The Impact of Non-contributory Pensions. A Case Study for Costa Rica

Hazel Elizondo, Sandra Flores, Alicia de Quinto

Abstract

This study attempts to analyze the effect of the non-contributory Costa Rican pension in employment, schooling, household composition and changes in well-being at household level. This regime has been granted since 1975 to elders aged above 65 that live in extreme poverty situation. In 2007 the pension experimented an increase in their amount by 186%, this with the aim to mitigate poverty in this population. Using data from the National Institute of Statistics and Census (INEC for its acronym in Spanish) in the period 2001-2009 we analyze whether households that receive the pension exhibit changes in labor force supply, household composition and well-being. The methodology applied includes a difference-in-differences model (DD), that compares households with members above 65 years before and after 2007. Then, exploiting a discontinuity in the treatment regarding the age of the oldest household member, we applied a Regression Discontinuity Fuzzy Design (RD) and a Difference in Discontinuity Design (diff-in-disc). Findings in the DD method suggest an impact of the pension on the labor outcomes for the receiver households, showing a decrease on the hours worked, labor force participation, labor income and child work. Regarding the two left methods, there is no evidence of impacts triggered by the non-contributory pension.

1 Introduction

One of the objectives of social security is the mitigation of the vulnerability that elderly people confront due to higher risks in income and consumption instability, as well as health deterioration. These risks can be translated into more probabilities of being poor and experimenting detriments on well-being. The severity of this situation turns deeper when this population belongs to the informal labor sector, so they cannot contribute for a formal pension that serves as an insurance to confront the risks of retirement. As a response of this, Governments around the world have been designed and applying schemes known as non-contributory pensions. The target population for this benefit are elders in retirement age that suffer for informality and poverty, among other specific characteristics of each benefit design.

The reasoning for the existence of non-contributory pensions is reinforced with the fact that just the 20% of the elder population receives the coverage of a pension in the world (Pallares-Miralles, Romero and Whitehouse, 2012). Additionally, according to the International Labour Organization (ILO, 2014)

the coverage of this pensions is often inadequate. In the case of Latin America, the contributory pension coverage varies from 10% and 60% of the elderly population, around 15 countries had executed non-contributory pension schemes in this region (Bosch, Melguizo and Pagés, 2013; Pallares-Miralles, Romero and Whitehouse, 2012).

The literature has been studying the direct theoretical effects of these pensions on the beneficiary. The direct effects are related to decisions in the labor supply, changes in the consumption and saving patterns, as well as effects on physical and mental health, changes in household composition and poverty, among others. Moreover, the indirect effects of non-contributory pensions are also part of the empirical analysis. In the literature, the indirect effects found include the variables just mentioned measured for the other household members. In this category of outcome variables is generally also included school attendance and child labor.

Several studies in Latin America have been conducted with the aim of knowing the impact of this social programs in the well-being of the beneficiaries and their families. For instance, studies applied in Peru had found that Pension 65[1], a non-contributory social program, has a positive impact on mental health, consumption and on labor participation, among other findings. In this line, the contribution of this research is providing more empirical evidence of the indirect effects of the non-contributory pensions in Latin America, through a study case for Costa Rica that aims to answer what is the impact of this pension on labor outcomes, household composition and well-being changes. This study pretends to exploit an increase on the pension amount that took place in 2007.

The relevance of the non-contributory pensions has been reinforced due to demographic changes that are affecting several countries. These changes can be summarized as elderly population that increasingly lives longer and represents bigger proportions of the population. According to the United Nations (2013), elderly people[2] will increase to the double and will have a considerable increase in their life expectancy by 2050 (Bosch, Melguizo and Pagés 2013). Costa Rica is not the exception of the recent demographic changes. This country has been experimenting an important demographic change since 30 years ago (Brenes, 2008). According to data obtained from the Economic Commission for Latin America and the Caribbean (ECLAC), the population with more than 65 years old in Costa Rica represented 5% of the population in 1995 and by 2015 this proportion ascended to 9%. Furthermore, both the mortality and the birth rate have been decreasing, being 4.62% and 14.31% in 2016, respectively. On the other hand, the life expectancy has been experimenting an increasing trend, reaching in 2016 82.6 years for women and 77.5 for men.

As discussed above, falling into poverty is a risk that elderly people confront and this is part of the reasoning for the execution of non-contributory pensions. Poverty affected on average the 19.2% of the households in Costa Rica, this for the period 2003-2009. Additionally, 3 of each 10 individuals older than 65 years old were hit by poverty in the period 2001-2009, extreme poverty affected almost 1 of each 10 individuals. This population and children (0-14 years old) have been typically the more affected by poverty, however since 2007 and until 2014 elderly individuals experimented a decreasing path in poverty. People above 65 years nowadays exhibits poverty incidence similar than the age groups historically less affected for this bad.

[1] Bando, Galiani and Gertler (2017), The Effects of Non-contributory Pensions on Material and Subjective Well-Being
[2] Includes people who are 60 years old or older

The non-contributory pension has been applied in Costa Rica since 1975. The population target includes not just elderly people but also widows, orphans, disable people and homeless. The common characteristic through these groups is the requirement on the extreme poverty condition of the beneficiaries[3]. In the case of the aged people, there is other eligibility rule, which mandates that the applicants have to be aged above 65 years old. The contributory pension in this country covers the 19.6% of the elder population, on the other hand the non-contributory pension covered on average the 21.8% of the target population in the years 2001-2005. In 2007 the Government increased the amount of the pension in 186% for all the beneficiaries, with the aim of mitigate poverty.

The data analyzed comes from National Survey of Multiple Purposes (EHPM for its acronym in Spanish) recollected by the National Institute of Statistics and Census (INEC for its acronym in Spanish) and presents a cross-sectional structure. The survey contains information for the period 2001-2009, period that will be included entirely in the econometric analysis. For all years, the data provides information of household characteristics as well as individual level data, being the household the unit of analysis picked for the purposes of the present research. Additional to the drawbacks that a cross section data implies, we confront an additional hardship since we cannot identify the moment when the beneficiaries started to receive the pension. This does not allow to control for the potential heterogeneous effect of having more or less periods receiving the pension as well as the impossibility of knowing the poverty status that individuals exhibited by the time they were included in the beneficiary system.

The methodology proposed includes three different models. The first specification is based on a DD, which serves as a general model that relies on the assumption of parallel trend of the variables analyzed before 2007 for receivers and non-receivers . This setting compares the group of receivers before and after 2007 with a control group aged above 65 years old, controlling for zone of residence, poverty level, income per capita, as well as gender and years of education of the household head. The second specification is a RD fuzzy design, which takes advantage of a discontinuity on the treatment assign regarding the age of the applicants. The identification strategy consists in a matching of households by level of income, as a way to deal with the unbalance in monetary wealth of the treatment and control group. The difference among receivers and no receivers in this setting is the age of his oldest member, the treated are households with a member between 65 and 69 years, while the counterpart is aged between 61 and 64. The specification is also controlling for a set of covariates which means are statistically different in both groups. This second approach corresponds to a local analysis of the treatment effect, but just allow us to identify the effect of receiving the pension and not the increase in the pension amount. To overcome this drawback we apply a difference in diff-in-disc that combines both models introduced above allowing for the identification of the effect that the increase in the pension has on the different outcomes variables included in the analysis.

The DD method yields empirical evidence that the increase in the pension that took place in 2007 had implication in the labor supply decisions of the receivers households. The number of hours worked per week descended by almost 2 hours, around 0.2 less individuals were in the labor force and the labor income decreases by almost 35,000 CRC (62 USD). There is also a decrease in the child labor and the probability of having a higher reservation wage within the household individuals increase. Conversely,

[3]This rule is checked with the absolute poverty line established by the National Institute of Statistics and Census (INEC by their acronym in Spanish)

in the dimension of household composition there are no contundent proofs of changes in none of the methods applied, meanwhile changes in assets (durable goods) although shows a significance in statistical terms, shows a counterintuitive effect (decrease of almost 0.2 assets for households treated). On the other hand, the results obtained in the RD and in the diff-in-disc method, which implement a local analysis of the pension impact limited to a more homogeneous comparison group, do not support the results obtained in the DD method. In both methods none of the outcome variables is statistically significative.

The paper is organized as follows. The next subsection presents a description of the non-contributory pension policy. Section 2 includes a review of the literature on the impacts of the non-contributory pensions, focusing mainly in the the Latin American evidence. Section 3 describes the data used regarding the different methods followed. Section 4 characterizes the methodology applied in order to answer the research question. In the section 5 we present a discussion of the paper findings. Finally, section 6 concludes.

1.1 Non-contributory pension in Costa Rica

The non-contributory pension is implemented in Costa Rica since 1975 with the objective of protecting those in economic need that are not eligible for the contributory existing regimes in the country. This benefit is given to individuals that fulfil the statues with priority on elder people and those who suffered an illness in the childhood that have neurological sequels. The population target includes elders, widows, orphans, disabled and homeless.

The executor institution is the Caja Costarricense del Seguro Social (CCSS for its acronym in Spanish), which has as well the execution of the contributory pensions in Costa Rica. The funding of the program is given by national budget through the Social Development Found and Familiar Assignations, the origin of the funds come from several specific taxes. In 2013, the budget assigned to the non-contributory pension program was 99,169,400 USD.

For the population studied in this research the eligibility lies in two main rules[4], the first one mandates that the applicants need to prove an extreme poverty status, which is defined as people that live in a household with a per capita income below the poverty line calculated for INEC. The second rule is related to the age of the beneficiaries that needs to be above 65 years old. The authorities check these rules by the request of legal documents and through residence visits to the applicants. Given the aim of the benefit, those individuals that receive the pension cannot be attached to the labor market. Even though there is no tracking of their employment status, in case of the breach of this restriction they are subject to the annulation of the benefit.

The benefit is granted just to one member in the house, even though more of one are eligible for the pension. The process to obtain the benefit starts just once the individual is 65 years old, there are no chances of receiving the pension or start the process to receive it before the age requirement is fulfilled. It is relevant to mention that there is no a established length in the duration of the

[4]The regulations of the program can be accessed at the following link: `http://www.pgrweb.go.cr/scij/Busqueda/Normativa/Normas/nrm_texto_completo.aspx?param1=NRTC&nValor1=1&nValor2=73579&nValor3=97016&strTipM=TC`

administrative process of application assessments. The process can take weeks and even months, this given the fact that the program confronts a problem of scarce staff for the burden of applications received. An important weakness of the program is the lack of established monitoring system that assess the socioeconomic status of the beneficiaries as well as changes in the household composition which can implies the unfulfillment of the poverty condition requirement.

The non-contributory pension coverage was on average 21.8%, this represents the average population aged above 65 years old for the period 2001-2005. For the total of the beneficiaries, on average the 55% were females, this for the period 2001-2009. The average rate growth of the number of beneficiaries at the end of the year, with respect the beginning of the year was 3% (51,236.4 cases) for the period 2001-2005. On average, 5,338.6 cases were finished in the period 2001-2005, dead of beneficiaries represented the 57% of the reasons for the ending in the benefit, the resting 43% represented other reasons.

