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Abstract

The aim of this paper is to study the *ex-ante* effects of the implementation of a Non Contributory Pension (NCP) program in Colombia and Peru. Relying on household survey data, we simulate the potential impact of the transfer on poverty, inequality, fiscal cost, and the probability of affiliation to the contributory pension system. This last effect is the most direct behavioral effect one can expect from the implementation of a NCP scheme. For the behavioral response we estimate a Nested Logit Model. Our results show that a NCP in Colombia and Peru contributes to the reduction of poverty and inequality among the elderly, particularly in rural areas at affordable fiscal costs. Furthermore, there is not a large impact on the probability of affiliation to contributory pensions when the program is targeted to the poor (and extreme poor), with the exception of Peruvian women for whom there is always a sizeable reduction on their probability of affiliation to the contributory pension system.

Keywords: Non-contributory pensions, social security, old-age, poverty.

JEL Classification: D30, I32, I38, J14, J26.

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1 Introduction

Old-age poverty in Latin America has been recently studied by Gasparini et al. (2010), Dethier et al. (2011) and Barrientos (2003, 2005). These studies show that poverty roughly follows a U form relationship with age. Rofman and Oliveri (2011) show disturbing low levels of pension coverage in Latin American countries, both during labour life and retirement. In their sample of 18 Latin American countries, 60% of elderly people (65+) receive a pension, but this figure hides large country differences. In one third of countries, less than 19% of the elderly is recipient of any type of pension (Honduras, Dominican Republic, El Salvador, Guatemala, Paraguay and Nicaragua). Another group of seven countries exhibit pension coverage between 22% and 60%. In Colombia and Peru, only 23% and 25% of the elderly receive a pension. The major pension reforms spread across Latin America during 1990's, aimed at replacing the public systems by private individual capitalization schemes, have not achieved an improvement in this indicator. Therefore, the governments must look for other options to fight old-age poverty.

It is in this framework that some non contributory pension (NCP) schemes have become popular in Latin America. Distinctive examples are the programs in Brazil (*Beneficio de Prestação Continuada)* and Mexico (*70 y más*). The *Renta Dignidad* (previously known as *Bonosol*) from Bolivia and the *Pension Básica Solidaria* (ex PASIS) from Chile are also well known social pension programs. In the case of Chile, the social pension is an innovation on their individual capitalization pension system reformed in 2008. In general, these transfers are focalized to poor elderly individuals who are not pensioners, and consider requisites like age, residence, citizenship, means-test, etc. Programs like the Brazilian and Bolivian are almost universal as these only require residence, citizenship and age of retirement.

One of the immediate effects of these programs is reducing old-age poverty and allowing –finally- retirement with a secure income to the poor elderly. Other effects are related to the positive impacts on life satisfaction and health of the recipients, not to mention the positive outcomes on the rest of the family. In this respect, Galiani and Gertler (2010) offer a comprehensive impact evaluation of the Mexican program *70 y más*. For the Brazilian program, the studies by Kassouf et al. (2011), Barrientos (2005), Carvalho Filho (2008, 2010) and Reis and Camargo (2007) account for some reductions on poverty, elderly work load and child labour, while enhancing school attendance of girls living with the pension recipient[1].

The aim of this paper is to study the *ex-ante* effects of the implementation of a NCP program in Colombia and Peru. Relying on household survey data from both countries, we simulate the potential impact of the transfer on i) poverty levels, ii) inequality, iii) fiscal cost, and iv) the probability of affiliation to the contributory pension system. This last effect is the most direct behavioural effect one can expect from the implementation of a transfer scheme without contributions attached. For some individuals, and depending on the generosity of the transfer, the prospect of having a NCP will be a good substitute of pension savings. For the behavioural response we estimate a Nested Logit Model in order to analyze potential changes in the individuals' probability of affiliation to the pension system. We consider two types of program transfers: universal and targeted. In the first case, the beneficiaries are all individuals who have reached the retirement age and have no pension. In the second case, besides the previous requirements, the transfer is targeted to the poor.

Our results show that a NCP in Colombia and Peru contributes to the reduction of poverty and inequality among the elderly, particularly in rural areas at affordable fiscal costs. The annual cost is about 0.32%-0.45% of GDP with the universal transfer and 0.10%-0.15% with the targeted scheme. Furthermore, there is not a large impact on the probability of

[1] See Duflo (2000, 2003), Bertrand et al. (2003), Ardington et al. (2009), Edmonds et al (2005) and Edmonds (2006) for literature in this respect.

affiliation to contributory pensions when the program is targeted to the poor (and extreme poor), with the exception of Peruvian women for whom there is always a sizeable reduction on their probability of affiliation.

Studies analyzing the behavioural impacts of social pensions, in particular about the effects on the affiliation to contributory pensions, are scarce; in this vein, this paper contributes to the empirical literature on old-age poverty and pension evaluation in Latin America.

The paper is organized as follows. In the next section we present important background of Colombia and Peru. Section 3 presents the methodology we used to estimate the individual behavioural response. Section 4 describes the data. Section 5 reports the effects of a NCP on poverty, inequality, fiscal costs and on the probability of affiliation to contributory pension systems. Finally, section 6 concludes.

2 Country background

In 2010, there are 3.07 and 1.73 millions of people older than 65 years in Colombia and Peru, representing 7.0% and 5.9% of total population, respectively. Women are majority, with 52.3% of participation in Colombia and 54.1% in Peru. Although the relative size of the elderly population is currently not very high (compared to developed countries), we should keep in mind that this participation will increase in the future due to the aging phenomenon that all countries are experiencing. For instance, the relative weight of elderly people in 2050 will be 17.5% in Colombia and 16.1% in Peru. Certainly, this evolution will have a direct impact on the cost of a NCP scheme.

The poverty rate of the 65+ population is 25.2% and 27.3% in Colombia and Peru. This is lower than the national average, which is 33.5% and 31.3%, respectively (Table 1). There are notable differences between urban and rural areas. For instance, in Peru, the total poverty rate

is 19.1% in the urban area whilst this jumps to 54.2% in the rural area. In the case of the elderly, the poverty rate is 14.6% in the urban area and 48.5% in the rural area.

Table 1. Poverty rate by age group and region, 2010 (%)

	Colombia			Peru		
	Urban	Rural	Total	Urban	Rural	Total
Poverty:						
<65	32.9	37.9	34.1	19.5	54.8	31.7
65+	21.9	36.7	25.2	14.6	48.5	27.3
Total	32.1	37.8	33.5	19.1	54.2	31.3
Extreme poverty:						
<65	9.8	19.2	12.0	2.6	23.3	9.7
65+	8.6	17.5	10.5	2.2	22.9	9.9
Total	9.7	19.1	11.9	2.5	23.3	9.8

Source: Authors' elaboration with ECV-2010 and ENAHO-2010.

Individuals work until very advanced ages or during the whole life because of the absence of regular incomes during old age (like a pension), which in turn risk their health and physical integrity. This sort of *Ceaseless Toil* -as noted by Benjamin et al (2003) when analyzing the elderly labour supply in rural China- is common in developing countries. According to Kassouf et al. (2011) the old poor from Brazil would not be able to ever retire from the labour market if the social pension had not been implemented. In Peru and Colombia, the elderly occupation rate is much larger in the rural area than in the urban area. In table 2 one observes that individuals from rural areas in both countries have higher occupation rates in old ages, which may indicate that they face difficulties to retire from the labour market and must keep working[2].

