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Mental retirement and non-contributory pensions for the elderly poor in Peru

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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 given to the potential acceleration of cognitive decline when individuals retire, i.e. when there is a decrease in their engagement of cognitive demanding activities. We use a unique and recent survey of the elderly poor 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 dealing with the potential endogeneity of retirement.

Keywords: cognitive abilities, old-age poverty, retirement, non-contributory pensions, Peru
JEL Classification: H55, J14, J24, J26

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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 a generally less stimulating setting of retirement. This explains the “use it or lose it” hypothesis (Rowe and Kahn, 1998; Schooler, Mulatu and Oates, 1999) in which one must keep an “engaged life style” in order to lessen the decline of cognitive functioning. Therefore, if individuals do not expend time on cognitive maintenance and repairing activities, we will observe a “mental retirement” effect (Rohwedder and Willis, 2010). On the basis of these ideas, a recent strand of the economic literature examines more thoroughly the causal effects of retirement on cognitive abilities (Börsch-Supan, 2013). For example, Rohwedder and Willis (2010), Mazzona and Peracchi (2012), Bingley and Martinello (2013) and Celidoni, Dal Bianco and Weber (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, it is expected that the recent emergence of non-contributory pension programs aimed at alleviating poverty in old-age will induce a significant number of elderly into retirement. For example, De Carvalho-Filho (2008) estimated that about 40 percent of recipients fully retired upon receiving a non-contributory pension in rural Brazil, with the rest of recipients drastically reducing 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 policies (see Table A1 in the Appendix). Although transfer generosity, coverage and access requisites vary widely in the region, we are again witnessing a major shift in the strategy to deal with social protection and poverty in old-age[1].

Cognitive abilities are an indicator of accumulated human capital that depreciates. Therefore, the retirement induced by non-contributory pensions may accelerate this depreciation unless the individual takes enough measures for cognitive maintenance or repairing (McFadden, 2008). This will eventually lead to a faster deterioration of human capital in later life. Elderly individuals 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, Adam and Perelman (2012), cognitive impairment or dementia is associated with lower quality of life, increased disability and higher health expenditures. Moreover, the majority of non-contributory pension recipients live in poor rural areas so it is important to maintain cognitive healthy elderly individuals as they play an important role in transmitting traditions, dialects, customs and community memories.

In this paper we study the effects of retirement on cognitive functioning in a sample of poor Peruvian elderly. Peru has recently implemented a non-contributory pension program that includes a new household survey for 65-80 year old individuals that contains questions on cognitive functioning. 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

[1] 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).

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 in later years. This is different from what has 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). Additionally, we use administrative data from *Pension 65* and exploit the variation of intensity of the program at district level as a source of exogenous variation which might affect retirement.

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, household demographics and objective health indicators. This allows us to reduce the potential bias due to omitted variables. 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 our case) and schooling at early ages in the formation of cognitive skills (Todd and Wolpin, 2003; Cunha, Heckman, Lochner, Masterov, 2006; Cunha, Heckman and Schennach, 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 (Hong et al., 2013). Diagnosed illnesses related to mental disorders are also controlled for. In a final specification, we use district-level fixed effects to account for unobserved characteristics that might affect cognition.

In order to deal with the potential endogeneity (reverse causality) of retirement and cognitive functioning we start estimating an IV model. As the main instrument for retirement, we use the number of months since *Pension 65* has been operating in the district of the respondent. As a secondary instrumental variable, we consider the total number of *Pension 65* beneficiaries in the district in October-November 2012, just before the ESBAM data was collected. Both variables are obtained from administrative data of *Pension 65*. We exploit the variation in the timing of implementation of the program across districts and argue that observing a stronger presence of *Pension 65* in the district increases the expectation of an individual to receive the transfer. Therefore, the individual can accelerate the decision of retirement, and only through this channel, affect cognition.

We also perform two sets of robustness checks. First, we check whether our results are sensible to our definition of the cognitive score. Second, we check whether the IV results are consistent after accounting for the discreteness of retirement. In particular, we follow Wooldridge (2010) and estimate a Control Function (CF) model, where we take into account the non-linearity of the endogenous variable.