Regarding to the amount of the pension, in 2006 the amount was 17,500 CRC (33.76 USD). In 2007, due to political reasons, the Government decided to increase by 100% the amount of the pension, from 17,500 CRC to 35,000 CRC (70.39 USD). A second increment was performed in July of 2007, this time the increment represented the 43% of the first increment reaching an amount of 50,000 CRC (100.56 USD). Another increments have been applied to the regimen until today, as a part of political reasons and adjustments of the amount.

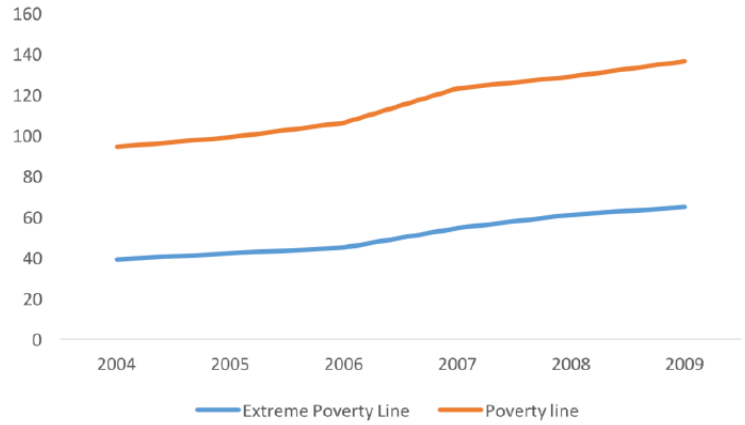
The poverty in Costa Rica is approximated using an income approach, what consists in the determination of a poverty line as the standard that society should reach in order to enjoy a minimum level of subsistence. This minimum standard is equalized to the monetary value of a basket of goods and services necessaries to reach it. The institution in charge of the set both the poverty line and to collect the data of the income level is the INEC[5]. There are two poverty lines, as well as two different baskets of good and services. The difference among the two parameters is the kind of elements included in them, being the lowest value the one that represent for the extreme poverty status with a basket called "alimentary basic basket". The second poverty line is computed with the value of the "total basic basket" that includes a bigger set of goods and services.

To define if a family or an individual is poor the total household income is divided by the number of members of the household, if the calculate income per capita is lower than the poverty line established so the individual and the family fall into the category. The cost of the basket is set up according to the inflation[6], during the period 2004-2009 the average interannual variation of 10,9% which explains the increment in the poverty line observed in Figure 1.

[5]The following link includes the methodology of the poverty line in Costa Rica: `http://www.inec.go.cr/sites/default/files/documentos/pobreza_y_presupuesto_de_hogares/pobreza/metodologias/documentos_metodologicos/mepobrezaenaho2010-02.pdf`

[6]In 2010 INEC made an actualization of the alimentary habits, the expenses included in the basket and consumption patterns

Figure 1: Costa Rica: Evolution of the poverty line in USD. 2004-2009



Source: Own elaboration with INEC information

2 Literature Review

There is a vast literature in determining the impact of non-contributory pensions, both the direct and indirect effects of the benefit. Usually the units analyzed are the individual that receives the pension. Nevertheless, family members can be also affected by the transfer to the beneficiary, which justifies the assessment of indirect effects in the literature. The outcomes measured varies in each setting, being health, consumption and labor force variables commonly find in the literature. The majority of the analysis includes a RD design, which emphasize the relevance of the method on the field. There is an extensive evidence in Latin America and South Africa of evaluation of the non-contributory pensions regimes which have been including a broad range of outcome variables in their designs.

A reference analysis for the South Africa's non-contributory regime was made by Duflo (2003). The author investigates the redistributive effects of the non-contributory pension for elderly people, focusing on the health and the nutrition of grandchildren. To measure the effect of the benefit the author uses anthropometric indicators such as weight-for-height and height-for-age. The analysis performed in this study make a differentiation among the gender receivers as well as the gender of the grandchildren of the receiver. The identification strategy is based on a comparison of the outcome variables of households that have a beneficiary and households with a member that will be eligible to receive the benefit once has the age requirement. The evidence found in the paper shows that when the benefit is received by a woman the weight and height of girls increase by 1.19 standard deviations but there is no a significant increase in the case of boys. When the receiver is a man there is no evidence of improvement in nutrition for grandchildrens. Previous the paper by Duflo (2003) Case and Daton (1998) performed a benchmark study which investigated the redistributive effects of a non-contributory pension for elderly people in South Africa as well as behavioral changes in food consumption, clothing,

housing, schooling, transportation, health, remittances, insurance and savings. The main goal of the paper is to test whether there are redistributional effects of the scheme for the receiver and his family.

Several articles approaches the assessment of the household composition and resources using the RD design for the data analysis. The choice of the analytical method is guided by the dependent variables presented in the research. Bando et al., (2017) studied the non-contributory pension on the Peruvian population, the Pension 65 program. The objective of the Pension 65 program is to give economic security to whose individuals who were aged above 65 years and lacking essential life resources. Indeed, at the inception of the program in 2011 recipients of the program received 78 USD bimonthly. The methodological approach in the study involved the use of a sharp RD design, which applied the SISFOH index score. The SISFOH index score consisted of the weighted average of some household characteristics, a household is defined as poor if its score falls below a set threshold value. Also, poverty thresholds were set for geographic regions referred to as "conglomerates." The selection of the methodology was guided by dependent variables, including the number of employees and remuneration based on time, physical health, well-being as well as individual beneficiary characteristics. The results from the study shows that the families with a recipient had their consumption level elevated by 40% and handovers to individuals staying out of the family rose. Additionally, the fraction of families that recounted transfer-based expenses rise intensified from 46% to 61%.

In a study by Bando et al., (2014), examined the effect of a non-contributory pension program on the economic security and well-being of pensioners and their families. The Assistance for Older Rural Adults Program provides a nationwide non-contributory universal pension scheme for seniors in Mexico. The study utilized a quasi experimental methodology, in which exogenous geographic variables and age limit were used to recognize the targeted population. In the approach, there is utilization of a theoretical model with three groups. (1) Treatment (TT): This type receives a pension in both periods; (2) Internal Control (IC): This type gets a retirement only in the second period, and (3) External Control (EC). They estimated DD regression models, which includes individual or household as the observation unit, the approach conditioned on unit and year fixed effects. The choice of the analytical approach was based on the dependent variables such as mental health, labor supply as well as household income and consumption. Among others results, the empirical evidence found in the paper concludes that pensioners fully share their transfers with the family members of the household.

Kassouf and Rodrigues de Oliveira (2012) evaluated the effects of the non-contributory for the pension program Continuous Cash Benefit Program (BPC for its acronym in Portuguese) in Brazil, on household composition and labor market outcomes of the elders and their co-residing relative by using a discontinuity approach. Based on variables such as the age of the household members, individual and household characteristics, the primary strategy for evaluating the BPC was to use the discontinuity that the age eligibility rule creates in the probability of being treated and, therefore, in the outcomes. For a pension program with a discontinuity in age, not all the eligible may get the treatment because of imperfect compliance, positioning the fuzzy RD as the best design. Besides RD, other methods were used, such as Propensity Score Matching, DD and some variations of the RD method. The approaches are complementary to each other. The DD uses the change in the eligibility age in 2004, the propensity score matching explores the difference between treated and who should be treated, and the RD estimations explore the discontinuity in the probability of being treated on both sides of the discontinuity.

The results showed a decrease in the labor force involvement of the older adults, implying that as a result of the program older individuals who are poor can retire. These results provided evidence that the program makes it possible for these poor elders to retire, there was also an impact in the labor force of the co-residents but the effect was heterogeneous concentrated for adults over 30 years old.

Barrientos (2003) examined the influence of cash transfer programs for elders in Brazil and South Africa regarding poverty among households with older people. Barrientos (2003) applied the following method in the analysis: based on poverty as a dependent variable, first, a calculation of poverty with a contributory pension is done and without a contributory pension to see how the rate of poverty change. The author found that there is an increase in poverty when there are not non-contributory pensions. As a second step in identifying the impact of non-contributory pension income on poverty, the author modeled probit regressions of the contributing factor of the likelihood a house member being poor. A multivariate analysis makes it possible to identify the impression of utilizing a non-contributing retirement fund recipient, based on the possibility that the members of the family are poor, managing family based and personal traits as well as income sources. Results showed that the non-contributory pension programs have a substantial and significant bearing on the likelihood of poverty when alternative sources of income, personal and family traits are controlled.

Martinez et al., (2015), quantitatively determined the effects of the Universal Basic Pension (UBP) cash transfers on the living standards of households with participating adults in El Salvador. Based on household income, monetary poverty, consumption per capita, participating in the labor market, health and household size, the retrospective analysis of program impacts were initially conceived as a RD design, comparing outcomes of households around the age-eligibility threshold of 70 years. This strategy was abandoned following an initial analysis of the program participation data, given little participation during the first year of eligibility and no variation in treatment around the threshold, which invalidated the RD approach. Instrumental variables identification strategy was applied to estimate treatment on the treated effects of the pension, using a purpose-specific sample of 2,255 households with adults between 66 and 74 years of age in the 32 poorest municipalities in the country. The results suggest that School attendance of 11 to 18 year olds individuals who live with a pensioner increased by six people, suggesting that the pension may also contribute to human capital investments for the next generation.

Martinez (2004) estimated the impact of the cash transfer to senior citizens on household consumption and investment in Bolivia. The approach used in the analysis was a RD design comparing eligible to ineligible households in pre and post-treatment periods. Based on food consumption as the dependent variable, the effect of the program on the outcome is estimated with a simple OLS regression. Results indicated that Bolivians tend to spend more in owning animals, agricultural inputs as well in the amount of crop harvested, which impedes investment. Therefore, cash transfers could enable liquidation of undercapitalized possessions, facilitate cash flow and reduce poverty.

3 Variable description

The objective of this research is to quantitatively determine the effects of a non-contributory pension regime on the household decision-making. For that purpose, although the pension is assigned individ-

ually, the analysis is held at the household level, differentiating households with a pension beneficiary from those in which none of the members receives the payment. It is important to notice that a further household member do not qualify for the pension if there is already a beneficiary in the residence.

The impact of this program is evaluated in three main dimensions: employment or schooling, household composition decision-making and well-being changes. In this vein, the outcomes are constructed following various definitions, such as the household's head case, whether at least one person in the household meets the condition, the number of members in the household that satisfy the status considered, etc. However, only the most suitable definition was considered for each output, which are summarized in Table 1.