[2] We only use statistics for men, because the percentage of inactive women can be very high due to the traditional role division in the household, particularly in rural areas.

Table 2. Elderly men who are working by area and poverty (2010, %)

	Urban				Rural				Total			
Age	Extreme Poor	Poor	Non poor	Total	Extreme Poor	Poor	Non poor	Total	Extreme Poor	Poor	Non poor	Total
Colombia												
65-69	37.3	44.3	38.1	39.3	40.0	59.2	78.1	72.5	38.5	49.3	46.7	47.2
70-74	35.3	22.3	28.6	27.1	41.3	50.0	64.6	59.6	37.3	32.1	37.6	36.1
75-79	29.8	21.3	29.0	27.4	25.1	32.6	52.3	43.5	27.3	26.3	34.0	31.8
+80	0	8.9	6.7	7.3	7.7	14.3	31.1	25.6	2.4	10.7	12.2	11.8
Peru												
65-69	78.3	73.0	65.7	67.1	96.6	94.2	95.4	95.3	94.0	81.6	71.3	74.9
70-74	66.0	56.8	45.9	47.8	89.9	96.8	91.4	93.0	84.4	78.0	55.1	61.6
75-79	92.0	51.3	32.4	36.4	87.9	89.1	84.6	87.1	88.4	68.1	40.0	50.7
+80	74.9	36.2	22.1	26.1	51.9	73.2	68.5	66.0	58.3	53.2	29.5	36.9

Source: Authors' elaboration with ECV-2010 and ENAHO-2010

Colombia and Peru are part of the Latin American countries that implemented structural reforms in their pension systems during the 1990's. Under this wave of reforms, many countries created defined contribution (DC) pension systems based on individual capitalization accounts and gave a prominent role to the private sector to manage pension funds. Some countries dismantled completely their old public defined benefit (DB) systems, whilst others kept the public scheme to be a complement to the private scheme in an integrated system. Different from this practice, only Colombia and Peru maintained both public and private pension systems as two competing schemes[3]. This means that workers in both countries can freely choose either the public or the private pension system.

In the Colombian public pension system, the retirement ages are 55 and 60 years for women and men, respectively (57 and 62 from 2014). People must contribute at least 1,225 weeks; though the contributions will increase by 25 weeks per year up to 1,300 weeks in 2015. In the private system, an individual can retire at any age, as long as her savings are sufficient to cover a monthly pension higher than 1.1 minimum wages (US$ 319 approximately). Under this regime, the legal retirement age (57 and 62) and the minimum time of contributions (1,300 weeks) only apply if the person requires a guaranteed minimum pension. The contribution rate

[3] The interested reader on these structural reforms is referred to Arenas de Mesa and Mesa-Lago (2006).

is 16% to the private or public scheme; the employer is in charge of the 75% of this contribution and the employee is in charge of the 25%. There are 6.5 million people registered in the public pension system (in 2011), but only 31% of them are regular contributors. The private system is composed by 10.2 million affiliates, with 42% effectively contributing. This means that only 28% of the labour force is actually contributing to pensions.

In Peru, the retirement age is 65 years in any pension system. Early retirement is possible in both systems under stringent conditions. The public system offers a minimum pension if the person has at least 20 years of contributions and is 65 years old. In contrast, the private system only offers the minimum pension to those individuals who were born before 1945, provided they have contributed for at least 20 years to any pension system. The final pension amount earned in the public system depends on pension rules that vary according to the amount of contributions and the cohort of birth, whilst that of the private system depends on the funds accrued up to the age of retirement. The contribution rate is 13% and 10% of the wage for the public and private regimes, respectively. In the private scheme, the pension fund administrators charge a fee of about 3% of the wage. The population affiliated to the pension system is 7.8 million (in 2011); 4.9 millions in the private system and 2.9 millions in the public system. This corresponds to 49% of labour force. However, considering only those individuals who are actively contributing, this figure is reduced to 22% of labour force.

The number of elderly receiving a pension is low in both countries and is biased towards richer groups. According to Rofman and Oliveri (2011), 23% and 25.1% of 65+ people received a pension in 2009 in Colombia and Peru, respectively. Furthermore, only 4.1% and 1.8% of elderly people from the poorest income quintile received a pension in Colombia and Peru. These figures jump to 31.8% and 58.4% for the richest quintile.

3 Methodology

We estimate the expected effects of a NCP relying on data from well established and representative household surveys in Colombia and Peru. First, we carry out a mechanic simulation –i.e. not considering individual behavioural changes- to compute variations in poverty and inequality when a NCP is introduced. Second, we estimate a nested Logit model in order to analyze potential changes in the individuals' probability of affiliation to the pension system. To complement the analysis, we compute the fiscal cost of the NCP under different scenarios.

Similar to Diether et al. (2011) and Gasparini et al. (2010), we consider two types of transfers; one being universal and the other mean-tested. In the first case, the NCP is received by all individuals that have reached the retirement age and have no pension. In the second case, besides the previous requirements, the transfer is targeted to the poor. The universal transfer demands more fiscal resources but it is easier to implement because there are not focalization costs.

3.1 Impact on poverty and inequality

We compute poverty and inequality indicators before and after the implementation of the NCP scheme. For poverty we use the headcount ratio, classifying the poor according to official poverty lines from each country (built with incomes in Colombia and expenditures in Peru)[4]. For inequality, we estimate the Gini coefficient with the corresponding variable in each country. A Gini coefficient of 0 represents perfect equality, while a coefficient of 1 implies perfect inequality.

[4] In Colombia, we add the NCP to the total household income and divide over the total number of household members. This new income per capita is compared with the corresponding poverty line. In Peru, we add the NCP to the total household expenditure and divide over the total number of household members.

3.2 Changes in the probability of affiliation to the pension system

Apart from the impacts on poverty and inequality, a NCP scheme has effects on some individuals' decisions. One of the most important and direct effects is, certainly, on the affiliation to the contributory pension system. For some individuals, the prospect of receiving a NCP in the future might be a good substitute to pension savings, so that we will expect a fall in the probability of pension affiliation. In the following we present the framework to estimate this effect.

