Universal Old-Age Benefits in a Multi-Pillar System: Evaluating Incentive Effects in Chile

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ABSTRACT

The purpose of this project is to simulate and measure the potential labor incentive effects of proposed reforms to the Chilean privatized social security system. The potential policy changes would create universal social security coverage by providing non-contributory pensions to the poor who are currently uncovered by any formal retirement or disability insurance. The simulations consider the system of pension support that currently exists for individuals under a given income level, to determine whether or not they respond to the negative incentives to contribute to social security and participate in the formal labor market; they also test the effect on non-contributory pension support on informal saving. Analysis is conducted using household survey data from Chile over the last six years, and a differences-in-differences approach to the discontinuous budget constraint that is created by the policy. The methodology also utilizes data on individuals’ knowledge of pension support programs and attitudes towards social security. Measuring this response aids in considering the potential effects of expanding the non-contributory pension support, as well as the impact of social security policy on the size of the Chilean informal labor market.

Keywords: Social security, Chile, non-contributory pensions, labor supply informal labor, saving.

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1. Introduction

In 1981 under the Pinochet regime, the Chilean social security system underwent major reform, shifting from a “pay-as-you-go” defined benefit system to a defined contribution system. These reforms completely privatized Chilean social security, mandating a 10% contribution of monthly payroll for all workers into a personal social security account (Gill et al, 2005). In the privatized system, there are a number of pension administrators among whom affiliates can choose to manage their pension plans, and who invest with relative freedom. The overall structure of the new system has three “pillars” (a term coined by the World Bank). The first pillar is a non-contributory basic pension for low-lifetime earners, which is financed by government revenue (mainly Chile’s VAT tax); the second is comprised of mandatory contributions, and the third voluntary contributions (Arenas de Mesa, 2000). The mandatory contributions pillar also includes a contributions-based subsidy to individuals who have participated for 20 years or more. In this paper I will evaluate the non-contributory pillar with regard to its effects on labor supply and saving.

The privatization of the Chilean pension system was the first of its kind, and sparked a series of privatizing reforms around the world, particularly within South America. It generated much analysis of the costs and benefits of a defined contribution system. Scholars have shown that there were advantages and disadvantages in many arenas, including private saving, labor supply, capital accumulation, political independence and stability of social security, and coverage. The complexity of the reform and its effects made a generalized evaluation difficult, though empirical studies have made progress in isolating certain effects (see Section II).
This paper focuses on the aspect of the defined contribution system that is the non-contributory pillar. If one accepts the necessity of a safety net for the poor in a defined contribution system, then the efficiency and microeconomic effects of this safety net are essential in evaluating the system as a whole. Moreover, pension support programs contribute significantly to both the macro level of coverage of the social security system, as well as the labor supply. In Chile, in the 25 years after the reform took place, coverage proved to be either lower than under the old system or stagnant; the labor supply effects were minimal. It was theorized that switching from a defined benefits system, in which individuals were uncertain about the outcome of their contributions, would encourage participation in the system and boost formal labor supply. However, for reasons that I discuss in the Literature Review, coverage rates in Chile remain quite low.

In response to persistent low coverage rates, the current President of Chile, Michelle Bachelet, has proposed expanding the non-contributory pension support program. The proposed reform would create a universal non-contributory pension for all elderly and disabled individuals under a specific income level; the level of the subsidy would decrease with income. This would cover all of the individuals who are currently unsubsidized by the government, as well as change the structures of both of the current pension support programs (Consejo Asesor, 2006). Analyzing the effects on the labor market of the current non-contributory pillar will inform the potential effects of proposed reforms, as well as the total effect of privatization on the labor market. Finally, labor supply effects of the safety net in a defined contribution social security system are relevant to the theoretical debate regarding optimal social security policy. Specifically, in answering the question of whether the government should mandate saving at all, negative
formal labor supply response to a safety net is an important aspect of the cost of the policy.

The purpose of this paper is to measure the incentive effects of the non-contributory pension program that was implemented with the privatized social security system in Chile in 1981. I consider the existence of a moral hazard problem created by guaranteed government-provided pensions and ask whether or not there is a negative formal labor supply response and/or decrease in informal saving as a result. I use a differences-in-differences methodology based on the income threshold for eligibility and self-proclaimed knowledge of the pension support requirements to achieve identification of the effect of an individual being treated by pension support on his or her participation in the social security system and the formal labor market.

In the rest of this paper, I will next review the literature surrounding the questions I have proposed, both in the narrow empirical sense and the broader theoretical sense. The following section will be the Economics and Methodology section, which will include a description of my data, as well as specific hypotheses and methods of testing those hypotheses. Section 4 will give a brief data summary and present the preliminary regression results. Section 5 is an analysis of these results, followed by the conclusions and extensions in Section 6.

2. Literature Review and Background

2.1. The Chilean System

The literature related to the question I ask in this paper is both theoretical and empirical. I will present a brief overview of the theoretical literature and motivate my question, and then review related empirical papers to put my methodology in context.
First, I review the exact structure of the new system, as well as previous evaluations of Chile’s privatization. Next, the theoretical literature analyzes the advantages and disadvantages of defined contribution versus defined benefit social security systems; it discusses the reasons for and problems with persistent low coverage in the Chilean defined contribution system. I then review the reforms that have been proposed in solution to the problems discussed. I motivate my empirical questions based on these hypothetical reforms, and present the relevant empirical literature.

As I mentioned earlier, there are three pillars of the privatized system: government-provided pensions, mandatory contributions, and voluntary contributions. The mandatory contributions place 10% of an individual’s monthly earnings into his or her individual account, but the actual charge is 13% of their salary; the remaining three percentage points go towards administrative fees. Additionally, workers are required to place 7% of their salary into a government-administered health care program. While the employer contributions that existed under the old system were removed, the employers are currently required to place the deposits for their workers; workers retain the ability to choose in which fund their contributions should be placed (Packard, 2002). Of particular relevance to this paper, the only requirement for individuals to be allowed to contribute to an individual account is that they contribute based on at least a minimum wage salary. Therefore, the self-employed or informal workers can choose to participate as long as they make at least the minimum salary; only formal workers, however, are required to contribute in the second pillar. Finally, the retirement ages are currently 65 for men and 60 for women. I will review the specific rules regarding the non-contributory pensions and the minimum pension guarantee in Section 3.
There is a large literature devoted to evaluating the effects of the privatization, as I mentioned in the last section. Authors have evaluated the predictions that switching to a defined contribution system would have positive effects on private saving, capital accumulation, coverage rates and labor supply participation, but have not proven these predictions to be accurate based on empirical evidence gathered since the reform took place. Macroeconomic theory would suggest that by reallocating social security contributions from government-run pension funds to private accounts would increase national saving because private accounts still involve forced saving rates, and government outlays in a given period do not equal inlays into privately funded accounts. Two problems with this theory are the following: mandatory saving rates do not necessarily imply an overall increase in household saving if individuals decrease informal saving simultaneously; and government saving may also decrease with a shift to defined contribution accounts if other government spending increases after the reform (Stiglitz, 1999). Empirically, it has been difficult to distinguish whether the rise in domestic saving was due to social security reform or to other market liberalizing reforms that occurred during the same period (Edwards, 1998).

With respect to the effect on capital markets, it was expected that directing social security contributions towards private investment would accumulate capital in the markets (rather than in government coffers). Indeed, Mesa-Lago (2005) reports that Chile had accumulated nearly 50 billion USD of capital in private pensions funds, which was equivalent to nearly 65% of their GDP in 2003. However, difficulties arose regarding the ability of the funds to provide adequate returns to retirees. This has been blamed in part on the lack of investment opportunities within Chile, as well as on high administrative
costs. One reason for high costs in the private sector may be the lack of competition among insurance administrators: there are only six private retirement insurance providers, and the largest 3 comprise 80% of the market. While six administrators may seem to be very few, it is not as low as one might think in comparison with other Latin American countries. Chile’s neighboring countries with similar social security systems have at most 12 competing funds and as few as two (Mesa-Lago, 2005).