In the first dimension, the employment preferences are captured by means of different labor force indicators: weekly working hours, labor force participation, labor income, whether a child in the household is working, and reservation wage. According to the labor market model where there is a government that provides income transfers, the cash transfers have a negative effect on the labor market variables (Cavalcanti and Corrêa, 2010). The model explains that the income transfer increases the actual reservation wage of those individuals who receive the benefit. So, the beneficiaries increase their value of being at home because its opportunity cost of searching job has increased, therefore some beneficiaries choose to leave the labor market. Due to this, we expect an increase in reservation wage, and a systematic lower mean value for hours worked per week, labor force participation, labor income and child labor. For household members aged from 12 to 18, we additionally analyze changes in high school attendance[7]. In this case we expect an increase because, as was previously mentioned, an income transfer reduces child labor, decreasing their opportunity cost of schooling. Furthermore, an increase in the family budget can help to cover the costs of teenage education.

In the second dimension, the household composition is captured by measuring whether the households are conformed by one member, as well as the number of young members that live in the household. According to the household composition model, there are gains in the co-residence with the consumption of public goods and the savings generated from it. These gains will be higher the greater is the public good consumed and the share allocated to each member (Foster and Rosenzweig, 2002). It also depends on the presence of economies of scale, which arise when using jointly assets increases income, in comparison with the alternative scenario of using them separately (Winters et al., 2009). The decision of co-residence also has an impact in the protection against risks, for instance through diversification of income sources. Having in mind all the previous channels, under the household composition model it is expected that an income increase causes an increase of public goods consumption, leading to incentives to not split or join the household. In this line, it is expected that the probability of living in a single member household decreases for those households that receive the pension, in comparison with households that do not receive the benefit, as well as to observe a higher number of young members in these households.

[7]This variable was just constructed for high school since there is no variability for primary school, almost the 100% of children in aged between 6 and 12 attends to primary school

Table 1: Variable description

Dimension	Category and Expected Sign	Variable Definition
Empoyment or Schooling	Number of hours worked per week (-)	Average worked hours of the household conditional on all the individuals of the household, including the individuals that do not work.
	Number of individuals in the labor force (-)	Number of members of the household that are in the labor force
	Labor income (-)	Household labor income per month (Thousand CRC per month)
	Number of children that work (-)	Number of members of the household that are less than 16 and work
	High school attendance (+)	Dummy variable: 1 if at least the household has a member between 12 and 18 years old that attend to high school, 0 otherwise
	Reservation wage (Thousand CRC per month) (+)	Variable with 5 categorical options: • 1 if at least the household has a member with a reservation wage less than 30 • 2 if at least the household has a member with a reservation wage between 30 and 50 • 3 if at least the household has a member with a reservation wage between 50 and 75 • 4 if at least the household has a member with a reservation wage between 75 and 100 • 5 if at least the household has a member with a reservation wage bigger than 100. This variable exhibits the minimum reservation wage reported within household.
Household Composition	Households conformed by one member (-)	Dummy variable: 1 if the household is conformed just by one member, 0 otherwise.
	Number of young members (+)	Number of young members (less than 12) in a household
Well-being Changes	Number of assets (+)	Number of assets that the household has. The assets can be: mobile phone, landline phone, microwave, shower for hot water, tank to store water, washing machine, fax and radio.
	Housing physical conditions (+)	Variable with 3 categorical options: 1 if the house has a bad physical situation; 2 if the house has regular physical situation; 3 if the house has good physical situation.

On the other hand, this study exploits two indirect measures of well-being. The first one correspond to the housing physical state, which is obtained using a methodology suggested by INEC[8] that combines characteristics of the materials and state of the ceiling, walls, and floor. This indicator can be seen as a disaggregated measure of the housing spending, and as a proxy of living conditions that is recognized empirically as a indicator of well-being. The literature agrees that the material, size, and security of the house have a direct impact on the household well-being by means of segregation, ambiental problems, isolation from economics nets, health effects, among others[9]. The second measure considered under this dimension is the consumption of durable goods and house equipment, defined as the ownership of the following items: mobile phone, landline phone, microwave, shower for hot water, tank to store water, washing machine, fax and radio. The inclusion of this category improves the reliability of our conclusions, since it represents a more direct measure of material well-being[10]. Giving the income increase in receiver households, it is expected an improvement in both, the household physical conditions and durable consumption.

In the case of Costa Rica, there are two potential program eligibility requirements related to the age of the individual and her poverty status, so that only households with members aged 65 or more and in a context of extreme poverty can apply to the program. The extreme poverty condition is determined by evaluating whether the households' income per capita falls below the extreme poverty line benchmark. Once the application is formalized, an administration officer visits the household in the next weeks to verify the information provided, as well as to assess the physical state of the house and living conditions of the requester. As mentioned in the subsection 1.1, there is no a predefined duration for the application assessment.

The fact that the administration has the final word on the pension assignment preserves the analysis from possible perverse incentives that might arise if the pension would be directly granted to every eligible individual applying for it. Furthermore, the public budget proposed for this program varies almost every year, meaning that the number of households covered by the program changes frequently. This makes difficult for the potential candidates to predict whether they will be actually selected, as they ignore how many other eligible individuals have applied for the pension, what reinforces our previous argument. It might be also the case that candidates to the pension have strong incentive to misreport the actual number of household members living with them to exacerbate their poverty status. Indeed, individuals could declare, with the subsequent official evaluation, living in a residence with many other family members, and then move shortly after the pension is assigned. However, this possibility is discarded as the average number of household members is similar for the beneficiaries and the non-beneficiaries' households, i.e. the average number of household members is 3 in both cases.

The benefit is granted to a group of individuals that voluntary ask for it, this implies the presence of potential omitted variable bias in the estimators in both directions. The unobserved heterogeneity in individuals could make them less or more prone for the benefit application. Instances of potential unobserved characteristics are access to greater and best information, being proactive, having a greater

[8]The methodology in spanish of the creation of the variable is available in the following link in the section Creacion de Variables de Vivienda: http://sistemas.inec.cr/pad4/index.php/catalog/107

[9]For further discussion see McTarnaghan, S et al. (2016). Revisión bibliográfica sobre vivienda en América Latina y el Caribe

[10]For broader discussion see Meyer, B and Sullivan, J. (2003). Measuring the Well-Being of the Poor Using Income and Consumption

social network, as well as suffering from health problems. Analyzing for instance the numbers of hours worked in the household is expected an upward bias estimator given more proactive households. Being more proactive could encourage a household to ask for the pension and at the same time is working more hours per week. Conversely, households with higher social networks are less prone to ask for the benefit but this omitted variable could also implies that households work more hours per week which leads to a downward bias estimator. Another potential bias in the estimation is that the period when the households start to receive the pension is unobserved, this leads to an additional unknown source of heterogeneity that cannot be control in the estimation.

4 Data

4.1 Sample

The present study uses data that comes from the Household Survey of Multiple Purposes of Costa Rica (EHPM by its acronym in Spanish) provided by the National Institute of Statistics and Census of Costa Rica. The EHPM was recollected for the period 1987-2009 with a monthly periodicity having a cross sectional nature. The survey includes socioeconomic information of a representative sample of the Costa Rican population, including data on socio demographic aspects, housing physical conditions and economic activity. The present study uses annually information for the period 2001-2009 with household as the unit of analysis. The data is defined at the individual level including 402,674 observations, which corresponds to 105,618 households.

As will be discussed in the next section, we implement three methodologies: DD, RD and diff-in-disc, the setting for these methods includes the entire period 2001-2009. The sample analyzed for the first method is conformed by households with at least one member with 65 years or more, where the treatment group is conformed by those households who receive the non-contributory pension and the comparison group those households that do not receive the benefit. The sample accounts for a total observations of 19,072 households, where 5,451 are treated and 13,621 are part of the comparison group.

The sample analyzed for the second and third method is conformed by households where at least one member is between 61 and 69 years old. In this case, the comparison group consists of those household where the oldest member does not exceed 65 years, but whose age is close to this point, the treatment group consists of households whose oldest adult is between 65 and 69 years old. Thus, we obtained a total sample of 9,582 households. However, after applying a one to one propensity score matching for the income level with the aim to get a more comparable sample between groups, we identified a total sample of 1,458 households, where 729 are treated and 729 are comparison observations.

4.2 Descriptive statistics

Table 3 presents the summary statistics of each sample. In the DD sample we can observe that on average, the variables number of household members and age of the household head are similar for

Table 2: Number of observations according to each method

Sample	Treatment	Comparison	Total
DD sample	5,451	13,621	19,072
RD and diff-in-disc	729	729	1,458

the treatment and the comparison group. Indeed, the comparison households has just 0.1 members less than the treated and the household head age of the beneficiaries households is just 0.6 less than their counterparts. On the other hand, there are bigger differences in the rest of the control variables. Actually, the difference in terms of the household monthly income per capita, is 82,000 CRC (146 USD) lower for the treated households. Additionally, on average the household's head of the beneficiaries has 2.3 years of education less than their counterparts. To analyze if all the independent variables are statistically different from the two groups we applied a mean test. Applying these tests we find that the variables age of the household head, household income per capita, zone of residence, level of poverty, household head years of education and gender of the household head are statistically different for treated and comparison group. Table 5 in the Appendix includes the mean test results.

In the RD and diff-in-disc sample we can observe that, as in the DD sample, the variables number of household members and age of the household head are similar for the treatment and the comparison group. The comparison households has 0.1 members less than the treated and the household head age of the beneficiaries is just 0.8 less than their counterparts. In terms of the other control variables we observe some differences. For example, the treated households has less woman as a head of the household (16 p.p. lower) and reports higher proportion of households in poverty situation (11.8 p.p. more) than the comparison households. Mean tests confirmed that the variables geographic location, level of poverty, household head years of education and gender of the household head are statistically different for treated and comparison group. In Table 6 in the Appendix are presented the mean test results.

Table 3: Descriptive statistics

Variables	DD						RD and Diff-in-Disc sample					
	Treatment			Comparison			Treatment			Comparison		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Outcome variables												
Hours worked (weekly)												
Average	10.6	11.8	5,451	13.7	13.6	13,621	11.7	13.5	729	13.2	14.5	729
Labor force participation												
Percentage	57.8		5,451	63.0		13,621	64.6		729	66.8		729
Labor income (Monthly)												
Average (Thousand CRC)	108.7	180.0	5,451	214.6	408.9	13,621	120.9	236.5	729	112.4	217.8	729
Child labor												
Percentage	1.2		5,451	0.6		13,621	2.4		729	1.6		729
Number of assets in the household												
Average	5.9	2.0	5,421	4.2	2.0	13,571	6.2	1.9	724	5.1	2.0	722
Independent variables												
Household income pc (Monthly)												
Average (Thousand CRC)	49.8	57	4,488	131.8	223	10,383	56.0	101	655	61.1	106	647
Households in rural zones												
Percentage	53.7		5,004	34.3		12,808	58.6		659	53.2		661
Households with poor condition												
Percentage	47.1		5,035	18.3		11,715	49.1		729	37.3		729
Households with a woman head												
Percentage	56.1		5,396	66.2		13,591	49.1		720	65.1		718
Household head years of education												
Average	3.2	3.5	4,739	5.8	4.9	12,144	3.0	3.5	630	3.8	4.1	584
Household head age												
Average	68.0	15.3	5,392	68.6	12.1	13,583	61.7	10.8	720	62.5	7.0	718
Number of Household members												
Average	3.4	2.1	4,863	3.3	1.9	12,128	3.1	1.9	655	3.0	1.8	647

5 Methodology

5.1 Difference-in-differences

This analysis aims to measure the effect of receiving a non-contributory pension on different employment, schooling, household composition and well-being outcomes. To that end, we exploit an increase in the Costa Rica's non-contributory pension from 17,500 CRC to 50,000 CRC in 2007, comparing households that benefit from the non-contributory pension (treatment group) with those that do not receive this premium (control group), but might (or might not) receive other type of grants. These outcome comparisons before and after the increase offer a simple method for evaluating the effects of the non-contributory pension regimes.

