Mental Retirement and Non-Contributory Pensions for the Elderly Poor in Peru

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Abstract

This paper analyses the effects of retirement on cognitive abilities for the elderly poor on the basis of the "mental retirement" effect that accompanies retirement. Given the recent emergence and expansion of non-contributory pension programs to alleviate poverty in old-age across low and middle income countries, attention should be pay to the potential acceleration of cognitive decline when individuals retire, i.e. when there is a decrease in their engagement on cognitive demanding activities. We use a unique and recent survey of the poor elderly in Peru (ESBAM) which includes a cognitive test and serves as the baseline for a non-contributory pension program. We find a significant negative effect of retirement on cognitive ability after controlling for a number of demographics and objective health measures, and even after applying instrumental variables to deal with the potential endogeneity of retirement.

1 Introduction

Although cognitive abilities will certainly decline with age, the major event of labour retirement can accelerate this trend. This will occur because the individual is leaving a more cognitive challenging environment, as work is, to be in the generally less stimulating setting of retirement. This explains the "use it or lose it" hypothesis (Rowe and Kahn, 1998; Schooler et al., 1999) by which one must keep an "engaged life style" in order to lessen the decline of cognitive functioning. Otherwise, if an individual does not expend time on cognitive maintenance and repairing activities, we will observe a "mental retirement" effect (Rohwedder and Willis, 2010). Built on these ideas, a recent strand of the economic literature is looking more thoroughly at the causal effects of retirement on cognitive abilities (Börsch-

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Supan, 2013). For example, Rohwedder and Willis (2010), Mazzona and Peracchi (2012), Bingley and Martinello (2013) and Celioni et al. (2013) exploit country differences on retirement age legislation in the US and Europe as credible instruments to uncover a significant effect of retirement on cognitive functioning. All these studies are based on industrialized countries where social security coverage is extended and therefore retirement regulation can offer a convincing instrument.

The analysis of the "mental retirement" effect is more challenging in the case of less industrialized economies. Generally, in this setting, social security coverage rates are low, individuals tend to keep working at advanced ages or never retire, credit constraints are large and survey data including cognitive-skills questions are scarce. However, the recent emergence of non-contributory pension programs to alleviate poverty in old-age it is expected to induce a significant number of elderly into retirement. For example, Carvalho-Filho (2008) estimated that about 40 percent of recipients fully retired from labour market upon receiving a non-contributory pension in rural Brazil, with the rest of recipients drastically diminishing their working hours. In line with the literature on mental retirement, we consider that the implementation of non-contributory pension programs may accelerate the decline of cognitive abilities of the elderly if these individuals do not maintain an engaged life style after retirement. The introduction of non-contributory pensions is becoming very popular in Latin America. During the last 10 years, 12 countries have implemented such policy (see Table A1 in the appendix). Although transfer generosity, coverage and access requisites vary widely in the region, we are witnessing again a major shift in the strategy to deal with social protection and poverty in old-age[3].

Considering cognitive abilities as an indicator of accumulated human capital, with a certain depreciation rate, we might expect that, if individuals do not take enough measures for

[3] The structural pension reform of the 90's made pension systems financially sustainable with the implementation of individual capitalization accounts. However, the pension coverage rate remained low, with acute differences between rural and urban areas and among income groups (see Rofman and Oliveri, 2011).

cognitive maintenance or repairing (McFadden, 2008), non-contributory pensions induced retirement can accelerate this depreciation. This will eventually lead to a faster deterioration of human capital in later life. Elders with more cognitive impairments are less autonomous and can represent a major public health problem in the context of ageing societies. As reported by Bonsang et al. (2012), cognitive impairment or dementia is associated with lower quality of life, more disability and higher health expenditures. Moreover, the majority of non-contributory pension recipients live in poor rural areas so that it is important to maintain cognitive healthy elders as they play an important role in transmitting traditions, dialects, costumes and community memories.

In this paper we study the effects of retirement on cognitive functioning in a sample of poor Peruvian elders. Peru has recently implemented a non-contributory pension program and counts with a new household survey for old-age individuals (aged 65 to 80 years old) which includes questions on cognition. The Survey of Health and Wellbeing of the Elderly (ESBAM) is the baseline for *Pension 65*, the non-contributory pension scheme implemented at the end of 2011. Although this is a cross-section dataset, it contains a large number of retirees and working individuals at later ages, which allow us to observe cognitive differentials between working and non-working persons at later life. This offers something different from what have been done in industrialized countries where cognitive functioning is hardly observable in working individuals at advanced ages because early and normal retirement occurs mostly at legal ages (mainly between 55 and 65).

In our empirical strategy we first use OLS estimation to measure the relationship of retirement and cognition. In measuring this relation we depart from previous related literature by controlling the influence of different confounders on cognitive ability, such as schooling, sex, age, urbanity, ethnic group, local fixed effects and objective health indicators. This allows us to reduce the potential bias due to omitted variable. Specifically, we use arm-span, which is a better measure than height in old-age population to proxy the nutritional status acquired in childhood, that positively affects cognitive ability development (Case and Paxon, 2008; Guven and Lee, 2013a and 2013b). Thus, our paper follows the large body of recent research documenting the importance of accounting for parental inputs (proxied by arm-spam in this paper) and schooling at early ages in the formation of cognitive skills (Todd and Wolpin, 2003; Cunha et al., 2006 and 2010; Cunha and Heckman, 2007 and 2008).