Another major factor upon which scholars have evaluated privatization reform has been its ability to increase rates of participation in the social security system. High coverage rates are desirable from the standpoint of increasing personal saving as well as decreasing income volatility in old age. Theories pre-reform indicated that coverage would increase, as individuals would have a larger incentive to contribute to social security if they were certain that they would receive all of the benefits of their savings (Packard, 2002) (Piñera, 1995). However, lack of confidence in the markets and private fund administrators may have moderated such certainty. Mesa-Lago (2005) estimates that in the 25 years after the reforms, coverage rates actually declined from 63 to 58%, which is detrimental to the efficacy of the program overall. He cites other potential reasons for this decline, which include transition effects and a large informal labor market whose workers are not required to participate in the system.

Finally, it is worth mentioning the criteria of redistribution and equity, on which some have questioned the privatized system. However, Gill et al. (2004) cite regressive rates of return in the defined benefit system, which are mitigated by the privatized system. Also, the existence of both non-contributory and contributions-based safety nets allow for redistribution within a defined contribution system.
2.2. Optimal Social Security Design

To address the question of why coverage rates have either stagnated or decreased since the privatization, one must consider the effects of switching to a defined contribution system on labor markets: decreasing coverage rates either mean increasing evasion rates or more likely a shift away from formal work. One body of work uses models to simulate the labor market effects of social security reform. These models attempt to answer question of whether individuals see a mandatory social security contribution to an individual account as a tax or as deferred compensation. (The rational individual sees it as deferred compensation, and their labor supply would not be as negatively affected as if the contribution were a payroll tax.) These studies include Edwards and Edwards (2002), Orszag et al. (1999), Corsetti and Schmidt-Hebbel (2002), and Diamond (2002).

Though each article uses a slightly different theoretical framework, they conclude that there is an inherent problem with predicting the direction of the response to changes in payroll taxes, because the income and substitution effects work in opposite directions. In the case of moving from defined benefits to defined contributions, these effects tend to have a very small net positive effect (in the direction of more formal work). Additionally, some suggest that analysis of efficiency must take all distortionary taxes into account, and not simply payroll taxes. Though models thus far have done a good job predicting effects of privatization on the labor markets, they cannot easily be externalized to predict effects of other changes in the pension system, such as income support.

Based on the body of work that has been generated on evaluating the reformed system, a number of authors have discussed proposals for further reforms, or options
other than the defined benefit and defined contribution systems. In general, these plans include either adding some universal social security coverage through subsistence-level non-contributory pensions for the poor, and/or phasing out mandatory contributions altogether. Two such articles are James (1999) and Willmore (2000); both criticize the validity of the moral hazard problem and paternalism as justifications for mandatory contributions.

The Chilean pension system advisory group, as I mentioned in the last section, has also proposed a universal non-contributory pension program. The specific structure of the proposal is the following: for individuals who cannot contribute to the formal system at all, there will be a flat universal pension comprised of a monthly payment for everyone over the age of 65. Additionally, in order to create some incentives to accumulate personal pension funds, the government will subsidize personal funds in a decreasing manner until an individual reaches $200,000 in funds. This program, therefore, will not provide funding for the wealthiest 40% of the working population. Graphically, the reform would reflect the schematics below:
Thus far, there has been little discussion regarding the costs of the proposed reforms. One might expect that the creation of universal non-contributory pensions would cause a moral hazard problem for any individuals who do not desire a higher pension than the minimum. Therefore, a significant contributor to the costs of the proposed reform will be the extent to which individuals respond to government-provided pensions with lower levels of contributions and formal labor market participation.
2.3. Measures of Moral Hazard

There is both theoretical and empirical literature discussing moral hazard problems in welfare programs and social security. The existence of myopia is used to justify the existence of any government-run social security. The theory is discussed by Mulligan and Sala-i-Martin (1999), and put forth by Laitner (1988); it is based on the idea that individuals have imperfect knowledge about their future earnings and mortality, as well as anticipate that younger generations will respond to their needs later in life.

The empirical literature that measures moral hazard problems includes the labor supply literature analyzing effects of welfare programs on individual labor supply decisions. Within this literature, there is a range of approaches to measuring income and substitution effects caused by the presence of welfare programs. I will not review all of them here, but will mention some that are relevant to my particular questions. While the literature analyzing labor supply effects of income taxes is quite robust, the analysis of other forms of redistribution is relatively thin. With respect to targeted welfare programs for working individuals, there are a number of studies, which are reviewed in Moffitt (2002). These studies focus largely on reforms to AFDC (Aid to Families with Dependent Children) and TANF (Temporary Assistance for Needy Families), which are cash-based welfare programs enacted in the United States in 1935 and 1997 respectively. The authors use a common theoretical framework for the incentive effects of welfare programs; there are a number of methodological approaches used, however. Identification comes from either cross-sectional variation often in state-specific policies regarding eligibility cut-offs, or longitudinal variation derived from national policy changes.
Studies that focus on labor supply effects of specifically old-age welfare programs are fewer and further between. David Neumark and Elizabeth Powers have two papers that answer questions analogous to ones I ask in this paper, but are based on the US SSI (Supplemental Security Income) program. Neumark and Powers (2000) note that because the labor supply effects of public pension support are not contemporaneous with the welfare program, they are more difficult to study than income support for working-age individuals. Nonetheless, their analysis uses a differences-in-differences methodology based on state-level variation in eligibility requirements for SSI and working individuals’ probabilities of becoming eligible; they find roughly a 10% decrease in labor participation among those in the treatment group. Because this study is very closely relevant to the questions I have proposed, I adapt their model to the Chilean case and use a similar approach to my data.

Aside from the effects of the structure of social security on formal labor supply, individuals’ saving responses to social security also influence the efficiency of the system. There are both theoretical and empirical bodies of literature that discuss the nature of individuals’ saving choices. The theoretical literature looks at the demand for two different individual saving options: formal pooled insurance against income insecurity, and informal saving. Where formal insurance includes both defined benefit and defined contribution pension plans, informal saving options are those in which risk is not pooled in a market, such as personal investments in property, automobiles, loans between friends or family members, and investment in an enterprise or in education. By modeling demand for these types of insurance, one gains knowledge regarding the moral
hazard that exists in the market, which is also useful when considering the effects of government-provided pension support.

The empirical side of this theoretical literature looks at portfolio choices in social insurance systems to indicate the demand for pooled insurance versus individual saving or mere prevention of income insecurity (Ehrlich and Becker, 1972) (Packard, 2002). Presumably, if the price of pooled insurance (e.g., defined benefit pensions) is high relative to those of private saving or income insecurity prevention, then moral hazard is more prevalent. This literature is useful in the context of this paper because unlike the labor supply literature, it considers informal saving as a factor in social security. Studies consider the types of social insurance available and attempt to find determinants of demand for the categories of social insurance that I have described. Packard (2002) includes eligibility for the minimum pension guarantee in Chile as a possible determinant of demand for informal saving. While the data and methodology are distinct from those in this paper, I utilize his definition of informal saving in my regressions, which I discuss in the next section.

Based on the literature, we see that individuals’ responses to the structure of the safety net in a defined contribution social security system affect the efficiency of the entire system, and therefore its optimality with respect to either a defined benefit system or a system without any mandated saving. Additionally, we see the differences-in-differences methodology employed to measure labor supply responses to changes in the tax environment and welfare, which will aide the methodology section of this paper. Finally, the literature provides an understanding of informal saving in contrast with risk-
pooled insurance against income insecurity, which is useful in considering how pension support affects choices among types of saving.