In this case, we have considered only households with the oldest member being more than or exactly 65 years old for the treatment and the control group. Given that the key assumption for DD estimation

is that the trajectory of the control group in terms of the considered outcome variables would be similar to the trajectory of the treatment group over time in case of treatment absence, restricting the age lower limit assures that beneficiaries and non-beneficiaries would react similarly to changing environmental conditions over time. An alternative selection of the control group could be narrowing the observations few years below and above the retirement age. However, using this definition does not allow us to disentangle the policy effects and potential responses of the mere fact of retiring, especially when measuring labor outcomes. In other words, we assume that the pension policy represents the only major cause for the treatment group to behave differently from the control group on average over time.

5.1.1 Identification

Firstly, we identify two groups indexed by treatment status $T = 0, 1$ where 0 indicates households who do not receive treatment, i.e. the control group, and 1 indicates households who do receive the treatment, i.e. the treatment group. Moreover, we observe households in two time periods, $t = 0, 1$ where 0 indicates a time period before the treatment receives treatment, i.e. pre-treatment, and 1 indicates a time period after the treatment group receives treatment, i.e. post-treatment. Therefore, let

Y_{1ist} = outcome of household i and period t if there is a pension increase

Y_{0ist} = outcome of household i and period t if there is not a pension increase

These are potential outcomes, in practice we only observe one of them which in this case is Y_{1ist}. The DD setup specifies that in the absence of a pension increase policy, the outcome is determined by the sum of two common effects, a time-invariant and a period effect:

$E(Y_{0ist}|s, t) = \gamma_s + \lambda_t,$

where s denotes the group assigned (treatment or control), and t refers to the period (before or after 2007).

Let D_{st} be a dummy for receiving the pension, where the groups are index by s and observed in period t.Assuming that $E(Y_{1ist} - Y_{0ist}|s, t)$ is a constant denoted by β, we have:

$Y_{ist} = \gamma_s + \lambda_t + \beta D_{st} + e_{ist},$

where $E(e_{ist}|s, t) = 0$. From here, we get:

$E[Y_{ist}|s = contr, t = after] - E[Y_{ist}|s = contr, t = before] = \lambda_{after} - \lambda_{before}$

and

$E[Y_{ist}|s = treat, t = after] - E[Y_{ist}|s = treat, t = before] = \lambda_{after} - \lambda_{before} + \beta$

The main idea is to use the same trend observed for untreated households to predict the counterfactual trend for the treated households in the absence of treatment. Thus,

$E[Y_{0ist}|s = treat, t = after] =$

$E[Y_{ist}|s = contr, t = after] + (E[Y_{ist}|s = treat, t = before] - E[Y_{ist}|s = contr, t = before])$,

which builds on the fundamental assumption that $E[Y_{0is1} - Y_{0is0}|s = treat] = E[Y_{0is1} - Y_{0is0}|s = contr]$. This assumption is known as the parallel trend assumption.

Therefore, the causal effect if interest is:

$(E[Y_{ist}|s = contr, t = after] - E[Y_{ist}|s = contr, t = before])$

$-(E[Y_{ist}|s = treat, t = after] - E[Y_{ist}|s = treat, t = before]) = \beta$

5.1.2 Estimation

The simplicity of this empirical methodology allows to find the effect of interest by estimating the following regression:

$Y_{it} = \beta_0 + \beta_1 D_i + \beta_2 T_{it} + \beta_3 D_i T_{it} + \gamma' X_{it} + u_{it}$,

where Y_{it} is the outcome variable for household $i$in period t.The term D_i is the treatment variable, which takes value 1 if the household receives the pension, and 0 otherwise. The variable T_{it} refers to the period, which takes value 1 for the years after 2007 (from 2007 to 2009), and 0 for the years before 2007 (from 2001 to 2006). Lastly, X_{it} represents the vector of explanatory variables including zone, poverty level, income per capita, as well as gender and years of education of the household head. The causal effect is measured by β_3, which is the coefficient of interest.

5.2 Regression discontinuity design

Following the DD approach, we reconsider whether the chosen comparison is suitable for this case. The limited number of observations available required to include every household with the oldest member above the 65 years old threshold. However, we should take into account potential heterogeneity among these households in order to avoid the associated omitted variable bias and isolate the policy effect. The clearest example is that workforce aging has direct implications for labor productivity; indeed, the literature stresses that a worker's productivity systematically varies over her working life, for reasons such as the accumulation of experience over time, depreciation of knowledge, and age-related trends in physical and mental capabilities. The combination of these factors are typically related with profiles characterized by a strong increase in productivity until workers are in their 40s and a decline toward the end of their working life (Aiyar et al., 2016). Consequently, these unobserved effects might have strong implications on labor participation, as well as on other employment-related decisions, making the oldest members more prone to apply for the non-contributory pension.

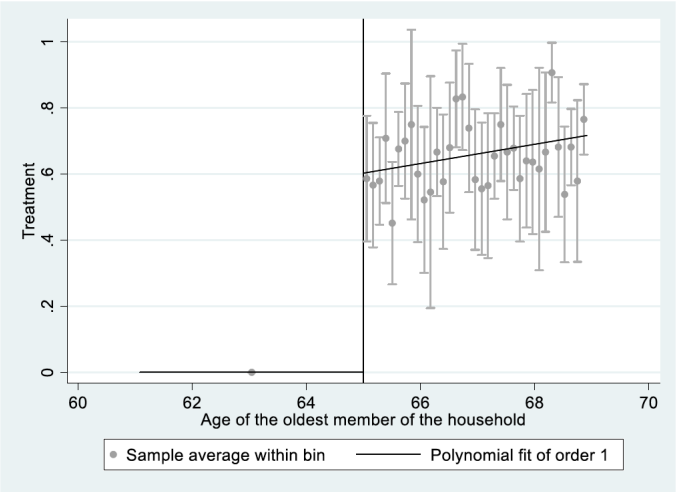
Lee (2008) formally shows that it is not necessary to assume that RD design isolates the treatment variation that is "as good as randomized"; instead, such randomized variation is a consequence of agents' inability to precisely control the assignment variable near the known cut-point. In this case, it is virtually impossible for individuals to misreport their age, so that households' responses to the pension assignment are observed directly after the cut-point. Therefore, we can consider that causal inferences from RD designs are potentially more credible than those from "natural experiments" strategies, as is the case of the DD approach.

In this nonexperimental setting, the treatment is therefore determined by whether the observed assignment variable exceeds the cut-point, i.e. whether the oldest member in each household is above the eligibility threshold of 65 years. The RD design is characterized by a treatment assignment that is based on whether an applicant falls above or below the cut-point, what generates a discontinuity in the probability of receiving the treatment at that point (Hahn, Todd, and van der Klaauw, 1999). Therefore, in order to estimate the treatment effect, our analysis can be conceived as a RD design, comparing outcomes of households around the cut-point of 65 years. The treatment status can then be described as a discontinuous and determining function on age. It is important to mention that, similar to many other surveys, the EHPM records the exact age of the individuals rounded down to the nearest integer. However, following Dong and Yang (2017), a discrete assignment variable may lead to biased estimates. The authors point out that RD design crucially relies on a continuous assignment variable, because a discrete variable does not allow to observe those households that are close to the cut-point, even if the sample is large. In order to avoid this potential bias, we redefine the age variable as continuous by assuming that birth dates within a year are uniformly distributed, which is the methodology proposed by the authors.

A further assumption is that unobservable characteristics vary continuously around this threshold, so that the program's allocation rule replicates a randomized trial for the treatment for a near cut-point interval. Therefore, it is expected that individuals between 61 and 64 years are similar to individuals over 65 years, except for the fact that the latter receive the pension. For that reason, the comparison group consists of those household where the oldest member does not exceed 65 years of age, but whose age is close to this point. Similarly, the treatment group consists of households whose oldest adult is between 65 and 69 years old. Given that individuals in both groups differ not only in their background characteristics, but also in how they respond to a particular treatment, we account for the heterogeneous treatment effects.

The existing literature typically distinguishes two types of RD designs: the sharp design, in which all subjects receive their assigned treatment or control condition, and the fuzzy design, in which some subjects do not. As can be seen in Figure 2, there are households that do not receive the pension, although they satisfy the eligibility criteria. The existence of households in the treatment group that do not participate in the program, characterizes the regression discontinuity as a fuzzy design. It is important to notice that the variable age largely explains the probability of receiving the pension. Indeed, as can be seen above the cut-point, the more the maximum age increases, the closer the probability reaches the upper value of 0.8.

Figure 2: Discontinuity on treatment for period 2001-2009



5.2.1 Identification

In a fuzzy design, D_i not only depends on $\{Z_i \geq z_0\}$, but also on other unobserved variables. Thus, if we regress the following equation using OLS, an omitted variable bias problem arises so that D_i is endogenous:

$$Y_i = \alpha_{RD} D_i + k_{z_0}(Z_i) + w_i,$$

where the term $k_{z_0}(Z_i)$ is a control function that is nonparametrically identified, including a high-order polynomial in Z_i interacted with a dummy $\{Z_i \geq z_0\}$. However, we can still use $\{Z_i \geq z_0\}$ as an instrument for D_i. There is a close analogy between the fuzzy RD design and the instrumental variables (IV) estimators, since both can be expressed in the well-known Wald formulation:

$$\alpha_{RD} \equiv E[Y_{1i} - Y_{0i} | Z_i = z_0] = \frac{\lim\limits_{z \to z_0^+} E[Y_i | Z_i = z] - \lim\limits_{z \to z_0^-} E[Y_i | Z_i = z]}{\lim\limits_{z \to z_0^+} E[D_i | Z_i = z] - \lim\limits_{z \to z_0^-} E[D_i | Z_i = z]},$$

where the estimator is defined as a ratio of two parts: the numerator is defined as the difference of the limits, on the right and left, of the conditional expectation of the outcome on the realization of the assignment variable. Similarly, the denominator is defined as the difference of the limits, on the right and left, of the conditional expectation of the treatment on the realization of the assignment variable. The term Y_i represents the outcome variable, Z_i is the assignment variable (age of the oldest household member), and D_i corresponds to the treatment variable, which takes value 1 if the household receives the pension, and 0 otherwise.

