.1	Post*University	8466.7
	(1864.4)		(1380.7)
Covered*Post*University	4634.6	Other controls: Age (and square),	
	(2070.1)	gender, family size	
Covered	-253.4	(and square), composite	
	(812.5)	and intercept	
Post*No-education	1480.4		
	(988.3)	N	9006

Notes: The standard errors are in parentheses.
The estimation is weighted.

Table B.2: Simultaneous-quantile regression of consumption: effect of privatization

Variable	Quantile regressions		
	25th percentile	50th percentile	75th percentile
Covered*post	1723.9	2977.5	4688.5
	(623.7)	(747.7)	(1137.1)
Covered	472.8	-44.7	-402.5
	(441.0)	(768.3)	(1013.0)
Post	1935.3	2359.4	2397.8
	(240.8)	(226.8)	(339.6)
Age	336.7	454.3	591.0
	(32.7)	(33.9)	(57.6)
Age (square)	-2.7	-3.7	-4.5
	(0.3)	(0.3)	(0.5)
Gender (Female=1)	-184.8	-456.2	-466.5
	(166.3)	(164.2)	(386.3)
Family size	1135.5	1270.7	1136.8
	(116.7)	(217.9)	(312.0)
Family size (square)	-36.6	-38.2	-10.9
	(7.8)	(16.8)	(24.9)
Composite household	1859.1	2786.6	3430.7
	(196.9)	(233.1)	(395.6)
Intercept	-10248.6	-11849.9	-13936.9
	(760.5)	(902.8)	(1556.5)
Other controls:	Primary school, High school, Technical, University		
N	9006	9006	9006

Notes: The standard errors are in parentheses.

Table B.3: OLS regression of consumption: effect of privatization by age groups

Variable	OLS
Covered*post*age50	2534.7
	(1410.7)
Covered*post*age50-60	4239.1
	(1681.9)
Covered*post*age60	2489.4
	(1093.5)
Covered	-410.3
	(857.4)
Post*age50	2885.2
	(388.6)
Post*age50-60	4438.0
	(614.3)
Post*age60	3865.7
	(713.4)
Other controls: age (and square), gender, educational attainment, size (and square), composite intercept.	
N	9006

Notes: The standard errors are in parentheses.
The estimation is weighted.

Table B.4: OLS regression of consumption: effect of privatization by year

Variable	OLS
Covered*Year 1994	3670.4
	(1276.0)
Covered*Year 1997	3984.5
	(1184.2)
Covered*Year 2000	2873.3
	(1154.3)
Covered	-729.5
	(836.8)
Year 1994	2817.3
	(458.6)
Year 1997	3853.4
	(407.9)
Year 2000	3237.1
	(439.4)
Other controls: age (and square), gender, educational attainment, size (and square), composite, intercept.	
N	9006

Notes: The standard errors are in parentheses.
The estimation is weighted.

Appendix C

Does pension saving crowd out voluntary saving?

C.1 Construction of household pension wealth

This appendix explains the construction of household pension wealth. For individuals that declare being uncovered by social security, pension wealth is zero. For individuals that declare being covered by social security, pension wealth is computed following a number of steps. First, lifetime earnings profiles are computed, as well as lifetime profiles for the probability of being working. Second, pension wealth is estimated by applying separate procedures to those enrolled to the pay-as-you-go and those enrolled to the funded system. Third, individual pension wealth is the discounted value of future pensions. Finally, individual pension wealth is aggregated to get household pension wealth.

C.1.1 Lifetime profiles construction

The LSMS does not provide lifetime earnings profiles but only current earnings, so that the paper constructs them. In order to do so, it is assumed that current earnings of each individual are actually a point of his lifetime earnings profile. The simplest alternative to estimate the other points would be assuming that earnings are the same from the beginning of working life to retirement. It is also possible to assume a fix increase rate for all individuals, which could be applied backwards and forwards to current earnings. However, the paper conducts a simple econometric work to obtain sets of increase rates for different groups. Hence, individual lifetime earnings profiles are computed by applying to individual current earnings the set of increase rates that corresponds to the group the individual belong to.