3. Economics and Methodology

3.1 Model and Hypotheses – Incentives to Participate

While providing a universal non-contributory benefit would certainly increase participation in the social security system (which we can accept as a large benefit), it is prudent to understand the costs of such a proposal, in order to encourage the most efficient reform possible. Providing universal coverage would entail covering nearly 100% more individuals than are currently participating in the system. An unknown factor in evaluating this cost is the number of currently uncovered individuals who would contribute to their own social security in a system where all workers were included and there was a low-level non-contributory pension provided. In addition to the pure cost of extending coverage would be increased administrative costs, opportunity cost of other government spending, and labor supply effects of the taxes required to fund the subsidies. Thus, we see that the following empirical questions become important in cost considerations of proposed reforms: how much would individuals save privately given the existence of non-contributory pension assistance? And, would there be a negative formal labor response? In this section, I will consider these questions based on the responses of social security contributions, formal labor and informal saving to the current non-contributory pension support program that is in place in Chile.

The specific structure of pension support in Chile is the following. As I mentioned earlier, there are both subsistence-level pensions for the very poor called PASIS, which have no requirements for individuals’ contributions to the account, as well as a minimum
pension guarantee (MPG). The MPG requires 1040 weeks (20 years) of cumulative personal contribution before guaranteeing retirees over 65 a monthly income of roughly 80% of the minimum salary in Chile. The value of the non-contributory pension is then defined as 50% of the MPG (Biblioteca del Congreso Nacional, 1975). Empirically, there is a significant percentage of the Chilean population that has contributed enough to social security such that they have accumulated a pension that is larger than 50% of the MPG once they retire, but who have not contributed with enough regularity to receive the MPG. These individuals, though their pensions are larger than they would be under PASIS, receive no aid from the Chilean government (Consejo Asesor, 2006).

While both PASIS and the MPG provide negative incentives to contribute and by extension to participate in the formal labor market, this paper focuses on the non-contributory program. One reason for this focus is that the most direct method of simulating effects of expanding non-contributory pensions is to consider responses to the current non-contributory pillar. Another reason is the lack of significant effects of the MPG to have taken place to date. In 2006, 25 years had passed since the institution of the MPG, and the requirement for eligibility is 20 cumulative years of contribution. That implies that in order for the majority of workers to be eligible, the average density of individual contributions over time would have to be at least 80%. In actuality, between 1980 and 2004 the average density of contributions was closer to 50% (Subsecretaría de Previsión Social, 2007). Therefore, the sample of workers affected by the MPG in Chile is still too small to have statistical significance.

My hypothesis in this paper is that non-contributory pension support creates negative incentives for individuals who are within a certain low-income bracket to
contribute to their social security and subsequently to participate in the formal labor market. Given that a working individual’s wage is under a given level, he or she can know that their accumulated pension will never exceed 50% of the MPG. That individual would have no incentive to contribute to the social security system, and may rely entirely on government support. In reality, individuals’ incentives to contribute will vary continuously with a number of factors. Therefore, we expect these factors to have an influence on individuals’ rates of contribution and participation in the formal sector. The most significant factor will likely be the salary level: if one is under a certain income then he or she will expect to be covered by PASIS upon retirement. For a portion of the population, individuals’ monthly incomes will make them only borderline-eligible. For these individuals, the variance in their incomes as well as the time until retirement will affect their probability of becoming eligible for PASIS, and therefore their incentives to contribute. Also, an individual’s knowledge of the system will affect both their incentives to contribute and their probability of becoming eligible (since collection of benefits is active rather than passive).

A model of an individual’s choices regarding their contributions to formal social security, and by extension his or her formal labor market participation can be represented in the following form:

\[
\Phi(C_{it}) = f\left[ \Phi \left( \sum_{t=n}^{65} 0.10 \cdot W_{it} > 0.5 \cdot MPG \cdot A \right) \right]
\]

In this model, \( \Phi(C_{it}) \) the probability of an individual contributing formally to social security in a given time period \( t \); \( W_{it} \) is the wage that individual \( i \) earns, which may vary in all time periods \( t \) until the individual’s retirement; the right-hand side of the inequality
represents the value of the accumulated pension at the cut-off for receipt of PASIS, which is dependent on the value of the minimum pension guarantee. Although the MPG does vary somewhat with respect to inflation, we can assume that individuals see the cut-off as relatively stable over time. Finally, the rate of annuities for the minimum pension guarantee will be the same for all individuals assuming a given retirement age (annuity prices will not vary across genders or other individual characteristics related to mortality risk) (Brown, 2000). Therefore, the only variables that will affect the probability of an individual contributing to the system will be age \( n \) and wage \( W \) in period \( t \); the function \( f \) should be increasing \( W_{it} \) as it will increase as the probability of the accumulated pension exceeding the cut-off increases.

This model suggests that actual contribution rates in the population increase as wages exceed a certain value that would guarantee ineligibility for PASIS. However, depending on the functional form, it is also possible that as \( \sum_{t=n}^{65} 0.10W_{it} \) approaches equality with the total value of the annuitized minimum pension guarantee, the probability of contributions decrease non-linearly. We would expect this to be true if we see that as \( \Phi \left( \sum_{t=n}^{65} 0.10W_{it} < 0.5 \text{MPG} \right) \) approaches one, the individual’s expected post-retirement income approaches the 0.5MPG, or the value of the government-provided pension under PASIS. In this scenario, the trade-off between pre-retirement hours of work and post-retirement income is depicted in the following diagram.
This diagram shows the labor supply curves for individuals in three potential positions. As explained by the probabilistic model, no individual who is still participating in the labor market will be certain in which position he or she will be as they near retirement. However, based on information regarding wages across an individual’s lifetime and the time until retirement, he or she can determine with some level of confidence the most likely outcome. Therefore, we will see some individuals at point A. These individuals are those that will almost certainly be below the income cut-off for PASIS; they have essentially no incentives to contribute formally to the social security system. Individuals at point B represent those who contribute more than the amount given by PASIS, but have fewer than 1040 weeks (20 years) of contributions, and therefore receive no aid from the government. The slope of their budget constraint will be equal to 10% of their monthly work income. Next are the individuals who are affected by the
minimum pension guarantee. These are the individuals who are able to contribute to social security for 20 years, and will automatically receive the value of the MPG. Finally, we see the individuals at point C who either exceed 20 years of contributions, or whose wages are high enough for the total value of their lifetime earnings to exceed the minimum pension guarantee times the annuity rate.

In order to empirically test the hypothesis that contribution rates will drop off as individuals’ accumulated income reaches the value of one half of the MPG, I consider the effect of wages and knowledge of the PASIS program on the probability of an individual contributing to the system. This is done by restricting the population of study to those individuals who are within a certain range of the income cut-off for PASIS eligibility, such that $\Phi \left( \sum_{t=n}^{65} 0.10 W_{it} < 0.5 \text{MPG} \times A \right)$ is less than but near one. Additionally, the population must not include individuals who are close to 20 years of contributions, because the incentives of those individuals may change because of the rules regarding the minimum pension guarantee. As I described earlier, however, because the system had only been in place for 25 years in 2006, the population of participants who have low wages and have contributed for nearly 20 years is significantly small.