Hahn et al (2001) were the first to show this important connection and to suggest estimating the treatment effect using two-stage least squares (TSLS) in this setting. Moreover, they show that under

heterogeneity, the assumption of monotonicity is also needed for the identification of a LATE in a fuzzy RD. Therefore, the RD estimation identifies α_{RD} for those individuals with $Z_i = z_0$ who are affected by the threshold (LATE at z_0) under the following conditions:

RD1: $\lim_{z \to z_0^+} P[D_i = 1 | Z_i = z] \neq \lim_{z \to z_0^-} P[D_i = 1 | Z_i = z]$ (relevance)

RD2: $E[Y_0 | Z = z]$ is continuous in z at z_0 (continuity)

RD3: $[\alpha_{RD}, D_{z+\varepsilon,i}, D_{z-\varepsilon,i}]$ is jointly independent of Z near z_0 (independence)

RD4: Either $D_{z_0+\varepsilon,i} \geq D_{z_0-\varepsilon,i}, \forall i$ or $D_{z_0+\varepsilon,i} \leq D_{z_0-\varepsilon,i}, \forall i$ (monotonicity)

Condition RD1 assures the existence of limits and condition RD2 implies that in the absence of treatment, individuals close to the threshold z_0 are similar. Additionally, an independence condition together with monotonicity are needed to identify a LATE at z_0. Following Angrist et al (1996), we can express the RD estimate α_{RD} as:

$$\alpha_{RD} \equiv \lim_{\varepsilon \to 0^+} E[Y_1 - Y_0 | D_{z_0+\varepsilon} - D_{z_0-\varepsilon} = 1],$$

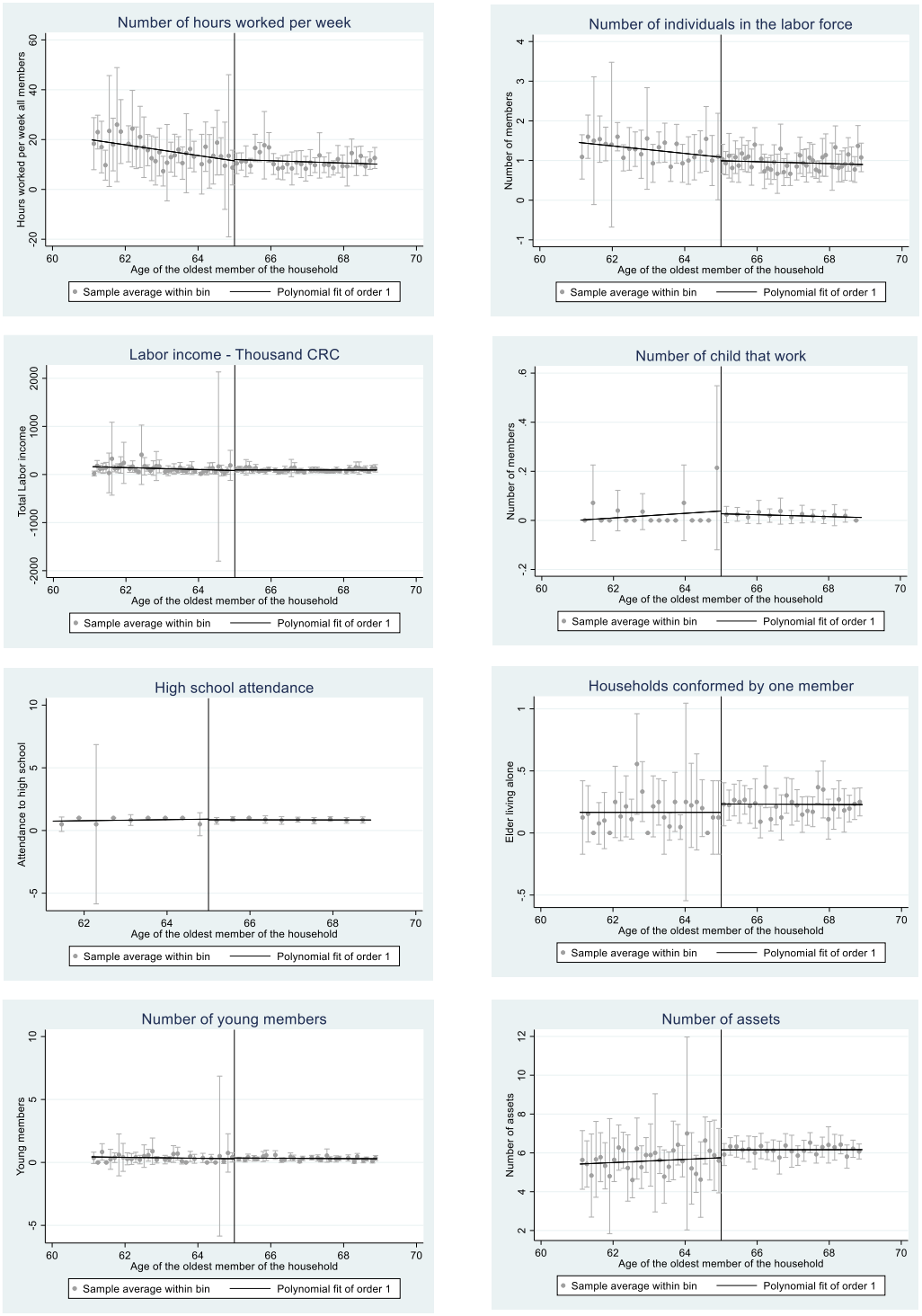
which is the ATE for the units for whom treatment changes discontinuously at z_0.

5.2.2 Estimation

Any RD analysis begins with a visual examination of plots of the outcomes against the assignment variable. Figure 3 illustrates the RD approach, showing the relationship between each outcome for candidates being considered for the treatment and the assignment variable (age of the oldest member of the household), used to prioritize candidates for that treatment. The vertical line in the center of each graph designates a cut-point, above which candidates are assigned to the treatment and below which they are not assigned to the treatment. In this case, we do not observe a jump at the cut-point in any of the variables analyzed, meaning that there is no discontinuity in the outcome variables.

Graphical analysis provides visual guidance for modeling the relationship between the assignment variable and the outcome variable. To estimate the exact magnitude of the discontinuity in outcomes at the cut-point, the treatment effect, we need from regression analyses. The specification of functional form follows a nonparametric strategy, hence the estimation of the treatment effect is viewed as local randomization, and the analysis is limited to observations that lie within the close vicinity of the cut-point (bandwidth). Because the main challenge is selecting the right bandwidth, an optimization process was used for this purpose, followed by the estimation of a linear regression with covariates to reduce the sampling variability in the estimator. Nevertheless, as discussed above, randomization around the threshold yields two comparable groups which are balanced in their observed and unobserved characteristics, what requires the definition of a fair comparison group.

Figure 3: Discontinuity on outcome variables for period 2001-2009



As has been previously mentioned, living in extreme poverty is a necessary requirement to become a pension recipient. However, due to the absence of a monitoring system is expected that some beneficiaries continue participating in the program for the rest of their life, so that they will not be excluded from receiving the pension even if their socioeconomic situation improves significantly. Because of the cross-sectional nature of the data, we cannot evaluate whether those individuals included in the treatment group were in extreme poverty situation in the moment they were eligible for the program. Hence, we will assume that in practice the program was assigned following the theoretical conditions. A further consequence is that for each year we observe beneficiaries not only in extreme poverty situation, but also households that have escaped from the poverty status by largely improving their economic situation. Indeed, the average household total income for the treatment group is about 189,052 CRC (equivalent to 334 USD) lower than for the comparison group for the whole sample period.

In order to address the sample imbalance, we apply a propensity score matching method defined as the probability of assignment to the treatment, conditional on total income. Thus, every beneficiary is matched with the "most similar" household in the comparison group, which results in a sample of 1458 households (729 beneficiaries and 729 "nearest neighbor" households in the comparison group). The "nearest neighbors" are the households with the closest income propensity score, that is, the probability of being a beneficiary of the program. The propensity score is estimated for the whole sample period from 2001 to 2009 using cross-sectional Probit regression of the treatment dummy (whether the household is a recipient of the non-contributory pension regime) on household total income, as is described in the following equation:

$$Pr(D_{it}) = \beta_0 + \beta_1 income_{it} + \zeta_{it}$$

This approach allows identifying an appropriate comparison group for the subsequent RD and diff-in-disc designs.

5.3 Difference-in-discontinuities design

The literature agrees that non-contributory transfers have complex intended and unintended effects on different individual and household outcomes. In Costa Rica, the non-contributory pension policy requires leaving the labour market as a necessary condition for receiving the grant, so that changes in the outcome variables might be caused by the mere fact of retiring, specially for labour-related measures. For that reason, it is very likely to observe a reduction in individual labour force participation rates for beneficiaries compared to non-beneficiaries, what can be considered an intended consequence, given that the aim of this policy is to alleviate poverty among elders by increasing the opportunity cost of working. However, there is limited interest in finding natural individual reactions to receiving the pension benefit, but in analyzing unintended effects such as decision making changes in the other household members. In this vein, the cross-sectional RD design does not allow to identify the outlying unintended impacts of the non-contributory pension, as it combines the retirement and the payment effects.

The non-contributory pension reform in 2007 allows us to implement the diff-in-disc estimator, which takes the difference between the cross-sectional discontinuity after 2007 (when both the non-contributory pension reform and retirement show a jump), and the cross-sectional discontinuity before 2007 (when only the initial pension policy and retirement show a jump). For that purpose, we will follow closely the identification and methodology proposed by Grembi et al. (2012), using the same treatment and comparison group definition as in the previous cross-sectional RD procedure: those households with the oldest member aged between 65 and 69 characterize the treatment group, and those households with the oldest member aged between 61 and 64 define the comparison group, which has been appropriately identified using the propensity score matching approach.

5.3.1 Identification

Define Y_{1it} as the potential outcome for individual $i$at time $t$in case of treatment ($D_{it} = 1$), and Y_{0it} as the potential outcome of the same individual at the same time in the case of no treatment ($D_{it} = 0$). In this case D_{it} coincides with the pension increase policy and the treatment year is $T_0 = 2007$, so that if $t \geq T_0$, those individuals above the age cut-point $z_0 = 65$ are treated. The assignment variable Z_i is time-invariant and defined at the household level. Formally, the treatment assignment is given by:

$$D_{it} = \begin{cases} 1 & if Z_i \geq z_0, t \geq T_0 \\ 0 & otherwise \end{cases}$$

To keep notation simple, we define:

$y_k^+ \equiv \lim_{\varepsilon \to 0^+} E[Y_{kit}|Z_i = z_0 + \varepsilon, t \geq T_0]$ and

$y_k^- \equiv \lim_{\varepsilon \to 0^-} E[Y_{kit}|Z_i = z_0 - \varepsilon, t \geq T_0]$, with $k \in \{0, 1\}$.

The presence of the initial pension policy descontinuity at z_0 implies that: $\Gamma_0 \equiv y_0^+ - y_0^- \neq 0$, and $\Gamma_1 \equiv y_1^+ - y_1^- \neq 0$. Therefore, the cross-sectional RD estimator does not correctly identify the pension increase policy after T_0. To see this, we define the following ATE in the neighborhood of the threshold z_0.