The paper estimates several sets of increase rates through a simple econometric technique. The data

is the three cross sections of the LSMS already introduced. The unit of analysis is the individual. The scope of analysis is the economically active population (individuals between 18 and 65 years old that are not household worker, invalid, sick or student). The methodology estimates a Mincer (1974) equation for log monthly earnings from wage employment, with sample selection. The dependent variable is earnings from wage employment only, because social security benefits are computed exclusively from them. It is assumed that there exists an underlying regression relationship

$$\log(y_i) = x_i\beta + \mu_{1i}$$

As in the most widely used version of Mincer's "human capital earnings function", the logarithm of earnings is modelled as a linear function of the following variables:

- Occupational experience (current age minus years of schooling). As individuals gain experience, their work should be more valuable.

- Square of occupational experience. This variable allows for possible quadratic relations.

- Years of schooling. As a proxy of human capital, this variable should increase labor income.

- Gender (one for woman and zero for man). Women may confront discriminatory practices from the labor market.

- Year dummies. In order to allow for possible general changes in income, dummies for the years 1994 and 1997 are included.

The dependent variable y_i, however, is not always observed. Rather, the dependent variable for observation i is observed if

$$z_i\gamma + \mu_{2i} > 0$$

The set of explanatory variables z_i of the selection equation, apart from the set of x_i, includes the following variables:

- Number of household members. A large household member may be less selective regarding labor conditions.

- Number of household income recipients. Other income recipients may generate conditions to be selective in labor conditions.

Table C.1: Heckman selection model for log monthly earnings

Explanatory variables	Selection equation	Outcome equation
Occupational experience	0.1010	0.0439
	(0.0036)	(0.0028)
Occupational experience (square)	-0.0015	-0.0006
	(0.0001)	(0.0001)
Years of schooling	0.0496	0.0920
	(0.0048)	(0.0036)
Woman	-0.5316	-0.5000
	(0.0299)	(0.0232)
Year 1994	-0.0577	0.2252
	(0.0376)	(0.0305)
Year 1997	-0.1723	0.2317
	(0.0364)	(0.0305)
Number of household members	-0.1647	
	(0.0067)	
Number of household income recipients	0.5988	
	(0.0194)	
Constant	-0.6202	3.2210
	(0.0906)	(0.0576)

Notes: Occupational experience is current age minus years of schooling minus six.
Number of observations equals 13182 individuals (2746 censored and 10436 uncensored).
Standard errors in parentheses.

Assuming that $\mu_1 \sim N(0,\sigma)$, $\mu_2 \sim N(0,1)$ and $corr(\mu_1,\mu_2) = \rho$, the Mincer equation is estimated using maximum likelihood. This procedure will provide consistent, asymptotically efficient estimates for all the parameters even if $\rho \neq 0$. Table C.1 shows these estimates.

The estimated coefficients are used to simulate lifetime earnings profiles for several groups. Groups are defined by years of schooling (from 0 to 20), gender (male or female) and year (1991, 1994 or 1997), as well as by number of household members (from 1 to 20) and number of household income recipients (from 0 to 8). The number of possible groups, given by the product of the possible values of each variable, is 23814. The lifetime earnings profile of each of these groups is computed by sweeping the occupational experience variable and its square backward and forward (which also changes the Mills ratio). These group lifetime earning profiles are used to compute sets of variation rates, which are the quotient of the income of one period divided by its lag. Then, a set of variation rates is available for each group.

The estimation of individual lifetime earnings profiles has three stages. First, observed current earnings of each individual are imputed as a pivot point of his lifetime earnings profile. Second, the other points are computed by applying to this point the set of increase rates that corresponds to the group the individual belong to, which is done backward and forward. Finally, each series is delimited from six plus years of schooling (the first year in the labor market) to the retirement age (the last year in the labor market).

The computation of pension wealth requires lifetime profiles for the probability of being working. The selection equation of the previous model is used to compute them. As before, the estimated coefficients are used to project group lifetime profiles for the probability of being employed. As there is no initial level this time, the projected series are directly imputed to individuals regarding the group they belong to.

In sum, each individual of the three surveys that belongs to the economically active population and that declares being covered by a pension system receives a lifetime earnings profile, labelled $\{e_i\}$, and a lifetime profile for the probability of being employed, labelled $\{p_i\}$.