Our results show that, relatively to those who continue working, retirement has a statistically significant negative effect on cognition (-0.15 standard deviations). The size of this effect is about four times larger than the effect of age on cognition. The dimensions of cognitive skills that seem to be most affected are *orientation* and *memory*.

The rest of the paper is organized as follows: Section 2 discusses the relation between non-contributory pensions and cognitive functioning. Section 3 presents the dataset and 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

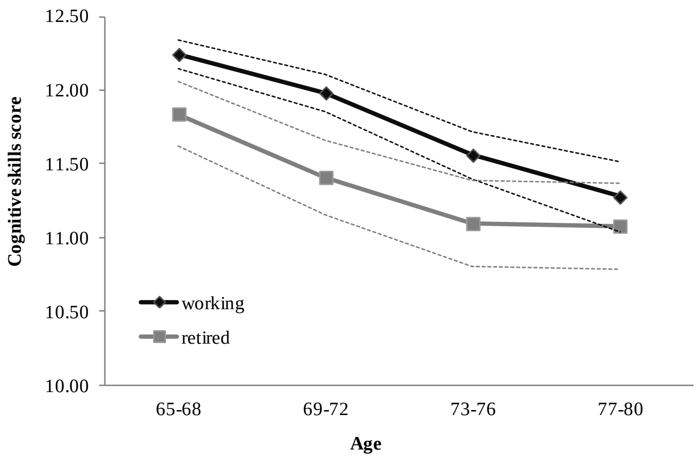
There is a great deal of differences among the new non-contributory pension schemes implemented in Latin America, but it is common to observe that the recipients are mostly elderly living in poverty and rural areas who were unable to save in the contributory pension scheme. Among the possible causes 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 to allow old-age individuals to finally retire from labour with a secure stream of income instead of continuing to work until very advanced ages or their entire lives. This “Ceaseless Toil” pattern, as noted by Davis-Friedmann (1991) and analysed in Benjamin, Brandt and Jia-Zhueng (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 pension program in rural Brazil suggests that about 40 percent of recipients fully retire from the labour market upon receiving the transfer, with the rest of recipients drastically diminishing their working hours (De 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 higher poverty incidence. Secondly, the educational attainment of rural elderly individuals is lower, so that any effect of retirement on cognitive functioning will start at an already relatively low level of cognition. Moreover, it is important to keep cognitive healthy elderly individuals as they are essential in transmitting traditions, dialects, customs 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 recounting 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 mean cognitive score is always lower for retired individuals of similar age, except for the oldest group where the difference is not significant (*t*=1.28). 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 it to that of retired persons. Overall, 71 percent of the elderly individuals in our sample are working, while this activity rate is 54 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 65-80 year old persons, which collects information about their socio-economic conditions, subjective wellbeing, expectations, beliefs and several subjective and objective health related issues. 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 to serve 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 at individuals aged 65 or over 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[2]. According to SISFOH's cut-offs, households can be classified as extreme poor, non-extreme poor and non-poor. The population to study in ESBAM are the 65-80 year old individuals living in 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

[2] 35% of the sample was collected in November and 65% in December 2012. Each household is assigned a score resulting from a weighted sum of different socio-economic variables such as material conditions of household, assets, incomes, education level and access to basic public services.

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 the questionnaire themselves for the elderly (persons with severe impairments like blindness and deafness), 152 pensioners (85 individuals self-reported as *Pension 65*'s beneficiaries) and individuals with missing information in relevant variables, the final sample considered in the regressions corresponds to 3,790 individuals (see Table 1).

Table 1. Sample composition in ESBAM

Age group	Rural	Urban	Total
65-68	819	488	1307
69-72	678	403	1081
73-76	527	311	838
77-80	345	219	564
Total	2369	1421	3790

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 M.F, Folstein S.E. and McHugh, 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 2000s 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 and Wallace, 1997). This is relevant for our sample of elderly poor who report low literacy rates (28.5%).