Moreover, to account for current nutritional status, we use individual altitude-corrected measure of haemoglobin as there is evidence that poor nutritional status is associated to an increase in the risk of dementia (Hyung Hong et al., 2013). Diagnosed chronic illnesses related to mental disorders are also controlled for. Our OLS estimation with full controls shows that retirement is associated to lower cognitive functioning (about 0.15 standard deviations of our cognitive score), relatively to those who continue working.

However, to deal with the potential endogeneity (reverse causality) of retirement and cognitive skills we also estimate an IV model. As an instrument for retirement, we use the reported degree of disability in body extremities (arms, hands, legs and feet). Given that individuals in the sample live in poverty, and mostly in rural areas, their work is presumably intensive in physical activities and is performed as long as physical health permits it. Hence, we argue that having a higher degree of extremities disability is positively correlated with retirement and, after controlling for other observable characteristics, should not directly affect cognitive abilities. The IV estimates show a significantly large negative effect of retirement on cognition (0.83 standard deviations) relatively to working adults. This suggests that not accounting for the endogeneity of retirement, as in the OLS estimates, lead to upward biased estimates. We do not observe important changes in our results after applying some robustness checks.

The rest of the paper is organized as following. Section 2 discusses the relation between non-contributory pensions and cognitive functioning. Section 3 presents the dataset and the variables considered in the empirical analysis. Section 4 discusses the empirical strategy. Section 5 reports the results and performs some robustness checks. Finally, section 6 concludes.

2 Non-contributory pensions and cognitive functioning

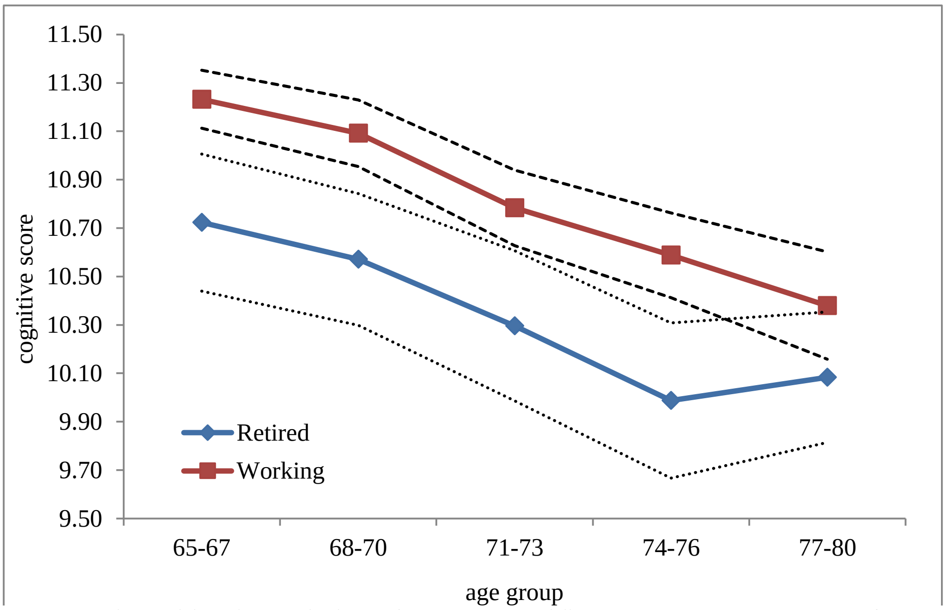
There is a great deal of differences among the new non-contributory pension schemes implemented in Latin America, but is common to observe that the recipients are mostly elderly living in poverty and rural areas who were unable to save in the contributory pension scheme. Among the possible causes of why these individuals did not make savings for old-age is that they worked mainly in informal and/or agricultural activities where no contributions are enforced, and their incomes were close to subsistence levels. One of the goals of non-contributory pensions is allow old-age individuals to finally retire from labour with a secure stream of income instead of keep working until very advanced ages or the entire life. This “Ceaseless Toil” pattern, as noted by Davis-Friedmann (1991) and analysed in Benjamin et al. (2003) to account for labour supply of the elderly in rural China, is commonly observable in less developed countries with low pension coverage.

The introduction of a non-contributory pension program can induce a massive retirement and provoke a faster reduction in the cognitive stock of old-age individuals. For instance, evidence from a non-contributory pensions program in rural Brazil suggests that about 40 percent of recipients fully retired from labour market upon receiving the transfer, with the rest of recipients drastically diminishing their working hours (Carvalho-Filho, 2008). The effect of retirement on cognitive skills can be particularly important in the rural area.

Firstly, there are more pension recipients in rural areas because of the higher poverty incidence. Secondly, the education attainment of rural elders is lower, so that any effect of retirement in cognitive functioning would start at an already relatively low level of cognition. Moreover, it is important to keep cognitive healthy elders as they are essential in transmitting traditions, dialects, costumes and community memory. In Latin American countries severely hit by political violence (e.g. Guatemala, El Salvador, Colombia and Peru) the old-age members of rural communities are the ones who have helped in accounting events, casualties and location of victims. Even in censuses and other official visits, they indicate the family composition and other household variables because prime-age members are frequently working in distant places. Furthermore, having a good cognitive functioning is important for making better financial decisions and can lessen public expenses in health for the elderly (Lei et al., 2012; Bonsang et al., 2012).