Consider the individual *i* maximizes her utility by choosing one of the following three options: i) affiliation to the private system, ii) affiliation to the public system, and iii) no affiliation. Each option is represented by j and associated to utility level U_{ij}, which is a function of the "true" utility V_{ij} (given demographic characteristics of individual *i*, X_i) and an error term ε_{ij}:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

ε_{ij} is the result of measurement errors of X_i, optimization errors of the individual, and the existence of non observable characteristics in the preferences. The utility maximization implies that option *j* is chosen if:

$$U_{ij} > U_{ik}\ , \forall k \neq j \tag{2}$$

The probability of choosing alternative *j* is:

$$P_{ij} = Prob\big(U_{ij} > U_{ik}\ , \forall k \neq j\big)$$

$$= Prob\big(V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik}\ , \forall k \neq j\big)$$

$$= Prob\left(\varepsilon_{ik} < \varepsilon_{ij} + V_{ij} - V_{ik}\,, \forall k \neq j\right) \quad (3)$$

Assuming that ε_{ij} has an extreme value distribution ($f(\varepsilon) = exp(-e^{-\varepsilon})$) and is independent and identically distributed over each alternative *j* (Creedy and Kalb, 2006), it is possible to find that:

$$Prob\left(\varepsilon_{ik} < \varepsilon_{ij} + V_{ij} - V_{ik}\,, \forall k \neq j\right) = \frac{e^{U_i}}{\sum_{j=1}^{n} e^{U_j}} \quad (4)$$

We will consider that the "true" utility V_{ij} is equal to the net pension wealth $\pi_{i,j}$ that each individual *i* obtains with alternative *j*, plus a component a_i. This last component does not change with the alternative *j* and summarizes the individual's preferences, given X_i.

$$V_{ij} = \pi_{i,j} + a_i \quad (5)$$

The Net Pension wealth is the stream of future pension payments in present value net of costs. π is different for each individual and changes with each alternative *j* because pension benefits depend on personal circumstances and pension rules of each system. Therefore the appropriate estimation model is the nested Logit model. In the nested models, the alternatives *j*=1,2,….J are grouped in M sub-sets or nests, which are not overlapped. The nests are denoted by B_1, B_2,…. B_M. The nested model is obtained by assuming that the error term ε_{ij} has a generalized extreme value distribution function:

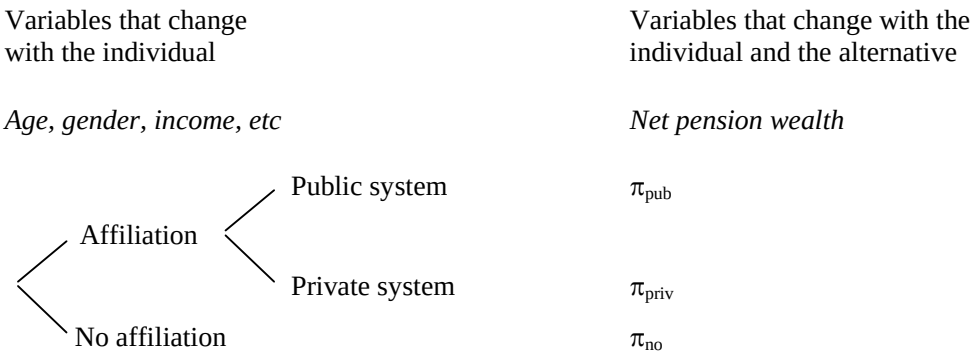
$$F(\varepsilon) = exp\left(-\sum_{m=1}^{M}\left(\sum_{j \in B_m} e^{-\varepsilon_{ij}/\tau_m}\right)^{\tau_m}\right) \quad (6)$$

The term τ_m is known as the *dissimilarity parameter*, which measures the independence degree in the non-observed utility among the alternatives in the nest *Bm*. The larger the parameter, the greater the independence degree is. Given the distribution of the unobserved part of the utility, the probability of choosing alternative $j \in B_m$ is the following:

$$P_{ij} = \frac{e^{V_{ij}/\tau_m}\left(\sum_{j\in B_m} e^{V_{ij}/\tau_m}\right)^{\tau_m - 1}}{\sum_{l=1}^{M}\left(\sum_{j\in B_l} e^{V_{ij}/\tau_l}\right)^{\tau_l}} \tag{7}$$

Graphically, the nested model is:

Figure 1. Nested Decisions



In the first nest, the individual decides to affiliate or not to the pension system. If affiliation is chosen, a second nest opens and the individual must choose between the public and the private regime. The advantage of this model is that, contrary to the case of a multinomial Logit, we don't need to assume that the errors ε_{ij} are independent and identically distributed.

3.3 Net pension wealth

Net pension wealth is the value of all pensions that an individual of age *x* (today) will receive between retirement age and death, net of costs (contributions and administrative fees). As pensions and costs are generated in different moments of time, it is necessary to use a discount factor to express all variables in present value. The net pension wealth in the private system is computed as the following:

$$\pi_{x,priv} = (P_{priv} \times cru_z)\delta^{x-z} - (a_{priv} + c)\sum_{t=x}^{z}(e_t w_t)\delta^{x-t} \quad (8)$$

$$P_{priv} = \left[a_{priv}\sum_{t=x}^{z}(e_t w_t)\beta^{z-t} + CIC_x\beta^{z-x} + RB\right]/cru_z \quad (9)$$

$$cru_z = 12\left(\sum_{t=0}^{M-z}\frac{p_{z,z+t}}{(1+\hat{r})^t}\right) \quad (10)$$

$$cru_{z,y} = cru_z + 12\theta_{priv}\left(\sum_{t=0}^{M-y}\frac{q_{y,y+t}(1-p_{z,z+t})}{(1+\hat{r})^t}\right) \quad (11)$$

$$\delta = 1 + d = 1 + \hat{r};\ \ \beta = 1 + r \quad (12)$$

Where:

z: Retirement age
$\pi_{x,priv}$: Present value of the net pension wealth (at current age *x*)
P_{priv}: Pension in the private system
a_{priv} : Contribution rate to the pension fund (% of wage)
c : Administrative fees and insurance premium (% of wage)
e_t: Probability of being employed at the age *t*
w_t: Wage at the age *t*
d : Discount rate
r : Pension fund return rate
$\hat{r}$: Annuity discount rate
RB: Recognition bond of the contributions made in the public system
CIC_x : Balance in the individual account of capitalization at current age *x*
cru_z : Annuity price at retirement age *z*
θ_{ffs} : Percentage of the pension received by the widow
M : Maximum survival age according to official mortality
$p_{z,z+t}$: Probability of survival of pensioner from age *z* to *z+t* according to official mortality
$q_{y,y+t}$: Probability of survival of the pensioner's spouse from age *y* (when the pensioner reaches the retirement age *z*) to *y+t* according to official mortality

The first term in the right side of equation 8 is the value of the future pension and the second term corresponds to the cost, i.e. pension contributions (a_{priv}) and administrative fees (c). When replacing equation 9 into 8, the discounted pension wealth is equivalent to the final balance of the capitalization account plus previous contributions made to the public system (RB). The term $e_t w_t$ indicates expected income, as it takes into account the probability e_t of being employed at age t, earning a wage equal to w_t. The annuity price cru_z is defined as the discounted capital needed to finance a unity of life pension. Equation 10 and 11 denote an annuity price for a single and a married affiliated, respectively.

The pension wealth generated in the public system ($\pi_{x,pub}$) is:

$$\pi_{x,pub} = (P_{pub}^{z-h} \times cru_z)\delta^{x-z} - a_{pub} \sum_{t=x}^{z} (e_t w_t)\delta^{x-t} \quad (13)$$

The public pension P_{pub}^{z-h} depends on the wage and number of years contributed between the affiliation (h) and retirement age (z). The minimum number of years required to receive a minimum pension is 20 in Peru and 25 in Colombia. Obviously, in the case of no affiliation, the net pension wealth is zero:

$$\pi_{x,no} = 0 \quad (14)$$

3.4 Net pension wealth for each transition

The computation of the pension wealth must take into account the possibilities of: changing system, staying in the same system, and exiting from any system. Figure 2 shows all possible combinations and the corresponding equation for each case.