Table 2. Distribution of cognitive score by question

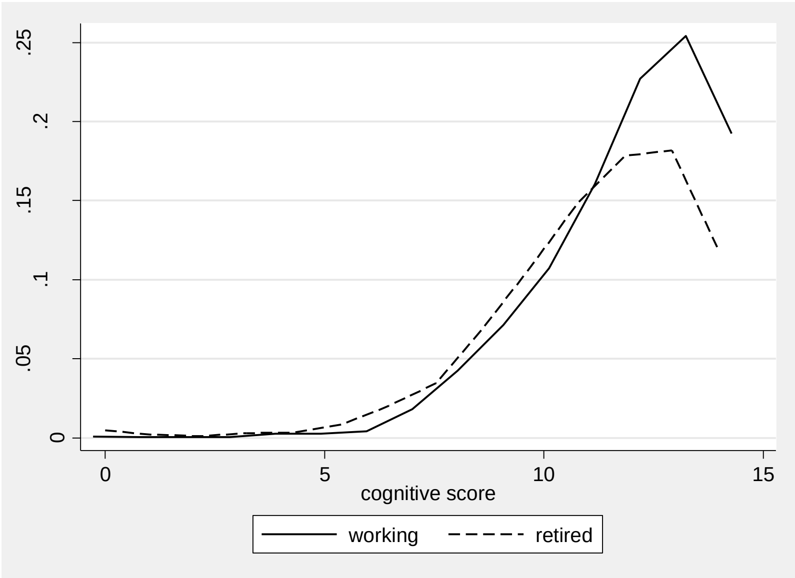
Cognitive skills question (N=3790)	Correct answers (%)						Mean Score
	0	1	2	3	4	Total	
Orientation	2.3	7.3	17.01	30.08	43.32	100.00	3.05
Word memory immediate recall	0.61	1.63	13.8	83.96	-	100.00	2.81
Command following	0.49	3.61	21.36	74.55	-	100.00	2.70
Word memory delayed recall	6.62	10.86	33.48	49.03	-	100.00	2.25
Drawing	12.79	87.21	-	-	-	100.00	0.87
Total	-	-	-	-	-	-	11.68

Source: authors' elaboration on the base of ESBAM.

Our score of cognitive functioning is computed with five questions dealing with different aspects of cognitive functioning. The first question is about *orientation* and asks about the day of the month, the month, year and day of the week. Each correct answer receives one point. The second question measures *immediate memory recall*; three words are mentioned and the respondent has to repeat them immediately after, in any order. These words are asked later again (forth question) in order to measure *delayed memory recall*. A point is given for each word correctly answered. The third question is a *command* of 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 receives one point. In the fifth question the respondent receives a point if she is able to replicate (*drawing*) a picture of two intersected circles, provided that the circles do not cross more than half. This measure captures the intactness of visual-spatial abilities. Our cognitive score is the result of summing up the points obtained on these five questions. Table 2 reports the distribution of points for each type of question.

The overall cognitive score ranges from 0 to 14 points (see figure 2). The average score is 11.68 with a standard deviation of 2.03. This score is 11.85 for working individuals and 11.28 for non-working individuals, being the difference between these statistically significant (t = 7.89). As shown in figure 1, the cognitive score captures the deterioration of cognitive functioning across age. In addition, for the total sample, cognitive score for men is statistically significant larger than that of women (t=-11.43), which also holds among the group of working individuals (t =-10.35). This is also the case among the group of retired, though the significance is lower (t=-1.99).

Figure 2. Cognitive score and retirement



Source: Authors' elaboration on the base of ESBAM.

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 memory recall* from a list of 10 words. Their second measure of *mental intactness* (ranges from 0 to 11) and 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. The measure of *orientation* is also available in the

Survey of Health, Ageing and Retirement in Europe (SHARE), although the values for the elderly Europeans are much higher[3].