A potential problem with the empirical study of the effects of changes in wages on probability of contribution is achieving clear causality. Identifying causality is not simple as a result of the endogeneity that arises between factors that affect an individual’s eligibility to receive PASIS, and his or her rates of contribution and participation in the formal sector. For example, Mesa-Lago (1990) notes that wages in the informal sector in Chile in 1982 were only 36% those of wages in the formal sector. Related, lower income individuals are also less likely to contribute to social security in a given month (they are
more likely to be unemployed or working in the informal sector). Therefore, it will be difficult to attribute variation in rates of contributions across these factors to the presence of the non-contributory pensions. Answering the question of whether the existence of non-contributory pensions decreases individuals’ informal saving is more difficult to answer without knowing full consumption and saving information. However, based on the data I use, I will be able to isolate causality reasonably well in the former question, and can use answers to hypothetical-type survey questions to address the latter question.

3.2 Data Description and Specifications

I will test the hypotheses that individuals who will be covered by PASIS respond by contributing less than they otherwise would by using data from a longitudinal household survey conducted in 2002, 2004 and 2006 in Chile. The survey is called “Encuesta Protección Social” (Social Protection Survey, or EPS), and was performed jointly by the Center for Microdata at the University of Chile and the Superintendency of the Pension Fund Administrators (SAFP). The survey randomly samples 8.1 million social security participants, collecting data from over 75,000 households.

The EPS consists of nine modules of questions regarding a breadth of information about the respondents, from demographic statistics, to a work and social security history, as well as questions regarding the respondents’ knowledge of the social security system and attitudes towards saving. Administration of the survey is independent of the government, so incentives to intentionally misreport are low; however, that does not prevent inaccurate recollection of information. The EPS data has also been matched up with administrative records from the SAFP on the individuals’ use of the social security system. Although the sample size for the dataset is quite large, there are a number of
questions that only a sub-set of the respondents answer, which can occasionally mean that restricted samples contain an unusually low number of observations. Additionally, the coding of the data, which was done by the Center for Microdata in Spanish, is frequently somewhat messy, and questions change slightly over the three years in which the survey was administered. Problems that arise based on these deficiencies of the dataset are discussed in the results section; the data does remain very useful for this and other potential papers.

There are several potential approaches to specifying regressions that will achieve some identification of the effects of PASIS. Section 2 of this paper discusses methodologies used in the larger labor supply literature. Based in part on the use of a differences-in-differences methodology by Neumark and Powers (2000), I decided to employ that type of specification. Another option would be a probit model that would predict the likelihood of an individual participating in the formal labor market and/or in the social security given a set of characteristic variables including eligibility for PASIS. Structurally, these two approaches are very similar, and require the same statistical assumptions (Blundell and MaCurdy, 1999). However, the presence of the interaction term in the differences-in-differences specification provides an intuitive and relatively simple economic interpretation.

The differences-in-differences estimator is also known as the natural experiment approach. Generally, the specification uses some sort of exogenous treatment to create treatment and control groups, and then considers the difference in means between them. In the case that one can generate enough randomness (group selection that is uncorrelated with trends in the outcome variables), then differencing the means across those groups
should remove selection bias. Additionally, with a differences-in-differences estimator rather than a simple difference, the specification will split the sample twice by treatments and controls, and consider the intersection of those four groups. The purpose of the second division is to remove possible selection bias that exists from endogenous selection into the first treatment group. One tends to get a more efficient (lower-variance) estimator using differences-in-differences than with an approach that simply attempts to control for all of the omitted variables. There are, however, some inherent assumptions that exist under the natural experiment model, which are that time effects are common across treatment and control groups, and that the compositions of the groups stay constant before and after the policy treatment in the case that the exogenous treatment is a policy change over time. It is often not possible to analyze a desired effect from the perspective of a natural experiment. However, in cases in which its use is possible, the approach has recently gained popularity as a result of its simplicity and ability to achieve relatively clear identification (Blundell and MaCurdy, 1999).

The treatment and control groups in this paper are based on individuals’ relationships to the arbitrary income cut-off used to define eligibility for PASIS (individuals with accumulated pensions below 50% of the MPG). I divide the sample between individuals who will be below the cutoff for eligibility upon retirement and those who will be above it. However, because there is an endogeneity problem here (higher earners are more likely to contribute to social security and therefore more likely to be in the formal sector), I also restrict the sample to individuals whose incomes are under 75% of the MPG, so that the treatment group includes individuals covered by PASIS and the control group includes those who are just over the cut-off and are
therefore uncovered. Additionally, in order to remove the selection bias inherent in this division, I split the sample again based on whether an individual claimed to know about the requirements for PASIS or not. If one does not know about the pension support that he or she might or might not receive, then their incentives to contribute to social security during their working lives will be unaltered by its existence. Thus, the differences-in-differences estimator will measure the effect of being both below the income cut-off and knowledgeable about the system, with the base case being those who are just above the income cut-off and not knowledgeable about the system.

In addition to the binary variables that I have discussed here, I will add control variables to increase the robustness of the regression including the continuous variables age, marital status, monthly work income, and regional dummy variables. Including these controls produces a conditional estimate of the treatment effect. This is desired since we expect that the effect of the program may differ for individuals of different ages, in different regions, etc. The regression is represented by the following reduced form:

\[ Y_{it} = \beta_0 + \beta_1 \text{LowIncome}_{it} + \beta_2 \text{Knowledge}_i + \beta_3 \text{LowIncome}_i \times \text{Knowledge}_i + \lambda_{it} + \epsilon_{it} \]

Here, \( Y_{it} \) represents the binary outcome variables of whether an individual is contributing, and whether an individual participates in the formal sector; \( \lambda_{it} \) is the vector of controls, and \( \epsilon_{it} \) is the error term. I use a probit specification rather than an OLS to capture the non-linear nature of a zero to one probability distribution.

For several of the included variables, operationalization based on the survey questions was not straightforward; in particular, the definition of formality, and the determination of whether or not an individual is under the cut-offs that are 50% and 75% of the MPG were imputed from the data. In order to not bias the results, I defined
formality conservatively based on the questions in Module II of the EPS, which asks for a work history. The formality variable is equal to 1 if a respondent answered a definite “yes” to the question, [in your current job] “Do you have a contract?” Or, if in response to the question “Where do you conduct your work?” he or she responded either that they work in an “independent establishment,” or in “the public sphere.” To determine whether an individual was above or below the income cut-off for PASIS, I used monthly statistics that are produced by the Superintendencia de Seguridad Social, which report the top monthly income allowable for recipients of each of the state-based social security programs. In 2002, the assistance pension (provided by PASIS) was set at 36,180.81 pesos/month, or $70; in 2006 it was 43,926.69 pesos/month, the equivalent of roughly $85 (www.suseso.cl).

Based on my hypotheses, I anticipate that the following signs on the coefficients of the regression specification shown above. First, because we expect that an individual is both less likely to contribute to social security and less likely to be in the formal sector if they are poorer, $\beta_1$ should be negative. Likewise, an individual who knows about the PASIS regulations may also be less likely to contribute to the system, and $\beta_2$ will also be negative. The most economically significant coefficient will be $\beta_3$, which we expect to be largely negative, since individuals who are both eligible for and know about the PASIS program will have significant negative incentives to contribute, given that they are guaranteed a government pension if they do not.

---

1 While the MPG is not indexed to inflation, over the last 10 years it has averaged 80%-95% of the minimum salary, which is indexed to inflation (Arena de Mesa, 2000). PASIS is always 50% of the MPG, and therefore both of them track inflation relatively closely so that there is not much additional uncertainty regarding future eligibility for pension support caused by variation in the income cut-offs.
In addition to the differences-in-differences specification, I include another regression that describes the discontinuity of contributions and formal labor participation that we would expect to see at the point where individuals become eligible for pension support. This specification does not necessarily prove causality in the case of a dip in participation at the income cut-off; rather, it is descriptive of the correlations. This specification is simply a probit regression of the binary outcome variable on both the log of monthly work income, as well as the binary indicator for being above or below the cut-off for PASIS eligibility.