In our sample of Peruvian elderly poor we are able to observe significant differences in our measure of cognitive ability (which is explained in detail in the next section) between working and retired individuals of similar age (see figure 1). The cognitive score is always lower –at 95 percent of confidence- for retired individuals of similar age, except for the oldest group where the difference is not significant (t=-1.56). Moreover, this figure depicts the well-known declining trend in cognitive abilities with aging. Contrary to other studies focused in developed countries, we are able to observe cognitive functioning for older working individual and compare to that of retired. Overall, 70 percent of individuals of our sample (65 to 80 years) are working, while that this activity rate is 55 percent for the oldest group aged 77-80.

Figure 1. Cognitive score by age and retirement



Source: Authors' elaboration on the base of ESBAM. Dotted lines correspond to 95 percent confidence interval.

3 Data

3.1 The Survey of Health and Wellbeing of the Elderly

The Survey of Health and Wellbeing of the Elderly (ESBAM) is a unique and recent survey collected by the National Institute of Statistics of Peru (INEI) in 2012. It includes a detailed questionnaire for the 65-80 years old persons, which collects information about their socio-economic conditions, subjective wellbeing, expectations, beliefs and several subjective and objective health related questions. Furthermore, ESBAM includes socio-economic questions at the household level and for each household member. Detailed questions on expenses and income are also recorded. All information is collected face-to-face by interviewers, while data on anthropological measures, arterial pressure and blood samples are collected by technicians specialized in collecting these measures. The goal of this dataset is serving as the baseline for the evaluation of *Pension 65*, which is a recently implemented non-contributory pension program administrated by the Ministry of Development and Social

Inclusion of Peru (MIDIS). The cash transfers of this program are targeted to individuals aged 65+ who do not receive a contributory pension and live in extreme poverty.

The data was gathered between November and December 2012 in twelve departments (half of the total in Peru) where MIDIS had already completed the census of socio-economic variables intended to update its targeting score system SISFOH[4]. The SISFOH's threshold scores serve to classify a household as extreme poor, non-extreme poor or non-poor, and vary geographically. The population to study in ESBAM are the individuals aged between 65 and 80 years who live in particular households -both in urban and rural areas- classified as poor, according to SISFOH. The sampling selection is probabilistic, independent in each department, stratified in rural/urban areas and carried out in two steps. In the first step the Primary Sampling Units (PSU) are census units in urban areas and villages in rural areas with at least 4 households living in poverty and with elderly members. The selection of PSU is made by Probability Proportional to Size (PPS) according to the total number of households. In the second step, 4 households are randomly drawn from each PSU for interview and 2 for replacements. After dropping 65 individuals that did not answer themselves the questionnaire for the elderly (persons with severe impairments like blindness and deafness), the final sample size is composed by 4,151 individuals aged between 65 and 80 years in 3,196 households (see Table 1). Due to missing information in relevant variables, the final sample considered in the regressions corresponds to 4,067 individuals.

Table 1. Sample composition in ESBAM

Age group	Rural	Urban	Total
65-67	670	411	1081
68-70	582	363	945
71-73	490	332	822
74-76	426	246	672

[4] Each household must receive a score that is constructed on the base of an algorithm (carried out with principal component analysis) that uses variables such as material conditions of household, assets, incomes, education level, household size, occupation, etc.

77-80	384	247	631
Total	2552	1599	4151

Source: Authors' elaboration on the base of ESBAM.

3.2 The cognitive score

ESBAM uses a reduced version of the mini–mental state examination (MMSE) (Folstein et al., 1975) to evaluate cognitive functioning of the elderly, which is similar to the adapted version used in the Survey on Health and Well-being of Elders (SABE) implemented during the early 2000's in seven capital cities of Latin America and the Caribbean. Taking into account the low literacy rates among Latin American elders, the reason for this adaptation was to minimize the strong bias produced by education on performing the test (Fillenbaum et al., 1988; Herzog et al., 1997).

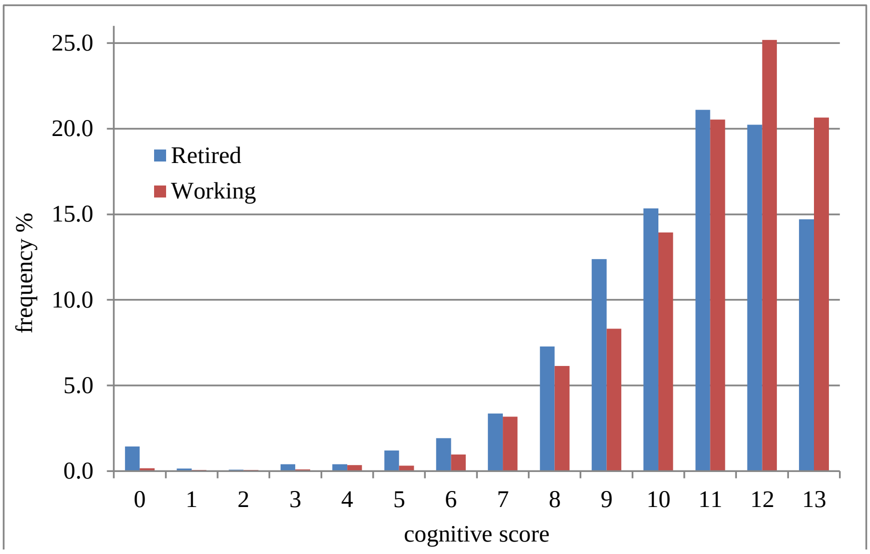
Table 2. Distribution of cognitive score by question

Question type	Points on correct answers (%)						Mean score
	0	1	2	3	4	total	
Orientation	2.7	7.6	17.0	30.0	42.7	100.0	3.02
Word memory immediate recall	1.1	1.7	13.9	83.3	-	100.0	2.79
Command following	0.9	3.7	21.5	73.9	-	100.0	2.68
Word memory delayed recall	7.2	10.7	33.9	48.3	-	100.0	2.23
Total							10.73

Source: Authors' elaboration on the base of ESBAM.