Figure 2. Possibilities of Net Pension Wealth

	Future Situation			
Current situation		PRIV	PUB	NO
	PRIV	$v_{x,priv}^{priv}$	$v_{x,pub}^{priv}$	$v_{x,no}^{priv}$
	PUB	$v_{x,priv}^{pub}$	$v_{x,pub}^{pub}$	$v_{x,no}^{pub}$
	NO	$v_{x,priv}^{no}$	$v_{x,pub}^{no}$	$v_{x,no}^{no}$

$v_{x,j}^{priv}$ indicates the net pension wealth of an individual of age *x* affiliated to the private pension who chooses the option *j* , which are staying in the private system ($v_{x,priv}^{priv}$), changing to the public system ($v_{x,pub}^{priv}$) and leaving the pension system ($v_{x,no}^{priv}$). The interpretation of wealth variables $v_{x,j}^{pub}$ and $v_{x,j}^{no}$ is similar. The detailed equations to compute the net pension wealth for each combination showed in figure 2 are placed in appendix 1.

3.5 Estimation of labour income

The expected labour income and probability of being employed are estimated with a Heckman equation. The estimations are country and sex specific (regression results in appendix 2). The individual stream of future expected incomes (w_t) and employment likelihood (e_t) are computed with the corresponding coefficients plugged into the vector of individual characteristics of each individual in the sample.

For those individuals affiliated to the private system, it is also necessary to estimate the stock of funds accumulated in their balances up to current age *x*. For this, we also use the Heckman regression estimates for each individual and the past average yearly pension fund rates of each country in order to reconstruct the size of the balances. This procedure is done backwards until 1994 (Colombia) and 1993 (Peru), as those are the years of creation of the private pension systems. For each -old enough- individual, we also compute her corresponding Recognition Bond (RB) with the rules of each country and the estimates from the Heckman estimations. Finally, we use a similar procedure to estimate the past contributions of

individuals affiliated to the public system. In both cases (private or private affiliation) we assume that individuals start contributing at the age of 25.

4 Data

We use national household surveys that are representative at national, regional and urban/rural level in both countries for year 2010. In Colombia we use the *Encuesta de Calidad de Vida* (ECV), whilst in Peru we use the *Encuesta Nacional de Hogares* (ENAHO). Both surveys are widely used to study poverty and living standards. When the expansion of data is required, we use the sample weights of each survey and must adjust these levels with the most updated population projections. This is particularly important to count the number of elderly people who will receive a social pension. Table 3 shows these population projections.

Table 3. Population Projections

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Colombia											
% of total population											
0-14	28.59	28.15	27.74	27.36	27.01	26.68	26.39	26.12	25.87	25.63	25.39
15-64	64.68	64.99	65.26	65.49	65.68	65.83	65.94	66.02	66.07	66.10	66.10
65+	6.72	6.85	7.00	7.15	7.32	7.49	7.68	7.86	8.06	8.27	8.50
in 1000s											
65+	3.060	3.155	3.260	3.370	3.487	3.608	3.742	3.876	4.017	4.166	4.329
Peru											
% of total population											
0-14	29.95	29.54	29.13	28.73	28.32	27.92	27.53	27.14	26.75	26.36	25.98
15-64	64.18	64.46	64.74	65.01	65.27	65.52	65.75	65.97	66.17	66.37	66.55
65+	5.87	5.99	6.12	6.26	6.40	6.56	6.73	6.90	7.08	7.27	7.47
in 1000s											
65+	1.729	1.786	1.846	1.908	1.973	2.043	2.118	2.196	2.278	2.363	2.452

Source: INEI (2009) for Peru and DANE for Colombia.

Table 4 reports official monthly poverty lines in Colombia and Peru. This information is needed to find the effects of the social pension on poverty. The amount assumed for this pension will be 60,000 pesos (US$ 31) in Colombia, which correspond to the average old-age

transfer that the Government grants to poor elderly in a social program with limited coverage[5]. In Peru, the amount will be 125 Nuevos Soles (US$ 44), which is equal to the social pension recently implemented (*Pensión 65*) and still limited to some districts. The last column of table 4 shows the relative importance of the NCP with respect to the poverty lines in different areas. As expected, the NCP is relatively more important in the rural area, so that we should expect a larger impact in reducing poverty in this area.

Table 4. Poverty lines in Colombia and Peru in 2010

	In national currency		In current US Dollars		Transfers as % of poverty lines	
Region	Poverty line	Extreme poverty line	Poverty line	Extreme poverty line	Poverty line	Extreme poverty line
Colombia						
Urban	193,701	83,741	98	43	31	72
Rural	115,703	69,134	59	35	52	87
Total	174,753	80,197	89	41	34	75
Peru						
Urban	293	155	104	55	43	81
Rural	208	137	74	49	60	91
Total	264	149	94	53	47	84

Note: The transfers used in Colombia and Peru are 60,000 pesos and S/.125, respectively.

5 Results

In this section we present the effects of a social pension when this is granted either universally or as a benefit targeted to the poor. A requisite in both cases is that the benefit granted at the legal retirement age and only if the individual is not already receiving another pension. The advantage of the universal pension is that there are not targeting costs, though the fiscal cost is larger. Furthermore, the universal pension is associated with less stigmatization of the low income people[6].

[5] This program is called "Colombia Mayor" and constitutes the bottom of minimum protection for the elderly in the country. The Government is promoting the extension of the program to all people older than 65 years who have no pension and belong to the two lowest levels of socioeconomic classification (SISBEN). It currently covers 933 thousand people.

[6] These advantages are similar to the ones suggested in the literature on universal basic income (see Van Parijs, 1997).

5.1 Poverty and inequality

Table 5 reports the effects before and after the implementation of a NCP on poverty and extreme poverty rates in each country[7]. These effects are the same regardless the program is targeted or universal because the individuals exiting poverty are the same with the universal or targeted scheme as we defined previously. The effects on the reduction of overall poverty at national level are modest; between 0.8 and 2 percentage points in Colombia and Peru, respectively. As expected, the reduction of poverty is larger for the group of 65+. At national level, this reduction is 5 points in Colombia and 13 points in Peru. Disaggregating by area, the effects of a NCP are more potent for the elderly living in rural areas. A NCP can reduce the poverty rate of the rural elderly of Colombia by 12 points, whilst in Peru this reduction is about 25 points. In this last case, the NCP reduces significantly the poverty rate of the old and rural Peruvians, from 48.5% to 23.7%. There are similar results in the case of extreme poverty rates. Extreme poverty falls more for the 65+ people and in rural areas. As before, a NCP has a stronger effect in Peru in reducing extreme poverty for the elderly. For example, extreme poverty falls from 22.9% to 5.9% for the Peruvian elderly of rural areas.

Table 5. Poverty rates with Non Contributory Pensions

	Colombia			Peru		
	Urban	Rural	National	Urban	Rural	National
Effects in poverty:						
Total population						
before	32.1	37.8	33.5	19.1	54.2	31.3
after	31.7	36.4	32.8	18.0	50.6	29.3
Population 65+						
before	22.0	36.7	25.2	14.6	48.5	27.3
after	19.3	24.6	20.5	8.9	23.7	14.4
Effects in extreme poverty:						
Total population						
before	9.7	19.1	11.9	2.5	23.3	9.8
after	9.1	17.9	11.2	2.2	20.2	8.5
Population 65+						
before	8.6	17.5	10.5	2.2	22.9	9.9
after	4.8	7.0	5.3	0.6	5.9	2.6

[7] To evaluate the condition of poor and extreme poor before and after the transfer, we use the household income per capita in Colombia and the household expenditure per capita in Peru. This follows the official methodology to estimate poverty in each country.