Notice that $(y_1^+ - y_0^+)$ represents the local average treatment effect on the treated (LATT), and $(y_1^- - y_0^-)$ represents the local average treatment effect on the untreated (LATU). Moreover, the cross-sectional RD estimator is defined as the discontinuity in the observed outcome Y_{it} at z_0, that is, $(y^+ - y^-)$. Then, we can show that this estimator, given that $y^+ = y_1^+$ and $y^- = y_0^-$, identifies the LATT plus the initial pension policy discontinuity for the treated:

$$y^+ - y^- = y_1^+ - y_0^+ + y_0^+ - y_0^- = LATT + \Gamma_0$$

$$y^+ - y^- = y_1^- - y_0^- + y_1^+ - y_1^- = LATU + \Gamma_1.$$

If the effect of the initial pension policy is equal for the treated and untreated ($\Gamma \equiv \Gamma_1 = \Gamma_0$), it follows that: $y^+ - y^- = LATE + \Gamma$. This means that the cross-sectional RD estimator gives biased estimates of of the causal effect of increasing the non-contributory pension.

However, information on the pre-treatment period ($t < T_0$) allows us to remove the bias. Analogously to the post-treatment period, let's define:

$\tilde{y}_k^+ \equiv \lim_{\varepsilon \to 0^+} E[Y_{kit}|Z_i = z_0 + \varepsilon, t < T_0]$ and

$\tilde{y}_k^- \equiv \lim_{\varepsilon \to 0^-} E[Y_{kit}|Z_i = z_0 - \varepsilon, t < T_0]$, with $k \in \{0, 1\}$.

To identify the causal effect of the pension reform, we implement an estimator that exploits both discontinuous variations at z_0 and the time variation after T_0: $\hat{\tau} \equiv (y^+ - y^-) - (\tilde{y}^+ - \tilde{y}^-)$, where $\hat{\tau}$ is the diff-in-disc estimator under the following assumptions:

DRD1: the initial pension policy is constant over time: $(y_0^+ - y_0^-) = (\tilde{y_0}^+ - \tilde{y_0}^-)$

Under DRD1, the diff-in-disc estimator identifies the LATT:

$\hat{\tau} \equiv (y^+ - y^-) - (\tilde{y}^+ - \tilde{y}^-) = (y_1^+ - y_0^+) + (y_0^+ - y_0^-) - (\tilde{y_0}^+ - \tilde{y_0}^-) = y_1^+ - y_0^+ = LATT.$

DRD2: The initial pension policy discontinuity is the same with and without treatment: $(y_1^+ - y_1^-) = (y_0^+ - y_0^-)$

Under DRD1 and DRD2, the diff-in-disc estimator identifies the LATE, which is the standard estimand in the cross-sectional RD, that is, a treatment effect that is still local but more general than the LATT, as it refers to the entire neighborhood of z_0:

$\hat{\tau} \equiv (y^+ - y^-) - (\tilde{y}^+ - \tilde{y}^-) = (y_1^- - y_0^-) + (y_1^+ - y_1^-) - (\tilde{y_0}^+ - \tilde{y_0}^-) = y_1^- - y_0^- = LATU.$

Therefore, $LATT = LATU = LATE$.

5.3.2 Estimation

Following Grembi et al. (2012), the difference-in-discontinuities estimator takes the difference between two discontinuities in the observed outcome Y_{it}, one before and one after the pension increase at $T_0 = 2007$. It is computed by estimating the extreme points of four regression functions of Y_{it} on Z_i: two on both sides of $Z_i = z_0$ (the maximum age is equal to 65 years), before and after T_0. In this case, the chosen estimation method is local linear regression for the sample in the interval $Z_i \in [z_0 - h, z_0 + h]$, where h is the distance of the observations on either side of z_0, both before and after T_0. The estimated model is:

$$Y_{it} = \beta_0 + \beta_1 P_i + J_i(\gamma_0 + \gamma_1 P_i) + T_t[\delta_0 + \delta_1 P_i + J_i(\theta_0 + \theta_1 P_i)] + \epsilon_{it}, \quad (1)$$

where J_i is a dummy variable, which takes value 1 if the household i receives the additional pension amount, and 0 otherwise. T_t is a dummy variable that takes value 1 for the period after T_0, and 0 otherwise. Lastly, $P_i = z - z_0$, what refers to the distance between the observed maximum age and the cut-point. The coefficient θ_0 is the diff-in-disc estimator that identifies the effect of the pension increase, given that $D_{it} = J_i \cdot T_t$.

6 Results

In this section we report the estimate results of the impact of the non-contributory regime on labor force indicators and schooling, household composition and well-being changes. As mentioned above, we use three complementary empirical methodologies to capture to what extend the households react to the policy. Table 4 reports the estimated outcomes, where each column represents the methodology implemented.

6.1 Difference-in-differences method

As it was mentioned in the methodology section, the DD method wants to exploit the increase in the non-contributory pension in 2007. This through the comparison of households that have at least one member aged 65 or more, where the beneficiaries are those who receive the pension and the comparison group those who do not receive it. In the first column of Table 4 are presented the results of the DD method.

With respect of the labor force indicators, which include hours worked per week, labor force participation, labor income, child labor and reservation wage, the results suggest that the program has a significant effect on the treated households for the period after 2007. We observe that the variable number of hours worked per week decreases by 1.747 hours for those households that receives the pension. In line with the previous result, there is a decrease of the number of individuals in the labor force by 0.179 individuals. Furthermore, the labor income is decreasing by 34,782 CRC (61.9 USD) and the number of child that work in the treated households decreases by 0.013 individuals in comparison with the control group for the period after 2007. Finally, those households that conforms the treatment group have a higher probability of being in the higher interval of the reservation wage (3.2 p.p more). Conversely, the variable high school attendance does not show a significant change on treatment after 2007, even though the result presents a positive sign that is expected according to theory.

Regarding to household composition, we analyze the probability of living in a household conformed by one member and the number of young members in the household. As can be observed in Table 4 none of the two variable coefficients are statistically significant, although the first variable mentioned exhibits a negative sign in line with the literature. For the case of the variable that reports the number of young members in the household, the sign reported is not the expected in theory and the magnitude of the coefficient is close to zero. Finally, in the well-being change dimension, conformed by number of selected assets and household physical conditions, the results give evidence that treated households have a negative impact in the number of assets which decrease by 0.178 in comparison with the control group. This is not congruent with the expected change according to literature. On the other hand, the household physical conditions variable is not statistically significant but present the expected sign. For further information see Table 7 in the Appendix that presents in detail the DD regression.

6.2 Regression-discontinuity design

The RD method aims to overcome the potential heterogeneity that the DD method cannot isolate and can lead to omitted variable bias. This setting includes in the treatment group households whose oldest adult is between 65 and 69 years old and in the comparison group those households where the oldest member is aged between 61 and 64. It is important to recall that both groups are matched by the household total income. In the second column of Table 4 are presented the results of the RD method.

We observe that none of the variables of each category have a statistically significant effect on the treated group. However, it is interesting to mention that almost all of the outcomes present the expected sign according to literature. In the employment dimension the treated households have a decrease in the number of individuals in the labor force and in number of child that work, as well as a less labor income in contrast with the comparison group. Furthermore, there is a higher probability that the teenage of the households attend to high school and the treated households have a higher number of assets.

The only category in which both variables present a counterintuitive sign according to theory is household composition. In this case the outcome proportion of households that live alone has a positive sign and the number of young members has a negative sign.

6.3 Difference-in-discontinuities design

In order to disentangle the unintended impacts of the non-contributory pension in retirement and payment effects, we apply a diff-in-disc that exhibits an improvement regarding the RD exposed in the last subsection. This method compares the treatment effect of receiving the pension after and before 2007, by exploiting in both periods the discontinuity on treatment generated by the age of the receivers. The estimator found in this model captures the isolated effect of the pension increment. Similar as in the RD, it includes in the treatment group households whose oldest adult is between 65 and 69 years old and in the comparison group those households where the oldest member is aged between 61 and 64. Third column of Table 4 shows the results of the diff-in-disc method.

We observe that none of the variables of each category have a statistically significant effect. Nonetheless, we can note that in general, with the exception of the variable high school attendance, the coefficients have the expected sign according to literature. Indeed, in the employment dimension the treated households present a decrease in the number of hours worked and in the number of individuals that participate in the labor force, as well as a decrease in the labor income in comparison with the control group. Furthermore, the household composition dimension shows that the beneficiaries have a lower probability of being conformed by one member, have an increase in the number of young members that compose the household and have a higher number of assets in contrast to their counterparts.

Table 4: Effects of the non-contributory pension on selected outcomes

	DD	RD Total (2001-2009)	diff-in-disc
Number of hours worked per week	-1.747***	7.172	-4.534
	(0.416)	(7.661)	(5.827)
Obs.	12,200	1,096	717
Number of individuals in the labor force	-0.179***	-0.708	-0.209
	(0.037)	(0.835)	(0.211)
Obs.	12,200	1,096	1,096
Labor income (Thousand CRC)	-34.782***	-1.860	-61.182
	(7.158)	(169.262)	(71.032)
Obs.	12,200	1,096	708
Number of child that work	-0.013***	-0.328	
	(0.004)	(0.422)	
Obs.	12,200	1,096	
High school attendance	0.030	0.043	-0.149
	(0.040)	(0.253)	(0.187)
Obs.	1,650	150	131
Reservation wage	0.032**		
	(0.017)		
Obs.	12,200		
Households conformed by one member	-0.008	0.010	-0.092
	(0.012)	(0.210)	(0.085)
Obs.	12,200	960	960
Number of young members	-0.028	-0.450	0.033
	(0.029)	(0.420)	(0.203)
Obs.	12,199	1,096	1,096
Number of assets	-0.178***	0.366	0.194
	(0.064)	(0.998)	(1.151)
Obs.	12,155	1,090	1,096
Physical condition of housing	0.015		
	(0.014)		
Obs.	12,155		
Zone	Yes	Yes	Yes
Gender of the household head	Yes	Yes	Yes
Household head age	Yes	No	No
Household head's years of education	Yes	Yes	Yes
Level of poverty	Yes	Yes	Yes
Household income per capita	Yes	No	No

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6.4 Discussion

In this subsection we intend to motivate the potential explanations for the differences found among the methodologies applied, even though the available information does not allow us to formally test the hypothesis stressed in this segment. A general approach that aims to give evidence of the average effect on households, consistently reports an impact on labor supply decisions within households, meanwhile a local analysis is not suggesting any relevant effect of the non-contributory pension in Costa Rica. The differences observed in the methods implemented could be driven by different intra household dynamics in terms of family composition and labor opportunities.