Our score of cognitive functioning is computed with four questions dealing with different aspects of cognitive functioning. The first question is about orientation and asks about the day of the month, month, year and day of week. Each correct answer receives one point. The second question is about memory; three words are mentioned and the respondent has to repeat these immediately after in any order. These words are asked later again (forth question) in order to measure delayed recall. A point is given for each word correctly answered. The third question is a command of the following three actions that the respondent has to follow orderly: “I will give a piece of paper. Take this with your right hand, bend in half with both hands and place on your legs”. Each correct action will receive one point. Our cognitive score is the result of summing up the points on these four each questions[5]. Table 2 reports the distribution of points for each type of question.

Figure 2. Cognitive score and retirement



Source: Authors’ elaboration on the base of ESBAM.

Our cognitive score ranges from 0 to 13 points (see figure 2). The average score is 10.74 with a standard deviation of 2.05. This score is 10.91 for working individuals and 10.34 for non-working individuals, being the difference between these statistically significant (t = -8.25). As shown in figure 1, the cognitive score captures the deterioration of cognitive functioning across age. For the total sample, cognitive score for men is statistically significant larger than that of women (t=-11.18), which also holds among the group of working individuals (t =-10.18). This is also the case among the group of retired, though the significance is much lower (t=-1.68).

[5] In the questionnaire there is question where the respondent must replicate a drawing of two circles intersected; and a point is given if the circles don’t cross more than half. We didn’t include this question in making the cognitive score because there are 125 respondents who refused to answer this.

The cognition questions in ESBAM and our aggregate cognitive score keep some similarities with those employed by Lei et al. (2012, 2013) with the China Health and Retirement Longitudinal Study (CHARLS). They form an index of *episodic memory* by averaging the scores of immediate and delayed recall from a list of 10 words. Their second measure of *mental intactness* (ranges from 0 to 11) includes the following items: a serial 7 subtractions from 100 (up to five times), a variable indicating whether the respondent needed any explanation or aid, orientation questions (month, day, year, day of the week and season) and ability to replicate a picture. Although our cognitive scores are not directly comparable with CHARLS because of different sample selection and questions, they are closely related. For example, after normalizing the mental intactness from 0 to 1 in Lei et al. (2013), we observe that this is 0.71 for the Chinese aged 65-74, while this is 0.77 in our orientation measure in the same age group. However, when computing this measure for 16 European countries from the fourth wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) we find that orientation is much higher, being in average 0.93 and ranging from 0.89 in Poland to 1.00 in Denmark.

3.3 The retirement variable

The retirement status is a key variable in our analysis. Following Mazzona and Peracchi (2012), Rohwedder and Willis (2010) and Bonsang et al. (2012) we consider individuals working for a pay in the labour market in contrast to retired individuals (non-working). Consequently, we treat both retirees and unemployed as retired. In our sample, 69.7 percent of respondents are working, 28.9 percent are retired and only 1.4 percent are unemployed. The questions about retirement and employment status in ESBAM follow conventional questions in household surveys to detect if the individual is actively seeking for a job or intends to come back to a previous post.

4 Empirical Strategy

4.1 Identification issues

In measuring the effect of retirement on cognitive functioning in developed countries, other studies deal with the potential endogeneity (reverse causality) of retirement by using instrumental variables. For example, the argument exposed in Rohwedder and Willis (2010) is that individuals who have suffered of more cognitive decline will self-select into retirement earlier than individuals who have not experienced this deterioration, and hence one will find a high correlation between cognition and retirement. Then, by exploiting country differences in age eligibility, retirement is instrumentalized with the difference between actual age and legal ages of retirement (normal and early). Studies using this strategy for US and Europe are Rohwedder and Willis (2010), Mazzona and Peracchi (2012), Bingley and Martinello (2013) and Celidoni et al. (2013). Bonsang et al. (2012) use variation in legal age for early and normal retirement as instrumental variables for an US panel dataset.

However, in a country like Peru, social security covers only a small fraction of the labour force because of the large informal labour market. About 25 percent of the total 65+ population receive a pension from social security, being this figure only 6 percent and 1 percent for the elderly poor and extreme poor. As mentioned in section 2, there is a high rate of labour activity among the elderly poor (about 70 percent) who also are less educated and work mostly in occupations where high cognitive skills are less demanded. Therefore, the use of retirement legislation as instrumental variables does not fit into our framework.

Although the endogeneity of retirement is less evident in our study, we attempt to deal with it by using the degree of disability in body extremities as our instrumental variable. As suggested by Carvalho-Filho (2008) the most common strategy of rural elderly with low lifetime income in developing countries is working until physical health permits it. Thus, severe disability in body extremities (arms, hands, legs and feet) is expected to be related with retirement but not directly with cognition performance. In ESBAM the respondent indicates whether she suffers of any difficulty from a list of five types of disabilities and report their severity, ranging from none=0, light=1, moderate=2 and severe=3[6]. One might argue that the same root causes of the physical disabilities might have caused cognitive disabilities (e.g. poor health and nutrition at early ages). However, we do not find evidence that the long-term indicator of nutritional status (arm-spam) varies along the different levels of disability in body extremities[7].