Sources: Authors' estimations.

The number of potential beneficiaries of the NCP is considerable in both countries (see table 6). If the program is targeted, there are 753,550 recipients in Colombia and 438,475 in Peru, which is equivalent to approximately one fourth of the elderly population in each country. Obviously, the number of recipients is much larger if the program is universal, being 78.4% and 74.1% of the elderly population in Colombia and Peru, respectively. Moreover, the proportion of old people receiving a NCP is higher in the rural area under any type of program. Although, if we consider the composition of recipients within each program, we observe that the targeted program is mainly composed by rural individuals, whilst that the universal program presents a similar share of urban and rural individuals. For example, in Peru 3 over 4 beneficiaries are from the rural area in the targeted program, while that this relationship is roughly one to one in the universal program.

Table 6. Number of beneficiaries by type of program

	Colombia			Peru		
	Urban	Rural	National	Urban	Rural	National
Total pop. 65+	2'392,212	682,611	3'074.830	1,083,222	645,537	1,728,759
Number of beneficiaries						
with universal	1'759,755	650,008	2,409,763	671,151	609,412	1,280,562
with targeted	504,707	248,843	753,550	133,305	305,170	438,475
% of pop. 65+						
with universal	73.6	95.2	78.4	62.0	94.4	74.1
with targeted	21.1	36.5	24.5	12.3	47.3	25.4

Source: Authors' estimations. The NCP, if targeted, is targeted to the poor.

Before implementing the NCP, inequality is higher in urban areas in both countries (see table 7)[8]. We observe that the effects of the NCP in reducing overall inequality are modest in each country and not statistically significant with the exception of a universal NCP in Peru for

[8] A possible explanation why Ginis are much larger in Colombia than those of Peru is because we use household incomes in Colombia and expenditures in Peru. It is well know that income data presents more volatility and dispersion than expenditure data. Furthermore, it appears that there is more inequality in Colombia than in Peru in year 2010. According to the World Development Indicators of the World Bank, the Gini index estimated with incomes are 55.9 in Colombia and 48.1 in Peru.

the elderly population. In contrast, the strongest effects are observed in the reduction of inequality within the rural elderly. In Colombia, a targeted transfer reduces the Gini of the rural elderly from 0.541 to 0.503, whilst in Peru this is reduced from 0.329 to 0.260. These figures represent a sizeable effect of the transfer and it is in correspondence with previous estimated achievements in the reduction of rural poverty. If the transfer is universal, the Gini for the rural elderly falls up to 0.494 in Colombia and 0.286 in Peru, but this result is only significant for the elderly Peruvian. Focusing on the rural elderly, we observe that a targeted transfer accomplishes more equalization than a universal transfer in Peru. In Colombia there are not notable differences between the types of transfers in reducing inequality.

Table 7. Gini coefficients before and after the NCP

	Colombia			Peru		
	Urban	Rural	National	Urban	Rural	National
Before NCP						
total pop.	0.569	0.515	0.580	0.337	0.308	0.388
pop. 65+	0.562	0.541	0.582	0.348	0.329	0.400
With NCP universal						
total pop.	0.565	0.504	0.575	0.333	0.304	0.381
pop. 65+	0.547	0.494	0.562	0.332	0.286*	0.365*
With NCP targeted						
total pop.	0.566	0.505*	0.577	0.334	0.296	0.382
pop. 65+	0.553	0.503*	0.570	0.338	0.260*	0.372

* Different from the corresponding Gini estimated before the NCP (at 95%).
Note: The NCP, if targeted, is targeted to the poor.
Source: Authors' estimations.

5.2 Pension enrolment rates

We measure the effects of a NCP on the probability of affiliation to any of the contributory pension systems. We restrict the sample of individuals to those for whom the simulation exercise is relevant. In consequence, we exclude handicap persons, pensioners, affiliates to special schemes like the military, police, judges, etc., unpaid family workers and full-time students. In addition, the sample is restricted to individuals between 25 and 65 years old in Peru. In Colombia, the sample is restricted to individuals between 25 and 45 years old, otherwise the estimation will be unnecessary more complex because of the different ages of

retirement by sex. For the computation of the pension wealth we need some parameters to be assumed and from actual data in each country, which are reported in table 8.

Table 8. Parameters employed in pension wealth computations

Parameter	Colombia	Peru
Contribution rate to the pension fund (% of wage)	11.5%	10%
Contribution rate for solidarity (% of wage)	1%	--
Administrative fee and insurance premium (% of wage)	4.5%	3.07%
Pension fund return rate (yearly)	6%	6%
Discount rate (yearly)	4%	4.6%
Annuity discount rate (yearly)	4%	4.6%
Annuity price for single man (yearly)	13.396	11.671
Annuity price for married man (yearly)	15.516	12.963
Annuity price for single woman (yearly)	13.974	13.118
Annuity price for married woman (yearly)	15.754	13.473
Age difference between spouses (man always older)	4	4
Minimum salary (yearly)	6.18 (mill. pesos)	S/. 7,200
Contribution rate to public pension system (% of wage)	16%	13%
Minimum pension in the public pension system (yearly) 1/	6.18 (mill. pesos)	S/. 5,810
Maximum pension in the public pension system (yearly) 2/	154.5 (mill. pesos)	S/. 12,003

Notes: 1/ In Colombia, the minimum pension is equal to one minimum salary.
2/ In Colombia, the maximum pension is equal to 25 minimum salaries.

The expected future income and probability of being employed are computed with the coefficients estimated with the Heckman equations for each country. The explanatory variables of the outcome equation are age, squared age, education and regions. In the selection equation we add non-labour income and a dummy for marital status to the outcome equation's variables (in appendix 2).

Once the pension wealth associated to each alternative is computed for each individual in the sample, we can incorporate this to the equations of the nested logit model and estimate the probability of affiliation to the private and the public pension system. The event of non affiliation is used as the base outcome. Other control variables apart from pension wealth are disposable income (net of taxes), age, squared age, marital status, education, region and non labour income.