Finally, I include a secondary set of regressions that test the question of whether informal saving by individuals is affected by the existence of non-contributory pensions. As mentioned earlier, since we do not have specific data on all types of saving and consumption, these regressions will not achieve identification, but instead help to describe trends in saving. The regressions are based on the survey question, “In what form would you invest your monthly contributions [if not in social security]?” There are 12 possible responses to this question, of which individuals rank their top three in order. The responses include that individuals would spend their contribution, or spend it specifically on property, an automobile, personal enterprise, their children’s education, loans to friends, a bank account, annuities, and life insurance among others. Based on these possible responses, I grouped them into categories that were: “WOULDSAVE,” which included answers that were consistent with formal saving methods; “WOULDSPEND,” which is comprised of the generic response for spending; and “INFORMALSAVE,” which included the categories for informal saving used by Packard (2002). As I discussed in Section 2, informal saving methods secure against loss of
income in old age by means other than formal market where risk is pooled. In the case of this dataset this includes property, automobiles, personal enterprise, children’s education and loans to friends are all included. I regressed these three binary outcomes on the characteristics that I expect to contribute to the variance in cross-section. Regressors include the log of monthly work income, a binary measure for low salary, age, education level, marital status, and household size. Finally, the entire sample of respondents is used in this specification, so that the cross-section includes the full income distribution. The results of these regressions will be reported in the next section, while analysis of their implications occurs in section 5.

4. Summary and Results

4.1 Summary Statistics

To understand the scope of the PASIS program and the size of the incentive effects, note the following summary statistics on the income cut-offs and individuals’ knowledge of PASIS. In 2002, the individuals below the income cut-off comprised roughly the bottom 4.5% of the income distribution. Additionally, 34% of those individuals were over 50 years of age, which was almost identical to the percentage over 50 in the entire sample. This suggests that the poor are not disproportionately young, which is consistent with the fact that income and eligibility are measured in terms of monthly salary rather than accumulated pension contributions.

On the other hand, when we consider the proportion of individuals with salaries under the $36,000/month cut-off that are contributing to social security, it is only 27% compared with the 83% of individuals in the entire survey population that contribute to social security. This fact represents several confounding economic effects, one of which
is likely to be the existence of pension support; this uneven distribution proves the
necessity for further analysis to achieve a causal explanation. Finally, we see in a related
trend that only 38% of individuals below the income cut-off are counted as participating
in the formal labor market, while roughly 50% of the total population is formal. The
disproportionately small number of low-income participants in the formal labor market
also helps to explain the dearth of contributions among that group.

With regard to the distribution of the respondents who knew or claimed to know
the requirements for PASIS eligibility, 20% of respondents in the entire survey
population claimed to know the requirements, while 26% of the eligible respondents
claimed to know. Likewise, 15% of people actually reported correct requirements, while
21% of those eligible could identify those requirements. Of those who claimed to know
about the program, less than 50% were over 50 years of age, which either suggests that
individuals begin to consider their retirement earlier in life, or that they gain knowledge
about pension support before they plan retirement. Additionally, of those who claimed to
know the pension support requirements, 81% were also contributing, which is not far off
the level of the general population. See the Appendix for graphical representations of
these summary statistics.

4.2 Primary Results – Contributions and Formal Work

The results of the differences-in-differences regressions, whose specification I
discussed in the last section are presented in the tables below, grouped by dependent
variable. Also, see a graphical representation in the Figure 7 of the Appendix.
<table>
<thead>
<tr>
<th></th>
<th>Observations = 1193</th>
<th>Psuedo-R2 = .0762</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Table 1 – Contributions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimates and standard errors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low salary</td>
<td>-.527*** (.102)</td>
<td>-.549*** (.104)</td>
</tr>
<tr>
<td>Knowledge of PASIS</td>
<td>-.229*** (.106)</td>
<td>-.226*** (.110)</td>
</tr>
<tr>
<td>Interaction knowledge*low salary</td>
<td>-.060 (.221)</td>
<td>-.043 (.224)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.0019 (.0031)</td>
<td>-0.0018 (.0032)</td>
</tr>
<tr>
<td>Married</td>
<td>-0.084 (.098)</td>
<td>-0.088 (.099)</td>
</tr>
<tr>
<td>Female</td>
<td>.287*** (.081)</td>
<td>.305*** (.081)</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>.296 (.283)</td>
<td>.299 (.287)</td>
</tr>
<tr>
<td>Log of 1 plus monthly work income</td>
<td>.520*** (.136)</td>
<td>.529*** (.136)</td>
</tr>
<tr>
<td>Region controls</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
The economic interpretations of the results in this table are the following. Individuals who are below the income cut-off for PASIS are 52.7% less likely to be contributing to a formal social security program (either the AFP system or the old system) than their slightly wealthier counterparts; individuals who claim to know the requirements for PASIS eligibility are 22.9% less likely to be contributing; and if one considers individuals who are both below the income cut-off as well as knowledgeable about the requirements for PASIS, they are 6% less likely to contribute than with either of the individual binary characteristics, although that difference is not statistically different from zero. These three coefficients are in line with our expectations based on the incentives outlined earlier in this section.

When I add in controls for age, marital status, gender and education, we see that only being female has a statistically significant positive effect on the likelihood of participating in social security. Adding in a control for monthly work income, we see that

<table>
<thead>
<tr>
<th>Table 2 – Formal work</th>
<th>Observations = 1193</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated coefficients and standard errors</td>
<td>Pseudo-R2 = .0162</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Low salary</td>
<td>-.293***</td>
</tr>
<tr>
<td></td>
<td>(.093)</td>
</tr>
<tr>
<td>Knowledge of PASIS</td>
<td>-.234***</td>
</tr>
<tr>
<td></td>
<td>(.102)</td>
</tr>
<tr>
<td>Interaction knowledge*low salary</td>
<td>-.141</td>
</tr>
<tr>
<td></td>
<td>(.195)</td>
</tr>
<tr>
<td>Age</td>
<td>-.017***</td>
</tr>
<tr>
<td></td>
<td>(.0029)</td>
</tr>
<tr>
<td>Married</td>
<td>-.063</td>
</tr>
<tr>
<td></td>
<td>(.095)</td>
</tr>
<tr>
<td>Female</td>
<td>.079</td>
</tr>
<tr>
<td></td>
<td>(.077)</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>1.144***</td>
</tr>
<tr>
<td></td>
<td>(.364)</td>
</tr>
<tr>
<td>Log of 1 plus monthly work income</td>
<td>.423***</td>
</tr>
<tr>
<td></td>
<td>(.119)</td>
</tr>
<tr>
<td>Region controls</td>
<td>No</td>
</tr>
</tbody>
</table>

*** = statistically different from zero at the 1% level, * = significant at the 10% level.
the coefficients of interest become smaller and lose all significance. However, there is a significant and large effect of monthly work income on probability of contributing, as we might expect. Finally, regression (4) considers only the discontinuity in contributions at the point where individuals go from being eligible to receive PASIS benefits to being ineligible. As discussed earlier in this section, this specification does not difference out the selection bias inherent in the treatment group, but does control for the correlation between income level and contributions. In this case, it is difficult to determine whether there is a discontinuity because the result is not statistically significant. In the next section, I will discuss the reasons why the differences-in-differences estimators lack significance, and show that it may still be possible that there is a response away from contributing among individuals in the treatment group.

The results in which an individual’s status in the formal labor market is the dependent variable are similar to those with contributions on the left-hand side. From Table 2, in regression (1), we see that being under the income cut-off for PASIS makes individuals 29.3% less likely to participate in the formal sector, while knowledge of the program requirements decreases that probability by 23.4 percentage points. The interaction term, as in the last set of regressions is not statistically significant, but shows that individuals who are both under the income cut-off and knowledgeable of the PASIS requirements are 14.1% less likely to be formal than their slightly more wealthy and less knowledgeable counterparts.