It is worth to note that the validity age retirement eligibility as an instrument has been recently contested due to the no inclusion of schooling in controlling the effects of retirement on cognitive scores (Bingley and Martinello, 2013). It is argued that schooling and cognitive performance are highly correlated, and simultaneously schooling has an effect on the age of retirement selected by the individual. Once Bingley and Martinello (2013) include schooling in the cognitive equation of Rohwedder and Willis (2010), they still find a significant effect of retirement on cognitive score, but the size of the effect is reduced. Furthermore, Bonsang et al. (2012) acknowledges the limitations of cross-country variation in age eligibility to instrument retirement because of the existences of institutional and cultural differences among countries beyond retirement schemes differences (for example, eligibility age tend to be higher in Northern than in Southern Europe). The authors argue that being unable to account for these differences can invalidate the exclusion restrictions and hence overestimate the effects of retirement in cognition.

[6] The simple average of these scales is 0.22 and 0.11 for the groups of retired and working individuals, respectively.

[7] The arm-spam of those with no-disability is 156.15 cm.; for those with light disability is 155.57 cm.; for those with moderate disability is 157.19 cm.; and, for those with severe disability is 156.38 cm. None of the mean differences are statistically significant at usual levels (99, 95 and 90 percent).

In contrast to other studies in developed countries we are able to observe cognitive functioning of individuals working at more advanced ages. However, we cannot control for individual heterogeneity as panel data is not available. Nevertheless, in measuring the effect of retirement on cognition we depart from previous related literature by controlling the influence of different confounders, such as schooling, sex, age, urbanity, ethnic group, local fixed effects and health indicators. This allows us to reduce the potential omitted variables bias in the measurement of cognitive scores. In our empirical strategy we first use OLS estimation to measure the effect of retirement on cognition with the following equation:

$$c_i = \alpha_0 + \alpha_1 r_i + x'_i \beta + u_i \tag{1}$$

Where c corresponds to the standardized cognitive score; r is a dummy variable for whether the individual is retired or not; x' is a regressor vector of exogenous variables; and, u_i is the regression error, which in the OLS model is assumed to be uncorrelated with r and x'.

Given the potential reverse causality between the decision of retirement and cognition or their potential correlation with unobservable variables contained in u_i, we consider an IV approach to solve the potential problem of endogeneity of the retirement decision. In contrast to equation 1, r is now considered as an endogenous variable, which satisfies the following reduced-form model:

$$r_i = x'_i \gamma + \delta z_i + v_i \tag{2}$$

Where the exogenous regressors in vector x' are instruments for themselves; z_i is an instrumental variable that is expected to satisfy the assumption that $E(u_i|z_i) = 0$ and to be correlated with r_i.

4.2 Control variables

We include a set of conventional control variables: age, sex, urban/rural residence, ethnic group and schooling. In addition we include district level fixed effects to capture unobservable characteristics at local level, such as labour market conditions, community deprivation of health and basic services, healthy environments, among others. Finally, we include objective health indicators collected in ESBAM that are expected to affect cognitive skills: haemoglobin, arm-span (proxy of parental inputs at early ages) and chronic diseases related to mental health.

Haemoglobin is measured from extracted respondents' blood samples and corrected by altitude by the National Institute of Statistics. We use this variable in order to consider the effect of anaemia, which has been linked to an increase in the risk of dementia through low oxygen levels affecting brain connections and hence reducing memory and thinking abilities and damaging neurons (Hyung Hong et al., 2013). According to WHO norms, haemoglobin levels should be roughly between 12 g/dL to 16g/dL. In our sample, the mean of haemoglobin is 13.1; 23.9 percent of respondents have less than 12 g/dL, and 4.6 percent has more than 16 g/dL[8]. The inclusion of this variable is aimed at measuring the effect of current nutritional status.

Moreover, it is recognized that cognition performance in later age is positively related with nutrition quality acquired in childhood. Case and Paxon (2008) find a strong correlation between height at early life (<3 years) and adulthood, so that this last variable can indicate the nutrition and health experienced at early life. In addition to these authors, Guven and Lee (2013a, 2013b) and Lei et al. (2012 and 2013) also use respondent's height to find that better nutrition in childhood is positively associated with cognitive ability development. Height is not measured in ESBAM because of the well-known limitations of taking this measure in old-

[8] Aanemia can affect an important number of elderly because old-age is associated with diet monotony, less intestinal mobility and intake of energy.

age population (height shrinking, difficulty to stand straight, etc.). Instead, we use arm-span which is considered a better measure in old-age individuals and is highly correlated with height (Kwok and Whitelaw, 1991; Kwok et al., 2002; De Lucia et al., 2002). The evidence for Latin America shows a significant relation between height and cognitive functioning at old-age (e.g. Yount el al., 2009, for Guatemala; and, Maurer, 2010, for 7 capital cities using the SABE data).

We also control for some chronic diseases that might affect cognition status irrespective of retirement. For example, it has been found in longitudinal studies that depression exacerbates the risk of cognitive decline among the elderly (Chodosh et al., 2007; Dotson et al., 2008). We will use a dummy variable indicating if the respondent reported having any of the following diseases diagnosed by a doctor: depression, cerebral haemorrhage and nervous system disorders, Alzheimer or memory loss. One fifth of our sample of interest reported having at least one of these disorders.