Table 9. Nested Logit estimates for the probability of affiliation to the contributory pension system

Variables	Colombia				Peru			
	Women		Men		Women		Men	
	priv system	pub system	priv system	pub system	priv system	pub system	priv system	pub system
net labour income	0.000003	-0.000007 ***	-0.000007 ***	-0.000003 ***	0.009843 ***	-0.00746 ***	0.006545 ***	-0.00191 ***
age	0.138087	-0.071362	-0.217124	-0.053059	-0.39587 ***	-0.25408 ***	-0.20765 ***	-0.16496 ***
sq age	-0.03287	0.074714	0.448352 *	0.022213	0.531053 ***	0.251618 ***	0.338887 ***	0.172325 ***
married	0.7262 ***	-0.153894	-0.994325 ***	-0.169116 *	-0.06351	0.215711 ***	-0.3724 ***	-0.42434 ***
educ1	0.371359	-0.872978 ***	0.366932	-0.530986 ***	0.412785	-0.7733 ***	-0.29259 *	-1.02747 ***
educ2	0.303425	-1.52582 ***	0.952308 ***	-1.013935 ***	0.275127	-2.38921 ***	-0.3698 **	-1.97986 ***
educ3	0.261899	-1.771828 ***	1.258698 ***	-1.151909 ***	0.083346	-3.70609 ***	-0.41679 **	-2.87574 ***
educ4	-0.29704	-0.139852	0.646696	-0.450287 **	0.202522	-4.37661 ***	-0.27675	-3.36609 ***
educ5	-0.12704	-1.322652 ***	1.121538 **	-0.938882 ***	0.268517	-5.26374 ***	-0.44401 *	-4.62611 ***
region1	-0.46363	1.346493 ***	-0.280077	1.137186 ***	-0.16526	0.29855 ***	-0.06339	0.327282 ***
region2	-0.1822	1.214026 ***	-0.202833	0.872807 ***	0.370737 *	-0.53574 ***	0.481118 ***	-0.17306 *
region3	-0.06951	0.968124 ***	-0.959809 **	0.945688 ***	0.021821	-0.40779 ***	-0.64314 ***	-0.47234 ***
region4	0.89108	1.956393 ***	0.305047	1.756356 ***	-0.80771 **	0.531402 ***	-0.53026 **	1.067632 ***
region5					0.377481 **	0.829809 ***	0.499374 ***	0.827245 ***
region6	0.040403	0.746843 ***	0.211927	0.791357 ***	0.1559	0.489497 ***	0.017359	0.639088 ***
region7	-0.71775 *	0.948408 ***	-0.215604	0.524758 ***	-0.54054 ***	0.367921 ***	-0.96422 ***	0.769315 ***
region8	1.019445 ***	0.794271 ***	0.296953	0.575487 ***				
no labour income	0.000046 ***	0.000029 **	-0.000167 ***	-0.000024	0.035444 ***	-0.05442 ***	-0.00111	-0.0123 *
constant	-6.65189	3.952576 **	0.704176	3.727424 ***	5.187316 ***	10.16555 ***	1.102756 *	6.395625 ***
pension wealth	0.000093 ***		0.000105 ***		0.188754 ***		0.065064 ***	
Log Likelihood	-1909.27		-2619.0862		-5146.98		-11494	

*** Sig. at 1%; ** 5%; * 10%.

As expected, pension wealth affects positively and significantly the probability of affiliation to any pension system. This effect is larger for the woman in Peru, but smaller for the Colombian women. The goal of table 9's estimates is compute changes in the probability of affiliation to each pension system when a NCP scheme is introduced. First, we need to check if the individual complies with the requisites to receive a NCP, and then, we compute her corresponding pension wealth. The pension wealth of a NCP is computed according to equation 15. This equation is similar to previous equations that compute the pension wealth of other pension systems, although the main difference is that there are not associated costs (contributions and fees). Second, the NCP wealth ($\pi_{x,ncp}$) replaces the value of zero that is associated to the outcome of no-affiliation for those individuals in the sample who satisfies the requisites of the NCP scheme. This last step allows us to predict the new probabilities of affiliation with the estimated coefficients of the nested logit model.

$$\pi_{x,ncp} = (NCP \times cru_z)\delta^{x-z} \tag{15}$$

Table 10 shows the results of the previously described exercise. In addition to the universal and targeted (to the poor) program, we consider a third program even more narrowly targeted to the extreme poor. In both countries, a universal program will reduce notably the probability of affiliation, particularly in Peru[9]. For example, the Peruvian women have a probability of affiliation of 28.8% before a universal NCP is introduced, but this falls to 10.6% after the transfer. This sizeable effect is related to the overwhelming number of woman without social security coverage. In contrast, the impact of the universal transfer on the probability of affiliation for Peruvian men is lower, which decreases from 36.2% to 28.4%. In Colombia, the probability of affiliation decreases 5.7% for women and 4.5% for men.

If the program is targeted to the poor, there are sizeable effects only for Peruvian woman, which probability of affiliation is reduced by 10.5%. In Colombia, the reduction of the probability of affiliation is less than 1% for both sexes. Similar results are observed when the program is targeted to the extreme poor. With that targeting the reduction of the likelihood of affiliation is only marginal (about less than 0.5%) except for Peruvian women. In the case of Peruvian women, the impact of a pension targeted to the extreme poor (a reduction of 9.7%) is similar to the one of a program targeted to the poor.

Table 10. Effects of a NCP on the probability of affiliation

	Type of program	Colombia					Peru				
		Priv system	Public system	Both systems	No affiliation		Priv system	Public system	Both systems	No affiliation	
		level	level	level	level	var.	level	level	level	level	var.
Women	1. baseline	26.22	6.00	32.22	67.78		22.35	6.44	28.79	71.21	
	2. universal	21.58	4.95	26.54	73.46	5.68	7.01	3.59	10.60	89.40	18.19
	3. targeted to poor	25.56	5.84	31.40	68.60	0.82	12.63	5.70	18.33	81.67	10.46
	4. targeted to ext. poor	26.10	5.97	32.07	67.93	0.15	13.15	5.91	19.06	80.94	9.74
Men	1. baseline	23.15	5.23	28.38	71.62		26.71	9.51	36.23	63.77	
	2. universal	19.30	4.57	23.87	76.13	4.51	21.25	7.15	28.40	71.60	7.83
	3. targeted to poor	22.42	5.05	27.47	72.53	0.91	25.49	8.99	34.48	65.52	1.75
	4. targeted to ext. poor	22.98	5.18	28.16	71.84	0.22	26.42	9.38	35.80	64.20	0.43

Note: the last column in each country shows the difference between the baseline and the corresponding program.
Source: Authors' estimations.

[9] A possible explanation for this differenced effect by country is that the relative value of the transfer is larger in Peru than in Colombia. In Colombia this represents 34% of the poverty line, whilst in Peru this is 47%.

Women can be more responsive to the introduction of a NCP program because the pension wealth associated to this transfer is larger than that of the men, which is due to the lower mortality of women with respect to men. Recall that in this case the pension wealth is the product between the annuity price –that is affected negatively by mortality- and the NCP amount. Moreover, the larger differences by sex found in the impact of the NCP in Peru reflect the larger differences of mortality profiles of the official tables used in Peru. In Colombia these mortality differences are less pronounced[10].

Another interesting outcome of our simulation is the evaluation of changes in the probability of affiliation by income quintiles (see table 11). As expected, the variation in the probability of affiliation to the contributory systems decreases with the quintile. Furthermore, the targeted programs practically don't affect the behaviour of individuals in the richer quintiles, particularly in Colombia where the transfer is relatively small.