C.1.2   Pay-as-you-go pension

The pay-as-you-go system requires a minimum number of contribution years to be eligible to receive a pension. In order to evaluate this condition, it is assumed that an individual is able to contribute all years between the beginning of his working life (assumed to be the birth year plus six plus the number of years of education) and the legal retirement age corresponding to his pension system in the year of analysis. As individuals may experience unemployment some of these years or they may not pay social security contributions, the number of periods from the previous estimation is multiplied by the average of the probabilities of being working (obtained from $\{p_i\}$) and a probability of paying social security contributions ($\pi = 0.6$). This product, the expected number of contribution years, is contrasted with the accessibility conditions, which are summarized in Table C.2.

The pension of individuals that fulfil the minimum number of contribution years is computed using the relevant pension formula. Specifically, Equation A.1 of Appendix A corresponds to the legal framework before the reform of the open pay-as-you-go (December 1992) and Equation A.2 of Appendix A applies after it. The reference wage is computed from $\{e_i\}$, using the relevant periods (for instance, if rw has to be computed as the average of the last 36 months of contribution, then it is equal to the average of e_{T-2}, e_{T-1} and e_T).

The pay-as-you-go system includes a maximum and a minimum pension. In real terms, the maximum pension experienced an important cut, while the minimum pension slightly increased. Table C.2 shows the evolution of these values. In general, Table C.2 summarizes how the main features of the Peruvian pay-as-you go system have evolved for the years of analysis.

The outcome of this step is the future monthly pension of individuals enrolled to the pay-as-you-go system, taking into account the rules changes.

Table C.2: Evolution of the main features of the Peruvian pay-as-you-go-system

Characteristic	1991	1994	1997
Minimum years of contribution	15 for males	20 for males	20 for males
	13 for females	and females	and females
Pension formula	Eq. A.1	Eq. A.2	Eq. A.2
Minimum pension	S/.50	S/.100	S/.200
	(S/.195 of Jun04)	(S/.168 of Jun04)	(S/.250 of Jun04)
Maximum pension	S/.304	S/.600	S/.600
	(S/. 1186 of Jun04)	(S/.1011 of Jun04)	(S/.749 of Jun04)
Retirement age	60 for males	60 for males	65 for males
	55 for females	55 for females	and females

C.1.3 Funded pension

Chapter 1 and specially Appendix A explained that pensions in the funded system are computed from the sum of the ICA and the eventual recognition bond. In order to estimate the ICA in the surveys, two assumptions are made. First, the contribution rate is assumed to be always 8.0%. Second, the evolution of the value quote $\{v_t\}$ is projected using an investment yield equal to 8.0%. This last number is less than 11.1%, the average real yield from the last fourteen years (from October 1993 to October 2007). Then, Equation A.3 is directly applied on $\{e_t\}$.

The recognition bond is estimated in two steps. First, the legal framework includes a minimum number of contribution years to be eligible to receive a bond. As it was done before, this condition is evaluated by using the product of the following factors: 1) number of years from the beginning of working life until present, 2) the average of probabilities for the same period, computed from $\{p_t\}$, and 3) twelve[1]. Second, the bond value is computed by estimating the reference wage from the income stream $\{e_t\}$ and by applying Equation A.4. It is important to consider that the value of the bonds has an upper limit of S/.60000 in terms of December 1992, that is, an upper limit of S/.154721 in terms of June 2004.

The future monthly pension of individuals enrolled to the funded system can be computed directly by using Equation A.5.

C.1.4 Individual pension wealth

Individual pension wealth is defined as the discounted value of future pensions at the retirement period, where the parameters are real interest rate, probabilities of surviving in different periods conditional on having survived until one specific period, and maximum attainable age.

The computation of individual pension wealth in the Peruvian case is quite simple, as the legal

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[1] There are two types of bonds: 1) Recognition Bond 1992, which recognizes contributions made until December of 1992; and 2) Recognition Bond 1996, which recognizes contributions made until December of 1996. The computations will be done considering December of 1992 or December of 1996 as the last period.

framework of the funded system provides the URC. The URC, legal numbers that convert lump sums into pension streams, are computed considering the three above-mentioned parameters. Hence, in the case of the pay-as-you-go-system, individual pension wealth is the product of the predicted monthly pension and the pertinent URC. In the case of the funded system, individual pension wealth is simply the sum of the ICA and the eventual recognition bond at retirement age.