Schooling is also expected to affect cognition performance at old-age. For instance, Glymour et al. (2008) report that there is a significant and positive effect of education on memory among the elderly, but this effect is not significant on mental status (serial 7-substractions). A recent study by Banks and Mazzonna (2012) -based on a regression discontinuity design- supports the hypothesis that an increase in compulsory education affected old-age cognitive abilities in England. In our sample, almost one third of the elderly are illiterate (29.9 percent) and 80 percent have not even completed primary school. Given this, we consider that an indicator for whether an individual is able to read and write is more relevant to explain cognitive skills. Concerning ethnic group, we use a dummy variable indicating if the respondent's mother tongue is indigenous, otherwise is Spanish.

Table 3 shows the unconditional mean values of the main variable considered in the empirical analysis for working and retired individuals. The mean of the value of the aggregate score and the value of its components is lower for retired than for working individuals. Retired individuals are more likely to be female, older, indigenous, illiterate, have poorer health (arm-span, haemoglobin, mental disorders and disabilities), and live in urban areas than working individuals.

Table 3. Differences between working and retired individuals

Variable	Working	Retired	Diff.[a]
Cognitive score	10.908	10.342	***
Orientation	3.150	2.732	***
Word memory immediate recall	2.818	2.750	***
Command	2.679	2.695	
Word memory delayed recall	2.262	2.165	***
Male	0.650	0.300	***
Age	70.713	72.307	***
Mother tongue is indigenous	0.341	0.222	***
Illiterate	0.247	0.420	***
Arm span (cm.)	157.737	152.485	***
Haemoglobin	13.144	12.720	***
Mental disorders	0.177	0.260	***
Urban	0.324	0.527	***
Disability in body extremities	0.076	0.123	***

Note: [a].T-test of mean differences between working and retired individuals. * p<0.1 ** p<0.05 *** p<0.01.

5 Results

This section firstly describes the results of the OLS model presented above, where retirement is considered as exogenous, and then we test the exogeneity of retirement and present the results of the IV estimation.

5.1 Main results

Table 4 shows the OLS estimations of our cognitive score (standardized)[9], considering the retirement dummy as exogenous. In addition to the set of covariates included in the first column, the second column includes district-level fixed effects to account for unobservable characteristics at district level.

[9] Guven and Lee (2013b) use a summary measure of cognition by averaging four dimensions of cognitive functioning which were previously standardized to have a mean zero and standard deviation of one.

Table 4: OLS estimation of the cognitive z-score

	(1)	(2)
Retired	-0.133***	-0.154***
	(0.035)	(0.036)
Male	-0.074*	-0.101**
	(0.043)	(0.045)
Age	-0.032***	-0.031***
	(0.003)	(0.003)
Mother tongue is indigenous	-0.364***	0.026
	(0.031)	(0.073)
Illiterate	-0.615***	-0.631***
	(0.037)	(0.039)
Arm span	0.006***	0.007***
	(0.002)	(0.002)
Haemoglobin	0.023***	0.024***
	(0.008)	(0.009)
Mental disorders	-0.165***	-0.208***
	(0.039)	(0.043)
Urban	0.128***	0.145**
	(0.028)	(0.070)
District-level fixed effects	No	Yes
Observations	4067	4067
R-squared	0.19	0.32

Note: Robust standard errors in parentheses. * p<0.1 ** p<0.05 *** p<0.01.

As expected, the model in column 1 shows that, our main variable of interest, the retirement dummy, is negatively associated with the cognitive score. Retired individuals show a cognitive score that is 0.13 standard deviations below the one for working individuals. In addition, being male, indigenous, and illiterate and having a mental related illness is negatively related to the cognitive score. As expected, there is also evidence of a deterioration of cognitive abilities with age[10]. In contrast, the short and long-term indicators of health, and living in urban areas are positively related to the cognitive score.

[10] We also try introducing age in quadratic form, and although the other coefficients and their significance did not change, age became no significant. This is, perhaps, because the range of ages in our sample (65 to 80) is not large enough in comparison to other studies that find a significant coefficient for polynomials of age. For instance, Bonsang et al. (2012) use individuals aged 50+ and Lei et al. (2013) use individuals aged 45+.

Once controlling for district fixed effects in the second column, the most relevant difference is that the indigenous variable is no longer statistically significant. This shows the concentration of indigenous population in certain, more deprived, geographical areas and the importance to account for unobservables at community level. Furthermore, the coefficient of retirement on cognitive score slightly increases from -0.13 to -0.15 standard deviations. It is also interesting to highlight that, after introducing our set of controls, being a male is associated with less cognitive functioning, which contrasts with our unconditional cognitive means by gender. Guven and Lee (2013b) find similar evidence among a sample of old Europeans. With the exception of a numeracy score, being male is negatively associated with different measures of cognition (verbal fluency, immediate and delayed recall and a summary cognitive score). A similar result holds for old male in China when a measure of memory is considered (Lei et al. 2013). However, males perform better than females when the measure of cognition is *mental intactness* (which includes a measure for orientation).

As discussed in section 4, retirement is likely to be correlated with individual unobservable characteristics that also affect cognition, or both variables can suffer of reserve causality. To deal with the potential endogeneity of retirement, we use an instrumental variable approach, where retirement is instrumentalized with the degree of disability in body extremities (arms, hands, legs and feet). The estimates in Table 5 correspond to the IV estimation of the cognitive z-score on the set of covariates included in the last model in Table 4.