Before starting to analyze the differences behind each method applied, it is relevant to point out that in Costa Rica the informal employment affects the 44% of the employed population. Informality mainly hit individuals that are in the age range of 25-34 years old and 45-59 years old. The population bounded in these age ranges is characterized by having the lowest levels of education in the country, according to the Continuous Employment Survey of Costa Rica in 2014 the 76% of the informal workers hold incomplete basic studies. Additionally the activity levels in the elder population is one of the lowest in Latin America, on average just 50% of the people aged between 55-65 were employed in Costa Rica in the period 2001-2009. On average, in this period the inactivity rate changed from 18% at the age of 55 to 52% when an individual reached 65 years old.

In the case of the RD method and the diff-in-disc, 77% of the cases the household head is the one that receives the pension, 6% of them are couples of the household head and the 13% of the beneficiaries are the parents of the household head (the remaining 4% corresponds to other cases). Given these proportions, can be inferred that the majority of the households are old in terms of age. Recalling that elderly people is highly hit by the informality and that their activity rates experiment a high decrease when reaching 65 years old, aged households could be vulnerable to suffer from bad labor market conditions or to be out of the labor market. Given the characterization of this households, receiving the pension could play a role of poverty relief due to the access of a more stable income after periods of suffering from inestable living conditions, rather than incentives to change the labor supply decisions.

Conversely, the receivers in the treated households in the DD are not as concentrated in the household head as in the RD and diff-in-disc sample. In this case 59% of the beneficiaries are household heads, in contrast the proportion of receivers that are the parent of the the household head ascends to 20% for the DD method. This difference in the household composition could explain the incongruent findings among models. Presumably, the treated individuals in the DD could be owning a better network within household that can motivates changes in the allocation of labor supply within household. These findings are supporting the hypothesis of spillover effects presence, that can be seen as incentives for the households member to decrease or to cut their participation in the labor market. Additionally, the DD includes a higher range of age which, as we have mentioned, could implies the presence of higher heterogeneity in the treatment and control groups analyzed, whereas the RD and the diff-in-disc appeal for a more homogeneous comparison groups in terms of age.

7 Robustness checks

As discussed in previous sections, the DD model specification incurred in omitted variable bias, due to unobserved heterogeneity among individuals. Therefore, to check whether the estimated effects of being a beneficiary household are consistent, we re-estimate a similar regression using an alternative sample restriction: households with the oldest member aged between 61 and 69, as opposed to the previous specification which selected members equal to or greater than 65 years old. Table 8 in the Appendix presents the estimates of both specifications, which are very similar in terms of sign and magnitude. Therefore, the estimated effect is not very sensitive to the exact specification used, as the coefficients seem plausible and reasonably robust.

The trade-off between bias and precision is a fundamental feature of the RD design. In practical terms, a main concern is that the bandwidth has to be large enough to include enough observations to get a reasonable amount of precision in the estimations. On the other hand, we might be willing to reduce the bias by shrinking the bandwidth, what results in extremely noisy estimates of the treatment effect. Therefore as a robustness check of the estimates, the RD design is re-estimated restricting progressively the sample to households with the oldest member aged between 62 and 68 (column 2), as well as between 63 and 67 years (column 3). Otherwise, the specification is conceived as a cross-section for years from 2001 to 2009 again. Table 9 in the Appendix shows that the estimates differ considerably for each sample specification, although none of them are statistically significant. Additionally, the results illustrate the previous discussion, as even when the milder restriction is not strongly affected by the reduction in the number of observations (indeed, for some outcomes this strategy performs better in terms of standard errors magniture), the most restrictive strategy presents far higher standard errors. Lastly, when comparing the most precise specifications shown in column 1 and 2, only two outcomes (number of individuals in the labor force and number of young members in the household) preserve the coefficient sign.

In order to isolate the effects of receiving the non-contributory pension from other consequences driven by the mere fact of retiring, we exploit the pension reform of 2007 to implement diff-in-disc methodology as detailed in previous sections. This policy change allows us to combine two sources of variation, before and after 2007 and just below and above the cut-point. Thus, we should be able to replicate two comparable RD procedures, one for the period before (2001-2006) and other for the period after (2007-2009) the pension reform, that measure the direction and magnitude of the discontinuity, or jump, in the outcome at the cut-point for each period. Similarly to the diff-in-disc design, the second RD estimator takes the difference between the cross-sectional discontinuity after 2007, when the non-contributory pension policy changed and other retirement effects show a jump, and the first RD estimator captures the jump before 2007, when the initial pension policy was in place and reactions to retirement also determine the discontinuity. This allows to directly analyze the difference between the RD estimators as an approximation of the outlying pension effect on the different outcomes. In this vein, we evaluate the validity of the diff-in-disc results using this complementary approach, from which we expect similar estimates. Table 10 in the Appendix shows the estimated coefficients for the RD design in both periods (column 1 and 2), the difference between the two estimates (column 3), the estimated coefficients for the diff-in-disc approach (column 4), and its corresponding confidence interval (column 5). Even when the diff-in-disc coefficients might diverge from the calculated RD

estimates difference, the latter falls within the confidence interval of the diff-in-disc estimates for three outcomes, and is at least very close to it for the remaining cases. Although the diff-in-disc and the two RD specifications were defined including the same explanatory variables, it might be the case that some relevant unobserved covariates that are affected by time variation are not being included in the RD specification, causing the observed differences between the estimates.

8 Conclusion

In recent years there has been a surge of non-contributory pensions in Latin American countries. By now 15 out of 26 countries have some sort of non-contributory or complementary system in place (Bosch, Melguizo and Pagés, 2013; Pallares-Miralles, Romero and Whitehouse, 2012). This programs intend to provide economic insurance to the elderly in poverty situation, as a response to the lack of coverage generated by dysfunctional labor markets with large informal sectors, and profound demographic changes. This paper analyzes the impacts of one such program in Costa Rica on employment and schooling-related decisions at household level, changes in the household composition, and well-being. For that purpose, we rely on three complementary approaches that give a broad overview of the outlying effects of this non-contributory pension transfer.

The results show a generally positive picture of the Costa Rican non-contributory pension, if we consider that the policy was designed to provide a pension to a population that never contributed to the formal system, so that it allows them to retire at age 65. However, conditional income transfers sometimes involve unintended consequences that characterize the policy as defective. In this case, the results show major spillover effects in the remaining households members, especially in terms of labour-related reactions. In fact, the DD estimates show that those households that benefit from the non-contributory pension reduce significantly by 0.179 the number of individuals in the labor force, compared to non-beneficiaries. In this vein, individuals in the treated households work 1.747 hours less than their counterparts, and receive a labor income 61.9 USD lower than those households that do not receive the pension. On the other hand, we find preferable effects for the number of children working, as those households receiving the pension have a modest 0.013 decrease in comparison with those that do not benefit from it. However, we do not find a significant impact on high school attendance.

In this analysis, family structures are characterized by households with senior members and households where the recipient is father or mother of the household head, who lives with her own family. Given that the Costa Rican non-contributory pension policy requires leaving the labor market as a necessary condition for receiving the grant, we might attribute the reduction in labor participation at the household level to the individual change. The alternative explanation is related to perverse incentives, as the remaining household members might take advantage of this transfer to change their time allocation preferences for work and leisure.

Further local econometric strategies rule out the first interpretation by comparing observations lying closely to the point of pension assignment. For instance, both the RD and diff-in-disc estimates reveal no significant reactions at the household level for any of the outcomes analyzed, what means that households do not change their employment-related decisions in the short-run, even when the recipient

must leave the labor market. In this case, the households with senior members predominate over other type of family structures, hence we would have expected a significant decreasing effect for labor force participation. Probably this is because unemployment and job instability hit the most vulnerable population groups, so that individuals with uncertain job prospects see in the non-contributory pension an opportunity to receive a steady income. Moreover, we do not find evidence neither for the incentive for other young members of the family to move in with the elderly participant, nor for the recipient to move out and live on her own.

Our findings should be viewed in the light of a number of caveats that point to directions for future research. The impossibility of following the same individual across time limits the credibility of the findings, a potential improvement in a similar setting is to use a panel data information that accurately measure the variable of interest. Even though our research studies the changes in well-being throughout indirect measures, specifically durable good consumption and housing physical conditions, a broader analysis should include direct measures of health conditions and subjective well-being. Albeit the inclusion of the covariates account for a basic set of control variables, a more inclusive characterization of the population of interest will enrich any analysis in this field. Among these desirable features we point out information of employment informality, ownership of properties and financial assets, information of intra household transfers, savings patterns and non durable goods consumption. Finally, having administrative information on the rejected applicants will certainly lead to better identification of the potential sample selection bias presented in our study.

References

[1] Angrist, J., Imbens, G., and Rubin, D. (1996). "Identification of causal effects using instrumental variables" Journal of the American Statistical Association 91(434): 444–455.

[2] Aiyar, S., Ebeke, C., and Shao, X. (2016). "The impact of Workforce Aging on European Productivity". Working Paper No. WP/16/238: International Monetary Fund.

[3] Bando, R., Galiani, S., and Gertler, P. (2014). "Non-Contributory Pensions". Working Paper N0. IDB-WP-517: Inter-American Development Bank.

[4] Bando, R., Galiani, S., and Gertler, P. (2017). "The Effects of Non-contributory Pensions on Material and Subjective Well Being". Working Paper N0. IDB-WP-840: Inter-American Development Bank.

[5] Barrientos, A. (2003). "What is the impact of non-contributory pensions on poverty? Estimates from Brazil and South Africa". CPRC Working Paper No 33: University of Manchester.

[6] Bosch, M and Guajardo, J. (2012). "Labor Market Impacts of Non-Contributory Pensions". Working Paper N0. IDB-WP-366: Inter-American Development Bank.

[7] Bosch, M., Melguizo, A., and Pagés, C. (2013). "Better Pensions Better Jobs:Towards Universal Coverage in Latin America and The Caribbean". Inter-American Development Bank.

[8] Brenes, G. (2008). "Cambio Demográfico y heterogeneidad geográfica 1978-2008". Final Report: Programa Estado de la Nación.

[9] Case, A., and Angus, D. (1998). "Large Cash Transfers to the Elderly in South Africa." Economic Journal 108(450): 1330–61.

[10] Cavalcanti, T., and Corrêa, M. (2010). "Cash Transfer and the Labor Markets". Revista Brasileira de Economia 64: 175-190.

[11] De Carvalho, I. (2007). "Old-Age Benefits and Retirement Decisions of Rural Elderly in Brazil". Journal of Development Economics 86: 129-146.

[12] Dong, Y., and Tao, D. (2017). "Mandatory Retirement and the Consumption Puzzle: Disentangling Price and Quantity Declines". Economic Inquiry 55(4): 1738-1758.

[13] Duflo, E. (2003). "Grandmothers and Granddaughters: Old-Age Pensions and Intrahousehold Allocation in South Africa". The World Bank Economic Review 17: 1-25.

[14] Foster, A., and Rosenzweig, M. (2002). "Household Division and Rural Economic Growth". The Review of Economic Studies 69:4, 839-869.