Table 11. Probability of affiliation to the contributory system by quintiles

Colombia		Quintil 1	Quintil 2	Quintil 3	Quintil 4	Quintil 5	Total
Women	Baseline	11.09	18.95	33.73	49.66	68.72	32.22
	with universal NCP	7.60	13.62	26.37	41.83	62.44	26.54
	with targeted NCP (to poor)	9.59	17.83	33.08	49.48	68.72	31.40
	with targeted NCP (to extreme poor)	10.64	18.89	33.72	49.66	68.72	32.07
Men	Baseline	10.03	13.31	27.39	38.09	60.25	28.38
	with universal NCP	7.20	9.71	21.90	32.08	55.72	23.87
	with targeted NCP (to poor)	8.26	12.18	26.38	37.65	60.19	27.47
	with targeted NCP (to extreme poor)	9.21	13.14	27.32	38.05	60.24	28.16
Peru							
Women	Baseline	5.32	11.56	22.72	42.39	63.28	19.17
	with universal NCP	1.63	4.60	11.62	25.45	43.48	10.57
	with targeted NCP (to poor)	4.40	10.50	21.68	41.72	62.96	18.29
	with targeted NCP (to extreme poor)	5.07	11.42	22.65	42.36	63.27	19.02
Men	Baseline	17.49	21.04	29.87	42.11	58.76	36.28
	with universal NCP	11.63	14.48	22.25	33.34	49.53	28.43
	with targeted NCP (to poor)	14.73	18.34	27.81	40.75	58.23	34.53
	with targeted NCP (to extreme poor)	16.48	20.18	29.44	41.94	58.73	35.85

Source: Authors' estimations.

[10] In addition, the age of retirement of Colombian women is 5 years less than that of the men, and therefore their pension wealth will be lower. This counter balances the favourable effect of woman's lower mortality on her pension wealth.

In sum, the effects of a NCP on the probability to affiliation to the contributory pension system depend on the design of the scheme. A universal program can cause large reductions on that probability, while that the two targeted programs considered in our exercise have moderate or low effects, except for the Peruvian women.

5.3 Fiscal costs

The fiscal cost of each type of scheme is computed by multiplying the transfer amount by the total number of qualified recipients. Table 12 reports the results for a universal NCP scheme and a program targeted to the poor.

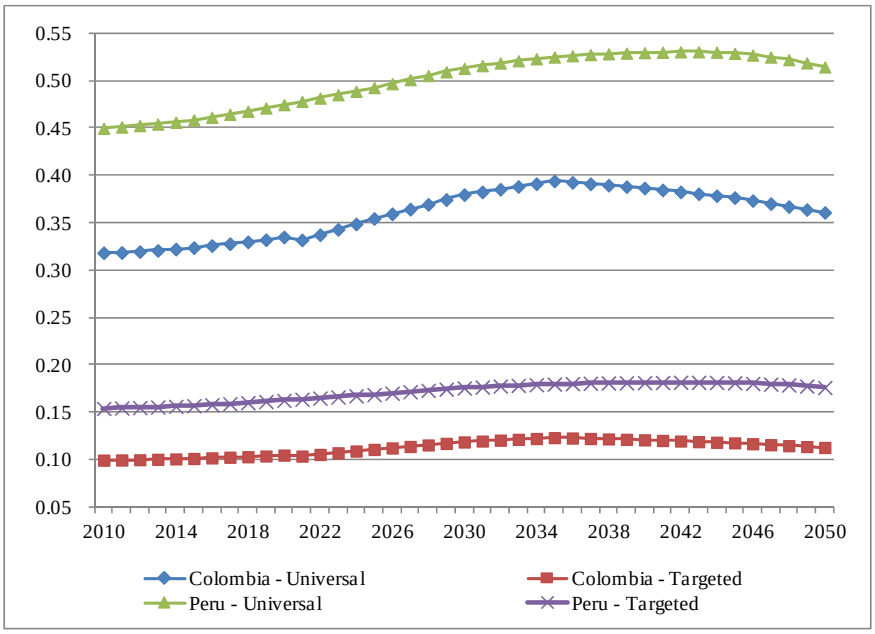
Table 12. Cost of a NCP program, 2010

	Colombia		Peru	
	Universal	Targeted	Universal	Targeted
Number of recipients	2,409,763	753,550	1,280,562	438,475
US$ millions	882	276	681	233
% GDP	0.32	0.10	0.45	0.15
% Total taxes revenues	2.60	0.81	2.98	1.02

Source: Authors' estimations. The NCP, if targeted, is targeted to the poor.

The universal program costs 0.32% and 0.45% of GDP in Colombia and Peru, whilst the program targeted to the poor sums up 0.10% and 0.15% of GDP, respectively. These amounts are not very high considering that social public expenditures are about 13.6% and 10% of GDP in Colombia and Peru in 2010. Furthermore, a quick inspection into the long run evolution of the elderly population in each country allows us to foresee how NCP's cost can evolve. Figure 3 shows the potential expenditures in NCP programs for the period 2010-2050 based on the most recent UN population projections and assuming a conservative real GDP growth rate of 3%. In both countries, fiscal costs related to NCP increase over the next 25 to 30 years, but later on these costs decrease as the speed of the aging process slows down.

Figure 3. Expenditures in NCP programs (as % of GDP), 2010-2050



Source: Authors' estimations.

6 Conclusions

The relevance of a non contributory pension scheme stems from its expected positive impact on the levels of poverty and inequality, especially among the elderly. The majority of them have no access to a pension and are less attractive in the labour market. A NCP can possibly become in a powerful tool for improving the quality of life of those individuals whose chances of escaping poverty are almost nil. Furthermore, a vast majority of elderly people in rural areas must keep working until a very advanced age –even death- since they are unable to retire with a secure income stream, which in turn puts at risk their health and physical integrity. A social pension directed towards this group will, certainly, enhance their standard of life.

Our results for Colombia and Peru show that the impacts of a NCP (universal or targeted to the poor) are notable to reduce poverty among the elderly, particularly in rural areas. In Peru, old-age rural poverty can be reduced from 48.5% to 23.7% with the introduction

of a NCP, whilst in Colombia it falls from 36.7% to 24.6%. The results are modest if one considers national poverty rates, though the effect is higher in rural areas than in urban areas.

As for the inequality indicators, the impact of the transfer is rather modest in both countries when considering the whole population. However, the reductions in inequality are more important and statistically significant among the elderly group living in rural areas. In Colombia, a targeted transfer to the poor reduces the Gini coefficient of the rural elderly from 0.542 to 0.503, whereas in Peru it falls from 0.329 to 0.260. We also observe that there are no sizeable differences between a universal and targeted pension in reducing inequality for rural old Colombians. Contrary to this, the targeted pension in Peru is more important than the universal pension when equalizing incomes. Even if inequality stays at lower but still high levels after the implementation of the NCP, we believe, as evidence has shown, that this program is an important step towards reaching greater equity levels among the elderly.

For every proposal made to improve a society's welfare, it is imperative to estimate and consider its fiscal costs when evaluating the policy's measure. Our estimations reveal that the NCP is not a burdensome proposal. In Colombia, the universal program has an annual cost of 0.32% of the GDP, while the scheme targeted to the poor cost 0.10% of GDP. Similarly, in Peru, implementing a universal program costs 0.45% of GDP, whilst the targeted program sums up 0.15% of GDP. According to the population projections and under conservative estimates of real GDP growth rate in both countries, these percentages can increase only slightly during the next 25 to 30 years.