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 treat both retirees and unemployed as retired. In our sample, 70.8 percent of respondents are working, 27.9 percent are retired and only 1.3 percent is unemployed. The questions about retirement and employment status in ESBAM follow conventional questions in household surveys to detect if the individual is actively seeking a job or intends to come back to a previous post.

3.4 Administrative data

We also have administrative data of the program's beneficiaries by geographical location (at district level) and time since the implementation of the program in each district up to November 2012, i.e. just before the survey collection. In particular, we have the number of months the program is operating in each district and the total number of beneficiaries by district, both variables being measured in November 2012. Given that this data shows variation in the timing of the implementation of the program, we argue that observing a stronger presence of *Pension 65* in the district can increase the expectation of an individual to receive the transfer and, therefore, accelerate the decision of retirement. Then, it is expected that only through this channel, cognition can be affected. For instance, Figure 3a shows the extent of variation of exposition of districts to the program, whilst Figure 3b depicts a positive association between the months exposed to the program in the district and the share of retirees in the same district.

[3] We compute the orientation measure for the 65-80 years old individuals who belong to the bottom income quartile in each of the 19 European countries surveyed in SHARE (wave 2 and 4) and obtain an average of 3.71 (from 3.40 in Spain to 3.87 in Switzerland)

Figure 3a. Number of months *Pension 65* is operating in the district

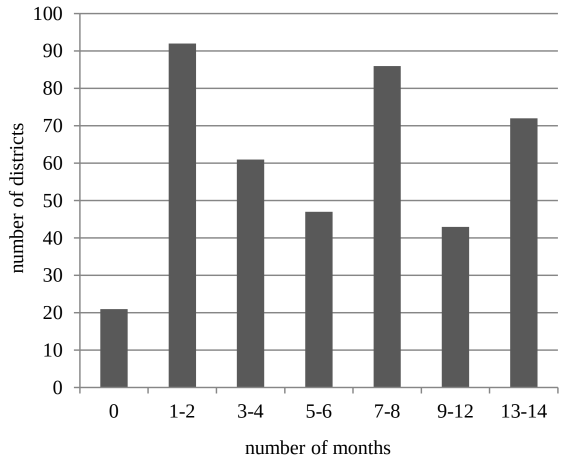
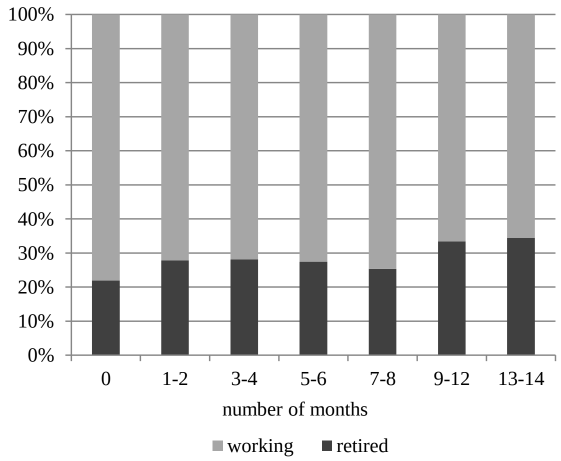


Figure 3b. Working status by number of months of *Pension 65* in the district



Source: Authors' elaboration on the base of ESBAM and administrative records of *Pension 65*.

4 Empirical Strategies

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 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 include 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 a 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 65+

population receive a pension from social security, of those only 6 percent are poor and 1 percent extreme poor. As mentioned in section 2, there is a high rate of labour activity among the elderly poor (71 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 address it by using the intensity of the *Pension 65* program in the district as our instrumental variable. Particularly, we use the number of months since *Pension 65* is available in the district. Since November 2011, *Pension 65* started to be gradually implemented along districts in Peru and we exploit the exogenous variation in the incidence (time and number of beneficiaries) of *Pension 65* as an instrument for retirement. We argue that observing a stronger presence of the non-contributory program in the district might increase the expectations of old individuals of receiving the pension and cease employment.