[15] Grembi, V., Nannicini, T., and Troiano, U. (2012). "Policy Responses to Fiscal Restraints: A Difference-in-Discontinuities Design". Working Paper No. 3999: CESifo.

[16] Hahn, J., Hausman, J., and Kuersteiner, G. (2001). "Higher Order MSE of Jackknife 2SLS", unpublished manuscript. Massachusetts Institute of Technology.

[17] Hanh, J., Tood, P., and Klaauw, W. (1999). "Evaluating the Effect of an Antidiscrimination Law Using a Regression-Discontinuity Design". Working Paper No. 7131: National Bureau of Economics Research.

[18] International Labour Organization. (2014). "Social Protection for Older Persons: Key Policy Trends and Statistics." Social Protection Policy Paper No. 11 : International Labour Organization.

[19] Kassouf, A., and Rodrigues, P. (2012). "Impact Evaluation of the Brazilian Non-Contributory Pension Program Benefício de Prestação Continuada (BPC) on Family Welfare". Working Papers: 2012-12: Partnership for Economic Policy.

[20] Lee, D. (2008). "Randomized experiments from non-random selection in U.S. House elections". Journal of Econometrics 142 (2008): 675–697.

[21] Martinez, S. (2004). "Pensions, Poverty and Household Investment in Bolivia".

[22] Martínez, S., Pérez, M., and Tejerina, L. (2015). "Pensions for the Poor: The Effects of Non-Contributory Pensions in El Salvador". Technical Note N0. IDB-TN-883: Inter-American Development Bank.

[23] McTarnaghan, S., Martín, C., Srini, T., and Collazos, J. (2016). "Revisión bibliográfica sobre vivienda en América Latina y el Caribe". Research Report: Habitat for Humanity.

[24] Meyer, B., and Sullivan, J. (2003). "Measuring the Well-Being of the Poor Using Income and Consumption".

[25] National Institute of Statistics and Census. (2004). "Concepts and Definitions Multiple Purpose Household Survey".

[26] National Institute of Statistics and Census. (2004). Multiple Purpose Household Survey [Data file]. Unpublished raw data.

[27] National Institute of Statistics and Census. (2004). "Variables Creation Multiple Purpose Household Survey".

[28] National Institute of Statistics and Census. (2010). "Methodological update for the measurement of employment and poverty".

[29] Pallares-Miralles, M., Romero, C., and Whitehouse, E. (2012). "International Patterns of Pension Provision II: A Worldwide Overview of Facts and Figures." Social Protection and Labor Discussion Paper No. 1211: The World Bank.

[30] Regulation of Non-Contributory Pension Regime 2013 (Costa Rica).

[31] Social Development Found and Familiar Assignations Act 2009 (Costa Rica).

[32] United Nations. (2013). "World Population Ageing 2013". Publication No. ST/ESA/SER.A/348: United Nations.

[33] Winters, P., Stecklov, G., and Todd, J.E. (2009). "Household Structure and Short-Run Economic Change in Nicaragua". Journal of Marriage and Family 71: 708 – 726.

Appendix

Table 5: Mean test Diff-Diff sample

Zone (1 Urban - 0 rural)	0.189***
	(23.48)
Gender (1 Man - 0 Woman)	0.107***
	(14.09)
Age of household head	-0.444*
	(-2.13)
Number of household members	0.00686
	(0.21)
Years of education of household head	2.152***
	(29.71)
Poverty (1 Poor - 0 No poor)	-0.262***
	(-35.75)
Income per capita	60972.2***
	(23.11)
Observations	19072

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Mean test of RDD and Diff-in-Disc sample

Zone (1 Urban - 0 rural)	0.0568*
	(2.35)
Gender (1 Man - 0 Woman)	0.180***
	(7.07)
Age of household head	0.506
	(1.10)
Number of household members	-0.0232
	(-0.22)
Years of education of household head	0.529**
	(2.76)
Poverty (1 Poor - 0 No poor)	-0.0700**
	(-2.69)
Observations	1458

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Difference-in-differences results

	Number of hours worked per week	Number of individuals in the labor force	Labor income (Thousand CRC)	Number of children that work	High school attendance	Reservation wage	Households conformed by one member	Number of young members	Number of assets	Housing physical conditions
D	-0.175	0.044	21.450***	0.005	-0.028	0.002	0.019**	-0.029	0.905***	-0.065***
	(0.289)	(0.027)	(3.989)	(0.004)	(0.031)	(0.011)	(0.009)	(0.023)	(0.046)	(0.010)
T	0.006	0.007	37.220***	-0.001	-0.091***	0.101***	-0.000	-0.018	-0.204***	-0.037***
	(0.280)	(0.022)	(7.344)	(0.002)	(0.024)	(0.010)	(0.007)	(0.015)	(0.038)	(0.009)
TD	-1.747***	-0.179***	-34.782***	-0.013***	0.030	0.032**	-0.008	-0.028	-0.178***	0.015
	(0.416)	(0.037)	(7.158)	(0.004)	(0.040)	(0.017)	(0.012)	(0.029)	(0.064)	(0.014)
Zone	2.463***	0.158***	33.672***	-0.006***	0.082***	0.007	-0.033***	-0.011	-0.691***	0.026***
	(0.232)	(0.020)	(5.540)	(0.002)	(0.019)	(0.008)	(0.005)	(0.014)	(0.032)	(0.008)
Gender	0.395*	0.152***	-0.417	0.002	-0.018	-0.036***	-0.171***	0.025*	-0.006	0.011
	(0.217)	(0.018)	(4.196)	(0.002)	(0.019)	(0.008)	(0.005)	(0.013)	(0.030)	(0.007)
Age	-0.209***	-0.024***	62.866***	-0.001***	-0.000	0.004***	0.005***	-0.019***	0.006***	0.001**
	(0.008)	(0.001)	(1.611)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
Years of education	-0.344***	-0.022***	2.612*	-0.001***	0.018***	0.010***	0.002**	-0.005***	-0.135***	0.010***
	(0.037)	(0.003)	(1.473)	(0.000)	(0.003)	(0.001)	(0.001)	(0.002)	(0.005)	(0.001)
Level of poverty	-8.799***	-0.579***	-84.355***	0.000	0.018	0.003	-0.023***	0.214***	0.831***	-0.039***
	(0.239)	(0.020)	(9.237)	(0.003)	(0.020)	(0.011)	(0.006)	(0.019)	(0.041)	(0.009)
Income pc	0.000***	0.000***	0.001***	-0.000**	-0.000*	0.000***	0.000***	-0.000***	-0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Obs.	12,200	12,200	12,200	12,200	1,650	12,200	12,200	12,199	12,155	12,155

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: DD design with alternative sample specifications

	DD	DD 61-69
Number of hours worked per week	-1.747***	-2.031**
	(0.416)	(1.030)
Obs.	12,200	3,595
Number of individuals in the labor force	-0.179***	-0.189**
	(0.037)	(0.095)
Obs.	12,200	3,595
Labor income (Thousand CRC)	-34.782***	-40.837**
	(7.158)	(16.590)
Obs.	12,200	3,595
Number of children that work	-0.013***	-0.021
	(0.004)	(0.013)
Obs.	12,200	3,595
High school attendance	0.030	-0.025
	(0.040)	(0.093)
Obs.	1,650	666
Reservation wage	0.032**	-0.037
	(0.017)	(0.040)
Obs.	12,200	3,595
Households conformed by one member	-0.008	-0.009
	(0.012)	(0.023)
Obs.	12,200	3,595
Number of young members	-0.028	0.135*
	(0.029)	(0.074)
Obs.	12,199	3,595
Number of assets	-0.178***	0.024
	(0.064)	(0.160)
Obs.	12,155	3,589
Housing physical conditions	0.015	0.052*
	(0.014)	(0.031)
Obs.	12,155	3,589
Zone	Yes	Yes
Gender of the household head	Yes	Yes
Household head age	Yes	Yes
Household head's years of education	Yes	Yes
Level of poverty	Yes	Yes
Household income per capita	Yes	Yes

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: RD design with different sample specifications

	RDD Total 61-69	RDD Total 62-68	RDD Total 63-67
Number of hours worked per week	7.172	-3.069	3.523
	(7.661)	(7.527)	(18.624)
Obs.	1,096	791	690
Number of individuals in the labor force	-0.708	-1.623	1.021
	(0.835)	(1.264)	(1.920)
Obs.	1,096	791	690
Labor income (Thousand CRC)	-1.860	50.029	310.802
	(169.262)	(99.307)	(198.777)
Obs.	1,096	791	690
Number of child that work	-0.328	-0.749	-0.271
	(0.422)	(0.794)	(0.355)
Obs.	1,096	791	690
High school attendance	0.043	-0.174	-0.003
	(0.253)	(0.275)	(0.463)
Obs.	150	110	63
Households conformed by one member	0.010	0.295	-0.540
	(0.210)	(0.281)	(0.937)
Obs.	960	688	621
Number of young members	-0.450	-0.820	1.185
	(0.420)	(0.606)	(0.905)
Obs.	1,096	791	690
Number of assets	0.366	0.430	4.344
	(0.998)	(1.546)	(4.216)
Obs.	1,090	786	685
Zone	Yes	Yes	No
Gender	Yes	Yes	Yes
Household head age	No	Yes	Yes
Household head's years of education	Yes	Yes	No
Level of poverty	Yes	Yes	No

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Comparison between difference of RD estimates before/after and diff-in-disc estimates

	RD After (2007-2009)	RD Before (2001-2006)	Difference (After - Before)	diff-in-disc	
Number of hours worked per week	-1.216	2.445	-3.660	-4.534	[-15.95 - 6.89]
	(12.089)	(10.632)		(5.827)	
Obs.	328	768		717	
Number of individuals in the labor force	-1.6197	-1.292	-0.328	-0.209	[-0.62 - 0.20]
	(0.989)	(1.480)		(0.211)	
Obs.	328	768		1,096	
Labor income (Thousand CRC)	-660.1	23.971	-684.071	-61.182	[-200.41 - 78.04]
	(641.790)	(68.862)		(71.032)	
Obs.	328	768		708	
High school attendance	0.273	-0.52	0.793	-0.149	[-0.52 - 0.22]
	(0.525)	(148.769)		(0.187)	
Obs.	59	91		131	
Households conformed by one member	-0.113	-0.063	-0.050	-0.092	[-0.26 - 0.08]
	(0.304)	(0.309)		(0.085)	
Obs.	328	632		960	
Number of young members	-1.3534	-0.28769	-1.066	0.033	[-0.37 - 0.43]
	(0.887)	(0.608)		(0.203)	
Obs.	328	768		1,096	
Number of assets	-3.004	1.9555	-4.960	0.194	[-2.06 - 2.45]
	(2.229)	(1.576)		(1.151)	
Obs.	325	765		1,096	
Zone	Yes	Yes		Yes	
Gender of the household head	Yes	Yes		Yes	
Household head age	No	No		No	
Household head's years of education	Yes	Yes		Yes	
Level of poverty	Yes	Yes		Yes	
Household income per capita	No	No		No	

Confidence interval in brackets
Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$