As for the possible changes in the behaviour of individuals, we observe that a universal transfer can decrease importantly the probability of affiliation to the contributory pension system in both countries, although the effect is larger in Peru. In Colombia this program can reduce the probability of affiliation to contributory systems by about 5%, and in Peru this reduction is about 8% for men and 18% for women. In contrast, a targeted scheme reduces only slightly this probability, being the reduction less than 1% for both sexes in Colombia and less

than 2% for Peruvian men. Peruvian women still show a large impact on the probability of affiliation (10.5%). We also assess the impact of a transfer targeted to the extreme poor and detect very small reductions (less than 0.5%) in this probability for Peruvian men and both sexes in Colombia. The persistence of Peruvian women showing a large fall in the probability of affiliation under different transfer types is driven by differences in mortality, a higher prevalence of poverty and extreme poverty and less participation in the formal economy.

In summary, our results show that the implementation of the NCP in Colombia and Peru contributes to the reduction of poverty and inequality among the elderly, particularly in rural areas. In addition, this program has affordable fiscal costs, and we do not expect a large impact on the probability of affiliation of individuals when the program is targeted. The negative impacts on pension saving behaviour and fiscal costs are mostly advocated by detractors of social pension policies, but our results show only moderate effects on these issues.

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Appendix 1. Net pension wealth (NPW) computations

A. NPW For a person currently enrolled in the private system:

a. Staying in the private regime:

$$v_{x,priv}^{priv} = \pi_{x,priv} \tag{A1}$$

b. Moving to the public system:

$$v_{x,pub}^{priv} = (P_{pub}^{z-x} \times cru_z + CIC_x\beta^{z-x} + RB)\delta^{x-z} - a_{pub}\sum_{t=x}^{z}(e_t w_t)\delta^{x-t} \tag{A2}$$

c. Leaving the pension system:

$$v_{x,no}^{priv} = (CIC_x\beta^{z-x} + RB)\delta^{x-z} \tag{A3}$$

According to equation A1, an affiliated to the private system who decides to stay in the same system obtains a net pension wealth equivalent to equation 8. Equation A2 indicates the total value of pensions that she would obtain in the public regime if she decides to move there, plus the accrued balance in the individual account, minus costs (pension contributions). Equation A3 indicates that the individual stopped contributing, so that her pension wealth will be equal to her previous pension balance.

B. NPW For a person currently enrolled in the public system:

a. Moving to the private system:

$$v_{x,priv}^{pub} = \left[\left(P_{pub}^{x-h} \times cru_z\right) + a_{priv}\sum_{t=x}^{z}(e_t w_t)\beta^{z-t}\right]\delta^{x-z} - (a_{priv} + c)\sum_{t=x}^{z}(e_t w_t)\delta^{x-t} \tag{A4}$$

b. Staying in the public system:

$$v_{x,pub}^{pub} = \pi_{x,pub} \tag{A5}$$

c. Leaving the pension system:

$$v_{x,no}^{pub} = \left(P_{pub}^{x-h} \times cru_z\right)\delta^{x-z} \tag{A6}$$

Equation A4 indicates the total value of the pensions that an individual affiliated to the public system would obtain if she decides to move to private regime. The very first term of the right hand side indicates the potential pension wealth she will obtain from the public regime, only if she has enough years of contributions before moving to the private system. In Colombia, this first term corresponds to the recognition bond. The second term of equation A4 indicates the capital accumulation in the private system; and the last term is the cost of such accumulation. According to equation A5, if the person decides to stay in the public system, she will obtain a net pension wealth equal to that of equation 13. Equation A6 indicates that the affiliated stopped contributing, so that her pension wealth will be only the pension capital accrued before leaving the system. Note that if the affiliated has not enough contributions, she will not receive a pension and hence the pension capital will be zero.

C. NPW For a person currently out of the pension system:

a. Going to the private system:

$$v_{x,priv}^{no} = \left[a_{priv} \sum_{t=x}^{z}(e_t w_t)\beta^{z-t}\right]\delta^{x-z} - (a_{priv} + c) \sum_{t=x}^{z}(e_t w_t)\delta^{x-t} \quad \text{(A7)}$$

b. Going to the public system:

$$v_{x,pub}^{no} = (P_{pub}^{z-x} \times cru_z)\delta^{x-z} - a_{pub} \sum_{t=x}^{z}(e_t w_t)\delta^{x-t} \quad \text{(A8)}$$

c. Staying out of the system:

$$v_{x,no}^{no} = 0 \quad \text{(A9)}$$

Appendix 2. Heckman equation results

	Colombia		Perú	
	Hombres	Mujeres	Hombres	Mujeres
lhwage				
age	0.0272 **	0.044518 ***	0.0506 ***	0.0519 ***
age2	-0.0233 **	-0.043907 ***	-0.0548 ***	-0.0566 ***
edu0				
edu1	0.2772 ***	0.285334 ***	0.3347 ***	0.3597 ***
edu2	0.5085 ***	0.616812 ***	0.7814 ***	0.8150 ***
edu3	0.8911 ***	1.115057 ***	1.0971 ***	1.4067 ***
edu4	1.7794 ***	2.052601 ***	1.5554 ***	1.9055 ***
edu5	0.9637 ***	1.305639 ***	2.0855 ***	2.3246 ***
region1	-0.2382 ***	-0.401643 ***	-0.2332 ***	-0.3489 ***
region2	-0.0987 *	-0.209875 ***	-0.1507 ***	-0.2246 ***
region3	-0.1319 **	-0.323854 ***	0.0157	-0.1947 ***
region4	-0.3452 ***	-0.361824 ***	-0.6456 ***	-0.8511 ***
region5			-0.6100 ***	-0.6438 ***
region6	-0.0909 **	-0.144792 ***	-0.5657 ***	-0.5355 ***
region7	-0.0268	-0.158116 ***	-0.2857 ***	-0.2859 ***
region8	0.0807	0.183583 ***		
_cons	7.0145 ***	6.160858 ***	-0.2400	-0.8576 ***
s				
age	0.0804 ***	0.148215 ***	0.0612 ***	0.1149 ***
age2	-0.1054 ***	-0.178129 ***	-0.0710 ***	-0.1334 ***
edu0				
edu1	-0.0864 **	0.211579 ***	-0.0708	-0.1354 ***
edu2	-0.1492 ***	0.495814 ***	-0.2105 ***	-0.2346 ***
edu3	0.0417	0.846187 ***	-0.2357 ***	-0.1247 ***
edu4	-0.0989	1.324620 ***	-0.3648 ***	0.0036
edu5	-0.0560	1.122737 ***	-0.3439 ***	0.2175 **
region1	-0.0273	-0.398624 ***	0.1289 **	0.0950 **
region2	0.0801	-0.170957 ***	0.0638	-0.0040
region3	0.2163 ***	-0.305175 ***	0.0068	0.0416
region4	0.0800	-0.194475 ***	0.2841 ***	0.4076 ***
región 5			0.0856	0.2850 ***
region6	-0.2006 ***	-0.589394 ***	0.0510	0.3723 ***
region7	-0.0452	-0.310657 ***	0.1177 **	0.2544 ***
region8	0.2380 **	0.169321 **		
y_nolabor000	0.0000 ***	-0.000009 ***	-0.0205 ***	-0.0330 ***
casado	0.4093 ***	-0.658702 ***	0.2945 ***	-0.4706 ***
_cons	-0.3705	-2.477556 ***	0.2499	-1.3295 ***
Mills lambda	-0.60377	0.071120		
rho	-0.73028	0.084380		
sigma	0.826766	0.842867		

*** Sig. al 1%; ** Sig. al 5%; * Sig. al 10%