It is worthy to note that the validity of age eligibility for retirement 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 existence of institutional and cultural differences among countries beyond retirement scheme 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 on cognition.

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 and objective measure of health. 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:

$$c_i = \alpha_0 + \alpha_1 r_i + x'_i \beta + u_i \qquad (1)$$

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'. To show the bias of omitting relevant variables, in the next section we show different specifications of equation (1), including covariates in x'.

To deal with 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. In contrast to equation (1), r is now considered an endogenous variable, which satisfies the following reduced-form model:

$$\mathrm{r_i = x'_i \gamma + \delta z_i + v_i} \qquad (2)$$

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.

In addition, following Wooldridge (2010) and taking into consideration the non-linearity of the potentially endogenous variable, we estimate a Control Function model. It consists of firstly estimating a probit for retirement $D(r|z)$ and then adding the residuals of this regression as an additional "control" in (1). The inclusion of the residuals controls for the endogeneity of retirement in equation (1).

Finally, we include in equation (1) district fixed-effects to account for unobserved heterogeneity at district level (e.g. labour market conditions, long-term community deprivation of education, health and basic services, healthy environments, among others).

4.2 Control variables

We include a set of conventional control variables: age, sex, and schooling. In addition, 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 (Hong et al., 2013). According to WHO norms, haemoglobin levels should be roughly between 12 g/dL to 16 g/dL. In our sample, the mean of haemoglobin is 13.1; 23.8 percent of respondents have less than 12 g/dL, and 5.5 percent have more than 16 g/dL[4]. 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-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, Lau and Woo, 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, Resnick and Zonderman, 2008). We will use a dummy variable indicating whether or not 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 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

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

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 (28.5 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.

Table 3. Differences between working and retired individuals

Variable	Working	Retired	Diff.[a]
Cognitive score (z-score)	0.10	-0.17	***
Orientation	3.16	2.77	***
Word memory immediate recall	2.83	2.78	***
Command	2.69	2.72	*
Word memory delayed recall	2.27	2.19	**
Drawing	0.89	0.82	***
Male (yes=1)	0.65	0.30	***
Age	70.64	72.34	***
Mother tongue is indigenous (yes=1)	0.34	0.21	***
Illiterate (yes=1)	0.24	0.39	***
Arm span (cm.)	157.73	152.43	***
Haemoglobin	13.14	12.72	***
Mental disorders (yes=1)	0.17	0.25	***
Urban (yes=1)	0.31	0.52	***
Disability in body extremities (yes=1)	0.08	0.11	***
Pension 65 users (thousands) in Nov.'12 in the district	0.27	0.31	***
Months Pension 65 is available in the district	7.15	7.76	***
Household size	2.98	3.28	***
Married (yes=1)	0.73	0.65	***

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

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

5 Results

This section describes the results of three groups of estimations: (i) OLS models when we gradually introduce covariates, without district fixed-effects and where retirement is considered as exogenous; (ii) the testing of the exogeneity of retirement and presentation of the results of the IV estimation; and (iii) a fixed-effect model with the complete set of covariates, which accounts for unobserved characteristics at district level.

5.1 Main results

Table 4 shows OLS estimations of our cognitive score (standardized)[5] considering the retirement dummy as exogenous and where covariates are gradually introduced.

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 0.27 standard deviations below the one for working individuals. When gender, age and schooling are introduced (column 2) the coefficient on retirement considerably decreases to -0.08 standard deviations. Guven and Lee (2013b) also find that being male is associated with less cognitive functioning among a sample of elder Europeans. In their study, with the exception of *numeracy*, 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 elder 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 *orientation*). Being illiterate is strongly

[5] 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.

negatively associated with the cognitive score (around 0.72 standard deviations across all models in Table 4). Finally, an additional year in age decreases the cognitive score to 0.03 standard deviations, which remains constant across the different models[6].