Table 5: IV estimation of the cognitive z-score

Second stage: cognitive z-score	(3)
Retired	-0.833**
	(0.394)
Male	-0.278**
	(0.116)
Age	-0.018**
	(0.008)
Mother tongue is indigenous	0.003
	(0.072)
Illiterate	-0.606***
	(0.040)
Arm span	0.007***
	(0.002)
Haemoglobin	0.025***
	(0.009)
Mental disorders	-0.151***
	(0.050)
Urban	0.216***
	(0.077)
First stage: IV	
Degree of disability in body extremities	0.092***
	(0.015)
F-test: retired	36.209
Durbin-Wu-Hausman test	2.837*
District-level fixed effects	Yes
Observations	4067
R-squared	0.24

Note: Robust standard errors in parentheses. * p<0.1 ** p<0.05 *** p<0.01.

The Durbin-Wu-Hausman test at the bottom of Table 5 confirms the endogeneity of retirement. In addition to the F statistic (36.2), which is considerably larger than the rule of thumb of 10, several other diagnostic statistics help us to argue the relevance of our instrument[11]. As expected, we find that a higher degree of disability in body extremities increases the probability of retirement and the coefficient is highly statistically significant.

The top of panel of Table 5 shows the IV regression of retirement and the exogenous regressors on cognitive z-scores. With our IV strategy we obtain a larger effect on cognition

[11] The R^2 and $adjusted - R^2$ from the first-stage regression are 0.32 and 0.23, respectively, which suggest that there is no need for caution of having a weak instrument. The partial R^2 of retirement and the degree of disability in body extremities, after controlling for the set of exogenous variables, is 0.0114, which is quite low but the F statistic, as mentioned above, is considerably larger than the rule of thumb of 10.

of about -0.83 standard deviations. This result suggests a substantial upward bias in the OLS results of Table 4, where retirement was treated as exogenous. This bias is likely to be related to the fact that the OLS estimator combines the desired direct effect of retirement on cognitive skills with the indirect effect that people with poorer cognitive skills are more likely to be retired.

In comparing the size of our IV retirement effect with other studies using a similar empirical strategy, we observe some similarities, although this comparison must be done with caution because of some differences regarding the cognitive score computation. For instance, Rohwedder and Willis (2010) estimate that the effect of retirement on cognitive score corresponds to 1.5 standard deviations. Furthermore, we infer from Bingley and Martinello’s (2013) results for a sample of US and European old individuals that this effect is about 1.7 standard deviations when no controlling by schooling, but this drops to 0.9 standard deviations when schooling is included, which is closer to our model. These authors also find a negative effect for males on cognition, being the size of the coefficient on males about 49 percent with respect to the one of retirement; while that in our case this figure is about 56 percent.

5.2 Robustness checks

This section explores whether our previous estimates are sensible to how we constructed the cognitive score. Then, we check whether considering our instrumental variable -the degree of disability in body extremities- as a dummy variable affects our estimates.

We estimate the z-scores of each of the four components of our cognitive score: orientation, word memory immediate recall, command and word memory delayed recall, on the same set of covariates included in Table 5. Each column of Table 6 corresponds to each of he mentioned component of cognition. The top part of the table shows the results of the OLS regressions and the bottom part the IV estimates. Given that in all the specifications in Table 6 the retirement indicator is instrumentalized by the degree of disability in body extremities, the first stage is the same across columns. Table 6 shows only the coefficient on retirement since it is our main variable of interest.[12]

Table 6: Robustness check – Different definitions of cognitive score

	Orientation	Word memory immediate recall	Command	Word memory delayed recall
Retired (OLS)	-0.132***	-0.093**	-0.060*	-0.103***
	(0.037)	(0.041)	(0.036)	(0.040)
Retired (IV)	-0.788**	-0.612	-0.933**	-0.010
	(0.348)	(0.452)	(0.444)	(0.361)
First stage: IV				
Degree of disability in body extremities	0.092***			
	(0.015)			
F-test: retired	36.209			
Durbin-Wu-Hausman test	3.405*	1.253	3.942**	0.061
District-level fixed effects	Yes	Yes	Yes	Yes
Observations	4067	4067	4067	4067

Note: Robust standard errors in parentheses. * p<0.1 ** p<0.05 *** p<0.01.

A first sight of the OLS regressions shows that the effect of retirement on orientation is very similar in magnitude to the one on our original score. In all the specifications the effect of retirement shows the expected negative sign, being the effect on command the lowest one (-0.06 standard deviations). Regarding the IV estimates, we observe that the effect of retirement on orientation and command is rather similar to our original cognitive score. A main difference is that in the case of the two memory components, retirement does not seem to be endogenous, and then the OLS estimate would be unbiased. In sum, the results of Table 6 suggest that our estimates are not sensible to the construction of the cognitive score measurement.

[12] The complete tables are available upon request.

Table 7: IV as a dummy variable

Second stage: cognitive z-score	(4)
Retired	-1.031**
	(0.477)
Male	-0.330**
	(0.136)
Age	-0.014
	(0.010)
Mother tongue is indigenous	-0.003
	(0.075)
Illiterate	-0.599***
	(0.042)
Arm span	0.007***
	(0.002)
Haemoglobin	0.025***
	(0.009)
Mental disorders	-0.134**
	(0.056)
Urban	0.236***
	(0.083)
First stage: IV	
Degree of disability in body extremities	0.131***
	(0.027)
F-test: retired	24.448
Durbin-Wu-Hausman test	3.410*
District-level fixed effects	Yes
Observations	4067
R-squared	0.20

Note: Robust standard errors in parentheses. * p<0.1 ** p<0.05 *** p<0.01.

