RESEARCH ARTICLE

Public pensions, economic development, and the labor force participation of older adults in Latin America in 1990–2010

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Abstract: This paper investigates the coverage of public pension programs in Latin America and discusses the relation between economic development, the existence of public pension programs, and elderly labor force participation. The paper presents stylized facts about the labor force by age and the connection between economic development and labor supply using aggregated data from 23 Latin American countries. The second part of the paper uses regression models to investigate the effects of economic development and social security system on the labor force participation of the older adults in 23 Latin American countries over the period 1990–2010. The results show that in lower income Latin American countries, most men remained in the labor force until age 65 or beyond and that with economic development and related changes, the labor force participation of older men, even those aged 55–59, starts to decline. Overall, the paper provides some insight on the evolution of labor supply patterns in less developed economies with rising income, changes in population age structure, shifts in occupational composition, and development in public pension programs.

Keywords: *labor force participation; economic development; older adults; elderly; public pensions; social security; retirement; Latin America*

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1 Introduction

Demographic changes, especially population aging might have important impacts on macroeconomic variables, public sector fiscal balance, and other areas such as public pension and public health systems (Mason, Lee, and Lee, 2010). The literature on this topic in developed countries is extensive (Costa, 1998; Burtless and Quinn, 2001; Gruber and Wise, 1999; 2004; 2010), and researchers know a great deal about labor force behavior in different countries in the developed world. In recent decades, population aging combined with early retirement has put social security systems across the industrialized world under pressure (Bongaarts, 2004; Bloom and McKinnon, 2010). Thus, legislation changes have taken center stage in public policy debates in recent years (Wise, 2004; Bloom and McKinnon, 2010). Today, retirement is an important stage on one's life cycle, but it is important to maintain the sustainability of the public pension systems (Costa, 1998; Mason, Lee, and Lee, 2010). Contrary to the past, most workers in more developed economies today enjoy a long and healthy period of retirement. These changes are a paradox since people are entering the labor force later because of increasing educational attainment and prolonged longevity, and in the meantime they are leaving the labor force at younger ages (Wise, 1997; 2004; 2010).

However, very little is known about the elderly labor force behavior in emerging economies, such as in Latin America (de Carvalho-Filho, 2008; Cotler, 2010; Finlay and Fink, 2011). Economics literature predicts that rising income, socioeconomic changes, and the emergency of public pension systems play a key role in affecting the number of the elderly that remain in the labor market (Clark and Anker, 1990; 1993; Clark, Young, and Anker, 1999). The study of retirement decisions in a developing country could contribute to better understanding the causes of the decline in older age labor force participation and the impacts of social security systems on these changes. It is argued that the income effects on labor force participation might be larger in low-income countries, and that the structure of the labor market, high information ratio, and the lower capital-worker ratio might affect labor market decisions differently from what is observed in industrialized countries (de Carvalho-Filho, 2008; Kaushal, 2014). In addition, workers in developing countries have shorter life expectancies and face more credit constraints, which can lead them to having a myopic behavior regarding social security provisions (de Carvalho-Filho, 2008; Kaushal, 2014).

Latin America is one example of an important context for elaborating linkages between economic development, pension benefits provision, and labor force participation of older adults (Melguizo, Bosch, and Pages-Serra, 2017; de Carvalho-Filho, 2008; Cotlear, 2011). The rapidly aging population presents one of the greatest public policy challenges in Latin America, and raises concerns about living conditions, social support, and health care provision for older adults, especially where family support has been weakened by economic development and where a universal welfare system is not yet in place. Latin America also consists of countries with relatively matured and less matured public pension programs of the world (Melguizo, Bosch, and Pages-Serra, 2017; Cotlear, 2011; Finlay and Fink, 2011). Furthermore, it is generally argued that the pressure of youth unemployment might be reduced by creating incentives for older adults to leave the labor force (Gruber and Wise, 2010). In many Latin American countries, the high unemployment rate among the youth is a social problem (He, 2017; Herranz, 2016; OECD, ECLAC, and CAF, 2016). Thus, the region provides a good example to study labor force participation of older adults and its associated macro factors. However, despite the growing interest in this area (Clark, Young, and Anker, 1999; Bloom *et al*, 2009; Finlay and Fink, 2011), there are very few studies that covered the whole region; instead, most previous studies focused on the experiences in some particular countries (Aguila, 2014; Contreras, de Mello, and Puentes, 2016; Mesa-Lago and Bertranou, 2016; Nava-Bolaños and Ham-Chande, 2014; Queiroz, 2008).

There has been a decrease in labor force participation of older persons in recent decades in both developed countries and developing countries, including Latin American countries (Aguila, 2014; Costa, 1998; Gruber and Wise, 1999; 2004; Queiroz, 2008; Wise, 2010). In Latin America, the expansion of the social security system, economic development, and rising income might have created incentives for more workers to leave the labor market earlier (Aguila, 2014; Queiroz, 2008). In addition, improvements in goods and services provided to older adults have transformed retirement into a more pleasurable and desirable stage of life. By using aggregated data from 23 Latin America countries (see Appendix), the present study aims to investigate how labor force participation of older men in the period 1990–2010 varied across Latin American countries that are in different stages of economic development, as reflected by differences in national economic conditions, retirement programs, and demographic structures.

1.1 Modeling Retirement Decisions

Labor economics textbooks highlight that retirement decisions depend on two factors: workers' wage and pension benefits (Coile, 2015; Ehrenber and Smith, 2016). The simple model assumes that a worker has just turned to be 60 years old and has a remaining life expectancy of 20 years. For simplicity, once retired, this worker does not participate in the labor market again. The worker faces a budget constraint limiting

his or her consumption and years of retirement. The downward slope of the budget constraint indicates that if the worker wants to have a longer retirement he or she will have to give up some consumption. Based on this trade-off, it is possible to introduce the worker's indifference curves between retirement and consumption. A utility-maximizing worker will decide to retire when his or her indifference curve is tangent to the budget constraint.