We see that the coefficient on low salary is somewhat smaller than the corresponding effect for the specification with contributions on the left-hand side. This fact is in line with our expectations in that the effects of the treatment on the probability
of contributing should be similar to the effects on formality, since social security contributions are mandatory in Chile. The difference in response between contributions and formality, therefore, is due to evasion of mandatory contributions and measurement error. In this case, the measurement error of the formality variable is larger than that of the contributions variable, since formality was imputed from the survey questions.

Again, I added in controls for age, marital status, gender and education, of which only the effects of age and education are significant. By far the largest and most significant effect is that of having a bachelor’s degree equivalent or higher. The coefficient on age is small but negative, suggesting that as individuals get older they are slightly less likely to participate in the formal sector. This result is likely to be driven by the top half of the distribution, which is over the age of 45. The large positive coefficient on having a bachelor’s degree tells us that more educated individuals are significantly more likely to be participating in the formal sector, as would be expected. As in the contributions results, adding in a control for monthly work income removes the effect of being in the low salary group, and has a significantly positive relationship with formality. The lack of statistical significance of the differences-in-differences estimator in the regressions of formal work is again problematic for the interpretation of the effects of the PASIS program; this will be discussed in the next section.

4.3 Secondary Results – Informal Saving

The next table displays the results of the regressions testing the secondary question and hypothesis that I described in the last section.
Based on these three regressions, we are able to note trends in individuals’ preferred methods of saving or spending contributions. First, the effect of being in the low salary group as compared with individuals whose monthly work incomes are over 35,000 pesos is large and significant in both the regressions with “WOULDSPEND” and “WOULDSAVE” on the left-hand side.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Dependent Variable</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log 1 plus income</td>
<td>.0076 (.0078)</td>
<td>.0210 (.0781)***</td>
</tr>
<tr>
<td>Low salary</td>
<td>.2298 (.0781)***</td>
<td>-.3168 (.0723)***</td>
</tr>
<tr>
<td>Age</td>
<td>.0079 (.0012)***</td>
<td>-.0074 (.0010)***</td>
</tr>
<tr>
<td>Female</td>
<td>-.0946 (.0307)***</td>
<td>.1409 (.0259)***</td>
</tr>
<tr>
<td>Married</td>
<td>-.1352 (.0321)***</td>
<td>-.0850 (.0276)***</td>
</tr>
<tr>
<td>Household Size</td>
<td>-.0068 (.0079)</td>
<td>-.0070 (.0069)</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>-.5471 (.0506)***</td>
<td>.1130 (.1016)***</td>
</tr>
</tbody>
</table>

Based on these three regressions, we are able to note trends in individuals’ preferred methods of saving or spending contributions. First, the effect of being in the low salary group as compared with individuals whose monthly work incomes are over 35,000 pesos is large and significant in both the regressions with “WOULDSPEND” and “WOULDSAVE” on the left-hand side.

We see that low-income individuals are roughly 23% more likely to say that they would prefer to spend their social security contributions than their counterparts, and 32% less likely to say that they would save their contribution formally. In the informal saving regression, the binary low salary indicator is not statistically significant, while the continuous variable for monthly work income is. For every 10% increase in an individual’s income, he or she becomes .19% less likely to say they would spend their contribution. Another way of thinking about this coefficient is recognizing that a doubling of monthly work income from 20,000/month to 40,000/month would move an individual from the 5th percentile to only the 7th or 8th percentile, but the change would
yield a 2 percentage point decrease in the likelihood of preferring to spend his or her contribution.

Another statistically significant and interesting result is that if an individual has been married, he or she is 13.5% less likely to say they would spend, and 21% more likely to say they would save it informally. Each additional year of age adds a small but positive probability that an individual will choose to spend his or her social security contribution, and a negative one that he or she will save it formally; age is also positively related to preferring to save informally. Household size is only significant in the regression of informal saving, and an increase in household size increases the probability of saying informal saving by .19%. Finally, having a bachelor’s degree decreases the probability that an individual would choose to spend his or her social security contribution by nearly 55%, and increases the probability of formal saving by 11%.

5. Analysis

5.1 Primary Results Analysis

In attempting to answer the question of whether there is a response to negative incentives to contribute to social security (and therefore to participate in the formal labor market), we have seen that while the coefficients from the regressions using a differences-in-differences approach suggest a negative response to PASIS, the estimators are not statistically significant. This raises a new question to be addressed: do the negative coefficients discussed in the results (Table 1) indicate that individuals choose not to contribute to social security or participate in the formal sector as a result of non-contributory pensions, or are they merely a statistical phenomenon? Technically, we know that the standard errors on the coefficients of the interaction terms are too large to
allow them to be statistically different from zero. However, further consideration may suggest a possible response among the treatment group. First, recall that the specifications take into account both individuals’ eligibility for and knowledge of the PASIS program, so the correlation that we see between the intersection of income and knowledge with contributions and formality is unlikely to be spurious, particularly if we control for age. Unfortunately, that identification does not make the results robust to statistical variation.

Consider why the results are not statistically significant, and note that in the regressions presented, the number of observations was only 1193 based on the restricted sample that was described in the methodology section. This sample is so small compared to the total surveyed population (75,000 households) because it is restricted to roughly the bottom 15% of the population that reported information on all of the included variables. Additionally, one disadvantage of using differences-in-differences is that each difference further restricts the population of interest. Naturally, the treatment group will always be smaller than the whole sample. In this case, however, there is also an unbalanced sample: the treatment group is smaller than the control group, because only 20% of the sample claimed to know about the PASIS requirements.

Additionally, there is significant measurement error involved with both dependent and independent variables. First, imputing the variable for being in the formal labor sector introduces measurement error; second, the treatment cutoff of 35,000 pesos per month in work income is actually a probabilistic cutoff. As is illustrated by the model of the paper’s hypothesis, not all individuals are certain of their income at retirement. Rather, the probability of an individual being treated by PASIS depends on his or her
monthly work income, age and knowledge of the PASIS program. Therefore, the variance of actual treatments around the estimated treatment cut-off also adds measurement error to the estimator, and thus downwardly biases the results. In combination with high standard errors as a result of small sample sizes, it becomes difficult to have statistically significant estimators.

A useful thought experiment would be to consider what size the coefficients on the regressors of interest would have to be in order for them to be statistically significant. In regression (3) in the table above, the standard error of the interaction term is consistently near .25 (in absolute value). Therefore, in order for the coefficient on the interaction term to be significant, it would have to have an absolute value of at least .50. A coefficient of this magnitude would imply that individuals who are both eligible for PASIS and have knowledge of the requirements are 50% less likely to contribute to social security than their slightly wealthier and unknowledgeable counterparts.

Intuitively, we would not expect such a strong response to the PASIS program given its size and the nature of the benefits. 50% is much larger than any estimated elasticity of labor supply to an income tax, let alone pension support. Additionally, mandatory contribution rates in a defined contribution system may not even be seen wholly as a tax (see Section 2). Therefore, it is hypothetically possible that there is a response to PASIS among the treatment group, but it is not strong enough to be robust in a statistical test. A test that may add information about the significance of a result in the case of a differences-in-differences estimator is the F-test. The F-statistic indicates whether two of the three coefficients in the differences-in-differences regression are jointly significant.
In the case of the contributions results presented in Table 1 of the last section, doing so for each pairs of the low salary and interaction terms and the knowledge and interaction terms shows that both being in the low salary group, and knowing about the pension program on the whole have has a statistically significant negative effects on contributions.\(^2\) In the case of the formal work regressions, the F-test shows that the joint coefficients on being in the low salary group are statistically significant, while knowing about the program is not. As I discussed earlier, however, when we consider the effect of being in the low salary group alone, it is difficult to identify causality of the PASIS program, because of the endogeneity problem in which individuals are less likely to contribute as they are poorer regardless of the pension support programs.