C.1.5   Household pension wealth

Household pension wealth is the sum of the individual pension wealth of the head of household and the spouse, if existing. The pension wealth of sons, daughters or other relatives covered by social security is also added if this member is older than 25 years of age. Thus, the analysis excludes individuals that will eventually leave the house and whose pension wealth, consequently, would not affect household saving decisions. This procedure is related to the criteria used to define social security enrollement. As it was already explained, the results of the paper are robust to the application of other age-limits. It is important to mention that individual pension wealth is discounted to the period of analysis before aggregating it by household.

C.2 First stage results

Table C.3: First stage results: Heckman selection model - Outcome equation for pension wealth

Explanatory variables	Regression 1	Regression 2	Regression 3	Regression 4
Year 1994	-3801.365	-2916.032	-4290.087	-4277.896
	(5957.764)	(7170.815)	(7303.340)	(7327.412)
Year 1997	-4403.05	-3930.44	260.72	144.42
	(5364.59)	(7413.90)	(7914.96)	(8061.08)
Household income	0.5494	0.5535	0.5604	0.5514
	(0.2136)	(0.2674)	(0.2287)	(0.2676)
Years of schooling	-1129.412	-1090.308	-1141.176	-1085.742
	(441.372)	(527.594)	(450.164)	(526.179)
Age	-1273.935	-1249.227	-1308.781	-1247.681
	(587.181)	(644.707)	(591.318)	(638.760)
Age (square)	17.898	17.722	18.629	17.982
	(6.654)	(7.347)	(6.750)	(7.148)
Gender	-5890.397	-5960.732	-5810.249	-5944.249
	(1785.223)	(1880.402)	(1805.407)	(1870.972)
Number of dependents	-2201.035	-2194.806	-2142.959	-2171.103
	(913.921)	(906.211)	(914.830)	(908.510)
Number of dependents (square)	18.2473	17.57314	12.09161	13.36249
	(95.8690)	(95.8416)	(97.0391)	(96.1674)
Number of income recipients	763.50	849.57	767.26	889.67
	(1266.48)	(1427.91)	(1277.21)	(1417.02)
Income·Year 1994·pay-as-you-go	-0.3609	-0.3307	-0.3722	-0.4616
	(0.2179)	(0.2268)	(0.2308)	(0.3341)
Income·Year 1994·funded	-0.1376	-0.1071	-0.1498	-0.2374
	(0.2218)	(0.2269)	(0.2351)	(0.3303)
Income·Year 1997·pay-as-you-go	-0.5227	-0.5252	-0.5348	-0.6056
	(0.2263)	(0.1607)	(0.2419)	(0.2)
Income·Year 1997·funded	0.2609	0.2563	0.2502	0.1749
	(0.2236)	(0.2)	(0.2)	(0.22)
Age·Year 1994·pay-as-you-go	-135.6577	-154.8211	-73.46434	30.57251
	(194.3856)	(132.202)	(277.680)	(289.4833)
Age·Year 1994·funded	-216.607	-234.2448	-154.6155	-49.63932
	(202.848)	(144.2696)	(282.2418)	(293.5606)

(continue in the next page)

Explanatory variables	Regression 1	Regression 2	Regression 3	Regression 4
Age·Year1997·pay-as-you-go	-111.6533	-115.022	-67.04275	12.85854
	(193.2056)	(122.3102)	(274.3246)	(212.3352)
Age·Year 1997·funded	-474.0959	-476.2219	-430.543	-348.3518
	(201.5871)	(147.0918)	(274.2656)	(227.8387)
Income·Year 1994		-0.0342		0.0943
		(0.3004)		(0.3950)
Income·Year 1997		-0.0114		0.0731
		(0.2887)		(0.3258)
Age·Year 1994			-44.6111	-153.0714
			(288.7379)	(327.6901)
Age·Year 1997			-141.8284	-220.5978
			(293.5098)	(269.848)
Intercept	81148.3	79384.62	81206.3	78689.03
	(18924.4)	(21044.00)	(18505.43)	(21343.75)

Notes: Number of observations equals 4900 households (3304 censored and 1596 uncensored).