Table 4: OLS estimation of the cognitive z-score

	(1)	(2)	(3)	(4)
Retired (yes=1)	-0.265***	-0.080**	-0.065*	-0.067*
	(0.036)	(0.037)	(0.036)	(0.036)
Male (yes=1)	-	0.044	-0.081*	-0.082*
	-	(0.034)	(0.044)	(0.044)
Age	-	-0.034***	-0.033***	-0.032***
	-	(0.003)	(0.003)	(0.003)
Illiterate (yes=1)	-	-0.729***	-0.723***	-0.724***
	-	(0.039)	(0.038)	(0.038)
Arm span	-	-	0.008***	0.008***
	-	-	(0.002)	(0.002)
Haemoglobin	-	-	0.017**	0.017**
	-	-	(0.008)	(0.008)
Mental disorders (yes=1)	-	-	-0.161***	-0.161***
	-	-	(0.039)	(0.039)
Household size	-	-	-	0.004
	-	-	-	(0.007)
Married (yes=1)	-	-	-	-0.002
	-	-	-	(0.033)
District-level fixed effects	No	No	No	No
Observations	3790	3790	3790	3790
R-squared	0.02	0.17	0.18	0.18

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

In column 3, we add three health indicators. As expected, it is found that current (haemoglobin) and long-term (arm span) nutritional status are positively associated to the cognitive score. In contrast, having mental disorders is negatively associated to cognition. Including these variables decreases the coefficient on retirement further. Finally, in column 4 we include two additional relevant variables expected to be positively associated to the

[6] We also try introducing age in quadratic form, and although the other coefficients and their significance did not change, age became not significant. This is, perhaps, because the range of age 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+.

cognitive score: a variable for the household size and a dummy for whether the individual is married\cohabiting or not. These variables are however not statistically significant and do not statistically affect the size of the coefficient on retirement.

Table 4 shows evidence that not including additional covariates to the regression of cognitive score on retirement significantly overestimate the coefficient on retirement (it decreases from -0.27 to -0.07 standard deviations). Because dealing with the omitted variable bias problem substantially reduced the magnitude of the coefficient on retirement, we might expect that dealing with the potential endogeneity of retirement would bring the coefficient even closer to 0.

As discussed in section 4, retirement is likely to be correlated with individual unobservable characteristics that also affect cognition, or both variables can suffer from reverse causality. To deal with the potential endogeneity of retirement, we firstly estimate a 2SLS instrumental variable approach, where retirement is instrumentalized with the number of months since the *Pension 65* program is available in the district.[7] Moreover, to account for the non-linearity of retirement, we estimate a full MLE Control Function model. The estimates in Table 5 correspond to the IV estimation (left panel) and CF estimation (right panel) of the cognitive z-score on the set of covariates included in the last model in Table 4.

The Durbin-Wu-Hausman test at the bottom of Table 5 shows that we cannot reject the null hypothesis that retirement is exogenous. Therefore, the OLS estimates in the last column of Table 4 are more efficient. The F-statistic (16.3), which is considerably larger than the rule of thumb of 10, confirms the relevance of our instrument. Moreover, in the first stage, we find that a stronger presence of the *Pension 65* program in the district is statistically associated with an increase in the probability of retirement. Even though retirement seems not to be endogenous in our sample of Peruvian elderly poor, and therefore the OLS results are

[7] Table A2 in the Appendix includes an additional IV estimation using the number of *Pension 65* beneficiaries in the district just before the ESBAM baseline was collected (October-November 2012). Similarly, according to the second stage we cannot reject that the effect of retirement on cognition is statistically different from zero.

unbiased, the top panel of Table 5 shows that the IV estimation of retirement on cognition is not statistically different to zero. This result confirms that dealing with omitted variables brings the coefficient on retirement towards zero.