For purposes of meta-analysis, it may also worthwhile to consider the results that are discussed above, despite their lack of statistical significance. Traditional statistical significance is often criticized for its so-called “size dependence problem.” This problem refers to the fact that statistical significance depends entirely on sample size, and the same effect in two populations where one is slightly smaller than the other would yield significance in one case and not in the other. Therefore, the statistical significance is anomalous with respect to the effect size (Chow, 1996). In research, then, one may recognize an effect of significant magnitude as important even if statistical significance is low. However, if we allow ourselves to relax restrictions for statistical significance of a result, then we must also consider what the minimum size of the effect must be order to justify disregarding some of the effects of chance.

\(^2\) F-statistic for low salary and the interaction term exceeds the critical value of 4.61 for both contributions and formal work, while the statistic on knowledge and the interaction term does not exceed 4.61 in the regressions of formal work.
By comparing the effect sizes to others in the literature, we may be able to gain some more information regarding their relevance. In the case of the contributions results presented in Table 1, we see that the differences-in-differences estimators suggest that contributions decrease roughly 6% in the treatment group and formal work decreases by roughly 14%, though neither is statistically significant. For comparison, Nueumark and Powers (2000) found a roughly 10% in labor participation in response to the pension support program SSI in the United States. This shows that the effects found in this paper are at least important with regards to the size of the implied effect, disregarding the problems with sample size.

The lack of statistical significance in the differences-in-differences estimator, despite the significant t-tests and consistently negative direction (in line with our expectations), may also represent the absence of a response to the pension support programs. The model that I laid out in my hypothesis section showed that the probability of an individual contributing to social security is some function of the likelihood of him or her being under the income cut-off for pension support at the time of retirement. One can imagine a number of reasons why individuals may simply not have enough information about their income over the course of their lives in order to game the system and respond to the negative incentives to contribute. It may also be the case that the number of people who are close enough to the income cut-off to have to respond (do less formal work) in order to remain covered by the government is too small to be seen in empirical study. Finally, it may be that individuals are simply irrational, and do not figure potential government pension support into the value of current earnings throughout their lifetimes.
A way of testing the hypothesis that individuals are simply too uncertain about their lifetime incomes to respond to the deterministic cut-off for pension support is to consider the differences in differences of contributions and formal work between individuals who earn up to the minimum wage, and will almost certainly not be eligible for any pension support, and individuals who are well below the cut-off for PASIS eligibility. This test acknowledges the probabilistic nature of the eligibility cut-off for pension support from the perspective of an individual who is still in the work force. If we see a stronger negative result for this treatment group division in terms of the effects on contributions and formal work in this test, it would suggest that some of the individuals who are likely to be above the income cut-off for PASIS are in fact uncertain about that. That uncertainty may actually cause some individuals that are in the control group for income in the regressions reported in Tables 1 and 2 to respond by lowering their contribution densities (decreasing formal work). One can see how such a tendency would downwardly bias the magnitudes of the coefficients in the regressions presented in Tables 1 and 2.

The following tables present the results of this test, in which the low salary cut-off is the same as earlier (35.000/month), but the control group is no longer individuals who are just above this cut-off, but rather those who are substantially above it. Consider the theoretical diagram that was presented in the methodology section. These regressions difference the contribution rates and formal work rates of individuals who are likely to be at point A as they near retirement from those of individuals who are likely to be at point C. Therefore, we expect that the response will be larger and more statistically significant (the total number of observations should be larger since more individuals are being
considered). Note that I only include the regressions that control for all demographic characteristics as well as monthly work income. In this case, the magnitudes and significances of the coefficients of interest are not very sensitive to the inclusion of these controls.

In these regressions, we see that in the case of contributions, the effect of being both below the income cut-off and knowledgeable about the PASIS in comparison with individuals who are well above the cut-off and not knowledge about has a much larger effect than was seen in Table 1. The differences-in-differences estimator shows that being in the treatment group decreases the probability of contributing by 20%. Again, this is not statistically significant at the 5% or 10% levels, but it is much more significant than was seen earlier. This suggests that uncertainty about future income during working life has a significant effect on the behavioral response to PASIS.

<table>
<thead>
<tr>
<th>Table 4 – Control group Income Below Minimum Wage</th>
<th>Estimated coefficients and standard errors</th>
<th>Observations = 1989</th>
<th>Psuedo-(R^2) = .0714</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable = Contributing</td>
<td>Dependent Variable = Formal work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Salary</td>
<td>-.783***</td>
<td>-.662***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.108)</td>
<td>(.095)</td>
<td></td>
</tr>
<tr>
<td>Knowledge of PASIS</td>
<td>-.197***</td>
<td>-.242***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.093)</td>
<td>(.089)</td>
<td></td>
</tr>
<tr>
<td>Interaction knowledge* low salary</td>
<td>-.200</td>
<td>.083</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.163)</td>
<td>(.144)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.016***</td>
<td>-.016***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.0024)</td>
<td>(.002)</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>-.062</td>
<td>-.095</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.064)</td>
<td>(.061)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>.175***</td>
<td>.180***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.063)</td>
<td>(.060)</td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree or higher</td>
<td>.218</td>
<td>.439</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.154)</td>
<td>(.157)***</td>
<td></td>
</tr>
<tr>
<td>Log of 1 plus income</td>
<td>-.052***</td>
<td>-.034***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.011)</td>
<td>(.010)</td>
<td></td>
</tr>
<tr>
<td>Region Controls</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

*** p<0.01
However, in the regression in which formal work is on the left-hand side, the differences-in-differences estimator is very small in magnitude and completely statistically insignificant. There is unfortunately not an explanation for this phenomenon aside from the fact that formal work itself is a noisy measure as I explained earlier, given that it was imputed from the data. This is true because, discounting evasion of mandatory contributions, the response in contributions to pension support has to be commensurate with a response in formal work, except for as a result of measurement error. Thus, it is likely that uncertainty regarding total lifetime income is an important reason why the differences-in-differences estimators that consider only individuals directly above and below the income cut-off pick up little response to PASIS. This supports the hypothesis that there is in fact a response in contributions to pension support, but for a number of reasons that the standard errors are too large to allow them to be statistically significant.

5.2 Secondary Results Analysis

With respect to the question of whether individuals’ informal saving is affected by the existence of non-contributory pensions, I use the results from Table 2 that predict whether individuals would prefer to spend their social security contribution, save it formally (with risk pooling), or informally. As I discussed in Section 3, if we expect that lower-income individuals are more likely to save informally, then there would be a negative coefficient on log of one plus monthly work income in the regression of informal saving, and a positive coefficient on the binary low salary variable.

Likewise, we expect there to be negative coefficient on the log of one plus income in the regression of “WOULDSPEND.” In Table 2, we see that the only positive coefficient on the log of one plus monthly work income is in the informal saving
regression, making you more likely to say you would save informally as you get wealthier. This suggests one of three things. First, it is possible that my hypothesis is untrue and low-income individuals do not do informal saving. Second, it could be the case that activities that I have categorized as informal saving in that they prevent against income insecurity are actually perceived purely as spending, which we would expect to increase over the income distribution. This may be the case if individuals see themselves as too credit constrained to invest in property or automobiles. Third, the positive coefficient on monthly work income in the regression of informal saving may in fact represent a crowding-out effect of pension programs. If a poor individual is not contributing to social security because of the existence of a pension support program and he or she would otherwise be saving informally, then one would not expect an effect to show up on the dependent variable INFORMALSAVE.