As mentioned before, our instrumental variable, the degree of disability in body extremities, takes four values (from 0-no disability to 3-severe) and it was considered as a continuous variables in the previous IV estimations. To check whether our estimates are sensible to this assumption, we consider our instrumental variable as a dummy variable, which takes the value 0 when the individual has no disability and 1 when the individual has at least some degree of disability. Table 7 reports that the effect of retirement on cognitive score is negative and somewhat larger in magnitude than the one in Table 5 (-1.03 versus -0.83

standard deviations). All the other coefficients and their significance practically do not change, except for the coefficient of age that loses its significance (*p-value=0.15*).

6 Discussion

In this paper we have shown that retirement has an impact on the cognitive functioning of the elderly poor on the basis of an IV strategy. This effect is sizeable and robust to the inclusion of a number of other factors associated to cognition. The richness of the survey data (ESBAM) employed in this study allows us to use objective measures of health that affect cognitive functioning, jointly with cognitive tests and other standard demographic variables, which are rarely available in developing countries. There is an emerging economic literature on the effects of retirement on cognitive abilities, but this is mainly based in developed economies. In this way, our study contributes to this literature by focussing on a developing country, which presents a completely different setting: low social security coverage rates, very long or never-ending working lives, credit constraints, etc.

Moreover, our study can be useful for policy-making to assess what potential negative effects can bring the recent emergence of non-contributory pension programs in Latin America and other low and middle-income countries. These programs can induce a significant number of elderly into retirement and hence accelerate the decline of their cognitive abilities if these individuals do not maintain an engaged life style after retirement. As a consequence, this might create an important public health problem in the context of ageing societies. Cognitive impairment or dementia is associated with lower quality of life, more disability and higher health expenditures. Furthermore, it is important to maintain cognitive healthy elders as they play an important role in transmitting traditions, dialects, costumes and community memories.

Perhaps, a way to lessen the potential effect of sudden retirement on cognitive is not only providing non-contributory pensions to the elderly poor, but also other attached components aimed at maintaining their cognitive functioning or at least retarding its decline. It might be the case that these new non-contributory pension schemes for the elderly should learn from the conditional cash transfers that tie the transfer to the accomplishment of some compulsory fulfilments to assure the wellbeing of the children.

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Appendix

Table A1. Non-contributory pension programs in Latin America

Country	Name of scheme	Year's creation	Benefit (percent GDP p. c.)	Age	Targeting	Number of recipients	percent Pop 60+ covered	Cost (percent GDP)
Argentina	*Pensiones Asistenciales*	1,994	14.4	70	Means-tested	75,229	1.3	0.23
Bolivia	*Renta Dignidad*	2,008	1.6	60	Universal	788,969	103.3	1.06
Brazil	*Previdencia Rural*	1,991	32.6	60 (m) / 55 (f)	Means-tested and for rural area	5,851,554	28.3	1.50
Brazil	*Beneficio de Prestacao Continuada*	n.d.	32.6	65	Means-tested	1,700,000	n.d.	0.30
Chile	*Pension Basica Solidaria de Vejez*	2,008	13.6	65	Means-tested	403,144	16.7	0.90
Colombia	*Programa Colombia Mayor*	2,003	5.1	57 (m) / 52 (f)	Means-tested, Regional	214,480	6.4	0.02
Costa Rica	*Programa Regimen No Contributivo*	1,974	20.2	65	Means-tested	83,438	19.7	0.18
Ecuador	*Pension para Adultos Mayores*	2,003	11.8	65	Means-tested	583,817	39.2	0.31
El Salvador	*Pension Basica Universal*	2,009	16.9	70	Means-tested	13,600	2.3	0.04
Guatemala	*Programa de aporte economico del Adulto Mayor*	2,005	19.5	65	Means-tested	103,125	11.2	n.d.
Honduras	*Bono para la Tercera Edad*	2,011	1.3	65	Means-tested	66,667	8.5	0.01
Mexico	*65 y mas*	2,007	0.4	65	Pensions-tested	2,200,000	22.4	0.11
Mexico	*Pension Alimentaria Ciudadana*	2,003	8.5	68	In Mexico City (Universal)	2,000,000	20.4	0.04
Mexico	*Amanecer*	2,007	5.2	64	In Chiapas State (Universal)	238,000	2.4	n.d.
Panama	*100 a los 70*	2,009	14.1	70	Pensions-tested	86,392	22.5	n.d.
Peru	*Pension 65*	2,011	9.3	65	Means-tested	247,673	9.1	0.19
Paraguay	*Pension alimentaria*	2,009	30.7	65	Means-tested	31,454	5.9	0.00
Uruguay	*Programa de Pensiones No-Contributivas*	1,995	27.8	70	Means-tested	31,577	5.1	0.62
Venezuela	*Gran Mision Amor Mayor*	2,011	40.8	60 (m) / 55 (f)	Means-tested	675,000	24.6	0.02

Source: Author's adaptation from http://www.pension-watch.net; World Bank Development Indicators and Government sites for Honduras and Peru figures.