Table 5: IV and CF estimations of the cognitive z-score

	IV		**CF**
	1st stage	**2nd stage**	
Retired (yes=1)	-	-0.043	-0.064
	-	(0.507)	(0.198)
Male (yes=1)	-0.278***	-0.076	-0.082**
	(0.020)	(0.149)	(0.041)
Age	0.019***	-0.033***	-0.032***
	(0.002)	(0.010)	(0.004)
Illiterate (yes=1)	0.009	-0.724***	-0.724***
	(0.018)	(0.039)	(0.037)
Arm span	-0.000	0.008***	0.008***
	(0.001)	(0.002)	(0.002)
Haemoglobin	-0.002	0.017**	0.017**
	(0.004)	(0.008)	(0.008)
Mental disorders (yes=1)	0.085***	-0.163***	-0.161***
	(0.018)	(0.062)	(0.039)
Household size	0.025***	0.003	0.004
	(0.004)	(0.015)	(0.007)
Married (yes=1)	-0.025	-0.001	-0.002
	(0.016)	(0.036)	(0.032)
Constant	-	1.183*	1.160***
	-	(0.634)	(0.399)
IV			
Months Pension 65 is available in the district	0.006***	-	0.018***
	(0.002)	-	(0.005)
Constant	-0.966***	-	-0.682***
	(0.197)	-	(0.042)
F-test: retired	16.260	-	-
Durbin-Wu-Hausman test	0.002	-	-
Rho	-	-	-0.002
Sigma	-	-	0.861
Lambda	-	-	-0.002
Wald test of $\rho = 0$: $\chi 2$ (df = 1)	-	-	0.000
Observations	3790		3790

Note: The Intrumental Variable (IV) model is estimated by 2SLS and robust standard errors are in parentheses. The Control Function (CF) model is estimated by full MLE and standard errors are boostrapped (100 replications, in parenthesis). * p<0.1 ** p<0.05 *** p<0.01.

As a first robustness check, the last column of Table 5 shows the results of estimating a Control Function model, which accounts for the discreteness of retirement. Similarly to the IV estimates, we note that the OLS estimate of retirement is downwardly biased. However, the size of the bias is negligible. From the likelihood-ratio test at the bottom of Table 5 we cannot reject the null hypothesis that the error terms of the reduced-form and main-equation are uncorrelated. This again suggests that applying the OLS model is appropriate.

Finally, to further deal with unobserved variables at the district level that might affect cognition, Table 6 includes district fixed-effects to the last model in Table 4.

Table 6: FE estimation of retirement on cognitive z-score

	FE
Retired (yes=1)	-0.150***
	(0.038)
Male (yes=1)	-0.093*
	(0.048)
Age	-0.032***
	(0.004)
Illiterate (yes=1)	-0.676***
	(0.040)
Arm span	0.008***
	(0.002)
Haemoglobin	0.025***
	(0.009)
Mental disorders (yes=1)	-0.197***
	(0.045)
Household size	-0.010
	(0.008)
Married (yes=1)	0.013
	(0.034)
District-level fixed effects	Yes
Observations	3790
R-squared	0.33

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

The most relevant difference is the substantial increase in the coefficient on retirement (from -0.07 to -0.15), which reflects the heterogeneity of districts in our sample (e.g. in terms of concentration of indigenous population, deprivations, among others) and that unobserved variables at district level influence retirement. Given that our IV is at district level we are not able to include FE at district level in the IV estimation of Table 5.

In comparing our estimates of the effect of retirement on cognition with other studies accounting for the reverse causality between retirement and cognition, we observe some substantial differences. Note, however, that this comparison must be done with caution because of differences regarding the cognitive score computation and sample selection. For instance, Rohwedder and Willis (2010) use age retirement eligibility as IV to estimate the effect of retirement on the memory score of a sample of American and European 50+ individuals. This effect is about -1.5 standard deviations, though it must be noted that these results are not controlled by variables other than the IV and the retirement indicator. Bingley and Martinello (2013) replicate the mentioned study and add schooling and gender as extra controls. We infer from their results that the effect of retirement on cognition is reduced to -0.9 standard deviations. Coe and Zamarro (2011) also use similar IV and sample (only Europeans 50+) as the previous studies but include a broader set of control variables such as socio-demographics, health and social activities. From the results of Coe and Zamarro (2011) we can infer[8] that the effect of retirement on memory is about -0.08 SD with OLS but it is not statistically different from zero when IV estimation is employed. So, adding more controls attenuates the problem of omitted variable and reduces the effects of retirement on cognition. The magnitude of this last effect is much closer to ours than what other studies have shown. In our case, we do not find endogeneity between retirement and cognition and, in addition, the effect of retirement on cognition is smaller in magnitude than in the previous studies, which might be due to the characteristics of our sample.