Standard errors in parentheses.

Table C.4: First stage results: Heckman selection model - Selection equation for covered

Explanatory variables	Regression 1	Regression 2	Regression 3	Regression 4
Year 1994	-0.2838	-0.2957	0.1264	0.1139
	(0.0551)	(0.0974)	(0.2388)	(0.2427)
Year 1997	-0.3385	-0.3855	-0.3126	-0.3324
	(0.0566)	(0.0997)	(0.2395)	(0.2446)
Household income	0.0000062	0.0000050	0.0000063	0.0000048
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Age	0.0694	0.0699	0.0706	0.0710
	(0.0176)	(0.0176)	(0.0175)	(0.0176)
Age (square)	-0.0008	-0.0008	-0.0007	-0.0007
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Years of schooling	0.0714	0.0713	0.0717	0.0716
	(0.0063)	(0.0062)	(0.0063)	(0.0062)
Gender	-0.2800	-0.2813	-0.2797	-0.2807
	(0.0608)	(0.0611)	(0.0607)	(0.0610)
Number of dependents	0.0170	0.0165	0.0154	0.0149
	(0.0310)	(0.0311)	(0.0311)	(0.0311)
Number of dependents (square)	-0.0038	-0.0037	-0.0037	-0.0036
	(0.0034)	(0.0034)	(0.0034)	(0.0034)
Number of income recipients	0.2083	0.2083	0.2076	0.2079
	(0.0223)	(0.0222)	(0.0223)	(0.0221)
Occupational group: whitecollar	0.5205	0.5267	0.5114	0.5205
	(0.0769)	(0.0884)	(0.0804)	(0.0885)
Occupational group: services	0.3171	0.3196	0.3137	0.3165
	(0.0550)	(0.0582)	(0.0566)	(0.0587)
Economic sector: extractive	0.1878	0.1905	0.1859	0.1885
	(0.0700)	(0.0700)	(0.0700)	(0.0702)
Economic sector: industry	0.2620	0.2628	0.2609	0.2620
	(0.0544)	(0.0553)	(0.0544)	(0.0553)
Economic sector: construction	-0.2042	-0.2061	-0.2041	-0.2080
	(0.0870)	(0.0903)	(0.0873)	(0.0903)
Economic sector: commerce	-0.3325	-0.3388	-0.3309	-0.3399
	(0.0846)	(0.0959)	(0.0872)	(0.0964)

Explanatory variables	Regression 1	Regression 2	Regression 3	Regression 4
Household income·Year 1994		0.0000008		0.0000013
		(0.0000)		(0.0000)
Household income·Year 1997		0.0000020		0.0000020
		(0.0000)		(0.0000)
Age·Year1994			-0.0093	-0.0096
			(0.0054)	(0.0055)
Age·Year1997			-0.0008	-0.0013
			(0.0055)	(0.0055)
Intercept	-3.0716	-3.0566	-3.1735	-3.1582
	(0.3809)	(0.3840)	(0.3890)	(0.3921)

Notes: Number of observations equals 4900 households (3304 censored and 1596 uncensored). Standard errors in parentheses.

C.3   Subsample households covered by social security

Table C.5: Instrumental variable regression of household voluntary saving rate on pension wealth
Linear effect

Explanatory variables	Regression 1	Regression 2	Regression 3	Regression 4
Adjusted pension wealth	-0.0005	-0.0007	-0.0005	-0.0007
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Covered by social security	24.2417	31.9808	24.2298	33.4568
	(19.5169)	(20.5362)	(19.6805)	(20.9828)
Controls	Household income, years of schooling, age (and square), gender,			
	number of dependents (and square), number of income recipients,			
	year 1994, year 1997, intercept			
Additional controls	None	Income·Year 1994	Age·Year 1994	Full set
		Income·Year 1997	Age·Year 1997	

Notes: Predicted household pension wealth is the product between the probability of being
covered by social security and the expected value of pension wealth conditional on being
covered by social security. Number of observations equals 1596 households

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