In order to test which of the three hypotheses regarding the effect of income on the tendency to want to save informally, I analyze each of the individual answers to the question “what would you rather do with your social security contribution?” This helps to determine whether there is an increased likelihood for low salary individuals to do some of the activities that are included in informal saving and not others, causing the categorical dependent variable to have insignificant coefficients. Unfortunately, the results of these regressions are statistically insignificant in some cases, which makes the induction for the purposes of aggregating trends in informal saving difficult.

One interesting result that we do see is that being in the low salary group increases the likelihood that the individual will report that he or she would prefer to invest their social security contribution in their business. This may in part be related to
the fact that low salary individuals are more likely to be in the informal sector rather than the formal sector, and own a small business. Another result shows that increasing monthly work income by 10% will increase the likelihood of reporting that the individual would prefer to invest his or her contribution in property by .34%. This implies that individuals are more likely to want to invest in property as they become wealthier, despite property investment being included in the informal saving category. There is also a negative relationship between monthly work income and reporting that an individual would prefer to invest in their children’s education (statistically significant at the 10% level).

Based on this sub-set of responses in the informal saving category that are statistically significant, it would seem that the most reasonable of the three hypotheses laid out regarding the effect of income on preferences for informal saving is that investments such as property and automobiles are seen less as a way of preventing income insecurity than education or small businesses and are therefore more preferred by wealthier individuals. Recall, however, that there is also a negative relationship between income and the likelihood that an individual would prefer to spend his or her social security contribution. Therefore, if the hypothesis regarding property and automobile investments is correct, then it is implied that the poor would rather spend their social security contributions on non-durable, non-luxury items. This is consistent with other empirical research on this topic.

In order to test which of the three hypotheses regarding the effect of income on the tendency to want to save informally, I do two things. First, I run the same regression, and restrict the sample to the bottom 60% of the distribution. In this regression, neither
the coefficient on log of one plus monthly work income, nor the one on being in the low salary group is significant. Therefore, the relationship is more positive among the strictly low-income group. This suggests that there is very little informal saving among the groups that are covered by pension support, which may point to a crowding out effect. One way of further testing this hypothesis would be to break out each individual response to the survey question, to see which the low-income individuals are most likely to include as a response.

Finally, note that the result from the informal saving regressions with the most economic and statistical significance is the large negative effect of having a bachelor’s degree on saying that one would rather spend his or her social security contribution. This result is evidence that even if there are confounding effects of income on saving preferences, highly educated individuals will choose to save and less-educated individuals will spend. Therefore, the informal saving regressions tend to reinforce our hypotheses regarding saving patterns over the income distribution: poorer individuals prefer to spend more of their money, but they tend to spend on non-durable and non-luxury items; more educated individuals will save more often; and there is an ambiguous effect of income on the desire to save informally. However, there is some evidence that social security may be crowding out investments of low-income individuals in things like their children’s education and family-owned businesses. Investments such as these would not show up as formal saving, though they are non-myopic expenditures.

6. Conclusions and Extensions

In this paper I have attempted to answer the questions of whether there is a labor supply response to negative incentives set up by non-contributory pension programs, and
whether informal saving is also reduced as a result of these programs. More broadly these questions inform the potential effects of expanding the Chilean non-contributory pension program, as well as the debate surrounding the optimal structure of social security systems. I used a differences-in-differences methodology based on individuals’ income eligibility for the PASIS program and their knowledge of the program’s requirements in order to capture the effects of non-contributory pensions on participation in the social security system and the formal labor market.

My results showed consistent negative coefficients on the low salary and knowledge of program regressors and interaction terms, although the differences-in-differences estimators were not statistically different from zero. This may suggest that there is a negative labor response, but because the treatment group is so small, the standard errors are too large to achieve statistical significance. I was able to determine that being in the low salary group has a statistically significant effect on both contributions and formality, while knowledge of the PASIS program only has a statistically significant effect on probability of contributing. Again, this perhaps points to a weak signal, but also to the strong endogenous effect of income on both outcome variables.

An alternative interpretation of the insignificant results is that individuals simply do not respond to government-provided pension support because there is too much uncertainty regarding their lifetime incomes and the potential for receiving support. This is supported by further analysis in which I allowed individuals with higher incomes into the control group, such that there would be a larger degree of certainty on average among control group participants, that their accumulated incomes would exceed the value of half
of the minimum pension guarantee. The large negative effect of treatment on contributions in these regressions further suggests the possibility of a response to pension support.

Therefore, it is not the case that a negative result implies that there is no response at all, but simply that it any response is not consistent across individuals. The high variance poses difficulties for application of the results to policy: since we cannot precisely estimate the elasticity of formal work to pension support, we cannot apply it to proposals for new types of pension support. It is not correct, however, to assume that because no clear response shows up to the PASIS program, that pension support could be expanded without significant labor supply and coverage effects.

Regressions testing the effect of non-contributory pensions on informal saving were less able to achieve causal identification. However, the positive and statistically significant relationship between the monthly work income and probability of preferring to save one’s social security contribution informally may point to a crowding out of informal saving among low-income participants. In analysis of the preferences for the components of informal saving, I also saw that low salary individuals would prefer to invest their social security contributions either in their children’s education and/or family-owned businesses, while wealthier individuals would prefer to invest in property or automobiles. This suggests that there is evidence for the theory that poor individuals would engage in some level of income insecurity prevention in the absence of social security. However, we are not able to know the magnitude of the informal saving that would take place.
The policy implications of a potential negative labor supply effect and crowding out of informal saving by non-contributory pensions are not that the removal of pension support is optimal. Further research is necessary to determine whether the moral hazard problems of old-age social security are sufficient to require government-mandated saving. In the case that we believe that such mandates are necessary, I would not advocate for a system without non-contributory pension support. (Incentive effects do not outweigh the necessity to create an equitable social insurance system; governments often take on redistributive programs that negatively alter individual incentives.) However, the costs of pension support programs will then be an inherent part of a system with mandatory contributions, and should therefore be fully understood in order to inform policy.

In further study, it will be useful to have longer longitudinal data to look at the effects of the program on individuals over time. This would be better able to take the effect of uncertainty regarding total lifetime income into account by testing the responsiveness of individuals of a given income level as they approach retirement age. Additionally, in this paper, small sample size and large standard errors likely impeded any potential significant effect from being shown. Another extension of this paper is to consider the minimum pension guarantee, which is a much larger pension support program that PASIS because more people are affected by eligibility; also, the potential discontinuities in incentives are much larger. Such a study will likely be possible in the next four to five years, as the effects of the program begin to take place.

Finally, another way of approaching the question of optimal social security programs is to look directly for the existence of moral hazard in income prevention.
There are several ways of doing this, one of which might be to use survey data to analyze saving patterns of individuals in the informal labor market, where social security contributions are not automatically deducted from payroll. With the appropriate data, one would be able to test the voluntary saving levels, types of instruments and costs and benefits of mandating coverage.
References


Superintendencia Seguridad Social, Departmento Actuarial, “Variables Previsionales Relevantes; Vigentes al mes de Noviembre de 2007.”

Appendix

Figure 1 – Probability of Contributing by Age

Figure 2 – Probability of Contributing by Income Level
Figure 3 – Probability of Knowledge of PASIS by Age

![Graph showing probability of knowledge of PASIS by age.]

Figure 4 – Probability of Knowledge of PASIS by Income Level

![Graph showing probability of knowledge of PASIS by income level.]

Pr(claimknowsPASIS) — Fitted values
Figure 5 – Probability of Formal Work by Age

Figure 6 – Probability of Formal Work by Income Level
Figure 7 – Rates of Contribution by Income Level and Knowledge of PASIS