[8] The population standard deviation of the memory score is not reported in Coe and Zamarro (2011), but we assume that this is similar (is 3.3) to the one reported in Rohwedder and Willis (2010) who also use the same cognitive score and data source (SHARE), although include two additional countries (USA and UK).

The occupations in which elderly individuals in our sample worked are likely to be very precarious (given that 80 percent of them have not even completed primary school) and did not involve the use of high cognitive skills. Therefore, while in our sample retiring reduces cognition, its impact is smaller than the one found on samples of relatively better-skilled workers in the US and Europe.

As a second robustness check we explore whether our previous estimates are sensible to the construction of the cognitive score. In particular, we estimate the effect of retirement on the levels of each of the four components of our cognitive score: *orientation*, *command, total memory (including immediate and delayed word memory recall),* and *drawing.* These regressions include the same set of covariates included in Table 6. Each column of Table 7 corresponds to separated FE estimations of the effect of retirement on each of the mentioned components of cognition. Table 7 shows only the coefficient on retirement since it is our main variable of interest.[9]

Table 7: Robustness check – Different definitions of cognitive score

	Orientation	Command	Total memory	Drawing
Retired (yes=1)	-0.146***	-0.039*	-0.108**	-0.029*
	(0.041)	(0.021)	(0.049)	(0.015)
District-level fixed effects	Yes	Yes	Yes	Yes
Observations	3790	3790	3790	3790
R-squared	0.35	0.28	0.20	0.23

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

[9] The complete tables are available upon request.

A first sight of the regressions in Table 7 shows that the effect of retirement on *orientation* is the largest, followed by the one on *immediate and delayed memory* combined[10]. In all the specifications the effect of retirement shows the expected negative sign, being the effect on *drawing,* which captures visual-spatial abilities, the less affected.

6 Discussion

In this paper we have shown that retirement has a causal negative impact on the cognitive functioning of the elderly poor. This effect is about four times larger than the effect of age on retirement 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

[10] The effect of retirement on *immediate recall* is -0.04 but not statistically significant and the one on *delayed recall* is -0.07, statistically significant at 10%.

healthy elderly individuals 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 cognition 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 transfer programs that tie the transfer to the accomplishment of some compulsory fulfilments to assure the wellbeing of the beneficiaries.

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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.

Table A2: IV estimation of the cognitive z-score (Full model)

IV: Number of *Pension 65* users in the district, Oct-Nov 2012

	IV	
	1st stage	**2nd stage**
Retired (yes=1)	-	0.181
	-	(0.490)
Male (yes=1)	-0.280***	-0.013
	(0.020)	(0.142)
Age	0.019***	-0.037***
	(0.002)	(0.010)
Illiterate (yes=1)	0.010	-0.726***
	(0.018)	(0.039)
Arm span	-0.000	0.008***
	(0.001)	(0.002)
Haemoglobin	-0.002	0.017**
	(0.004)	(0.008)
Mental disorders (yes=1)	0.085***	-0.182***
	(0.018)	(0.059)
Household size	0.025***	-0.002
	(0.004)	(0.015)
Married (yes=1)	-0.028*	0.005
	(0.016)	(0.036)
First stage: IV		
Pension 65 users (thousands) in Nov.'12 in the district	0.081***	-
	(0.021)	-
F-test: retired	15.551	-
Durbin-Wu-Hausman test	0.262	-
Observations	3790	
R-squared	0.16	

Note: The Intrumental Variable (IV) model is estimated by 2SLS and robust standard errors are in parentheses. * p<0.1 ** p<0.05 *** p<0.01.