More generous pension benefits also cause both income and substitution effects, but both effects operate in the same direction under such a system (Ehrenber and Smith, 2016). The simple economic model suggests that an increase in pension benefits would rotate the budget constraint at 80 years of age (Ehrenberg and Smith, 2016). In this case, the lifetime income associated with work is not affected; however, the lifetime income associated with pension benefits increases (Ehrenber and Smith, 2016). An increase in pension benefits moves the budget constraint outward increasing the demand for leisure, and it also reduces the price of retirement (Ehrenber and Smith, 2016). Therefore, higher pension benefits lead to earlier retirement. The economic model is completed by adding a series of variables that influence workers' behavior in addition to non-financial (economic) incentives. Empirical evidence suggests that retirement age is directly affected by benefit level, among other factors (Coile, 2015; Ehrenberg and Smith, 2016). Studies show that increasing workers' wage by 10% lowers the probability of retirement by 6%; and increases in pension benefits of 10% reduces age of retirement by one month (Ehrenberg and Smith, 2016).

The pattern of labor force participation of older adults could be affected by following four major factors: the existence of financial incentives to early retirement in public pension systems (Gruber and Wise, 1999; 2004), higher income and expansion of the leisure class that allow individuals to allocate their time out of the labor force (Costa, 1998), revised social security policies from political pressure caused by population aging (Profeta, 2002), and rising income and socioeconomic changes that negatively affect the proportion of older adults that stay in the labor market (Clark, Young, and Anker, 1999). Although research on older adults in developing countries has boomed since the 1990s (Aguila, 2014; de Carvalho-Filho, 2008; Cotlear, 2011), much of it concentrates on basic demographic analysis and the study of trends in mortality, morbidity, and migration; research on income, wealth, economic support, and labor supply of older workers is still relatively limited (Aguila, 2014; de Carvalho-Filho, 2008; Cotlear, 2011).

Growing national income levels can, however, enable older adults to retire, but national income growth is also usually related to a greater income potential and higher opportunity costs for continued work. Furthermore, a higher GDP may also correlate with health and skills at older ages, which can relate to a higher productivity potential at older ages, and hence this may explain the later retirement of richer countries in some countries in recent years (Dingemans, Henkens, and van Solinge, 2016; Larsen and Pedersen, 2013). The highly educated have more to gain from continuing work partly because of deferred payment systems where older workers above their marginal product are more commonly used among highly educated workers (Larsen and Pedersen, 2013; Dingemans, Henkens, and van Solinge, 2016). Earnings rise the most with age for the more educated. For example, while the average wage ratio of 45–54 years old to 25–29 years old was 1.26 for those with upper secondary education, it was 1.92 for those with university education (OECD, 1998). This implies that working until relatively older ages can be more attractive among the better paid highly educated, although the wage-cost ratio is higher, making this group more costly to employ.

Studying retirement and older males' labor force behavior has several important implications. First, rapid population aging may place a burden on the pension systems that are not ready to support such large group. Second, those systems have impacts on the labor supply of workers, and it is important to investigate whether the systems affect labor market behavior and how public policy can be implemented so as not to place excessive burden on current workers. Lam *et al*. (2006) provide an overview of

the labor force supply of older workers in South Africa focusing on possible effects of the public pension system on retirement. The South African pension system had a significant impact on reducing poverty levels and overall socioeconomic levels of the more disadvantaged population (Lam, Leibbrandt and Ranchhod, 2006). However, Lam *et al*. (2006) found negative impacts of its pension system on the labor supply of older workers, showing that age of pension eligibility is associated with high retirement rates. James and Cox-Edwards (2005) use the privatization of the pension system in Chile in 1982 to test whether it created expected incentives to later retirement. They found strong evidence of the effects of the new system on the labor supply of older workers: Restriction to early retirement and actuarially fair adjustment of benefit for later retirement explained the increase in labor force participation.

2 Data and Methods

2.1 Data sources

As no single data source could provide sufficient information to fulfill our research goals, this paper uses the aggregated data from the World Bank, the International Labor Organization, and other sources. The main limitation to work with Latin American data is the availability of completeness of information for all countries for a very long period of time. This study concentrates on the more recent period because most data necessary to perform analysis were available. Table 1 lists the variables used in the analysis and data sources used to construct each of the indicators. Per capita GDP, educational attainment, and employment rate were obtained from the World Bank (World Bank, 2016), the population age structure and the percentage urban (i.e., the proportion of urban population) were from the United Nations (United Nations, 2015), and the data of characteristics of the national social security programs and pension coverage of each Latin American country were from various published documents or materials published by the United States Social Security Administration and the World Bank. Information on pension coverage was also obtained in a publication by Rofman and Carranza (2005).

Table 1. Variables and data sources

Variables	Source	Period
Dependent Variable		
Labor Force Participation Rates (in %)	International Labor Organization	1990–2010
Independent Variable		
GDP per capita 10and GDP growth rates	World Bank	1990–2010
Average years of education	World Bank	1990–2010
Composition of employment	World Bank	1990–2010
Population age structure	United Nations	1990–2010
Percentage urban	United Nations	1990–2010
Social security rules	US Social Security Administration	1990–2010
Social Security Measures (coverage rate, beneficiary rates)	World Bank publication on pension coverage in Latin America and the Caribbean (LAC) and Rofman and Carranza (2005)	1990–2010

Note: GDP per capita is measured in purchasing power parity (PPP), 2010 US$.

2.2 Methods

The analysis is divided in two parts. The first part of the paper presents analyses of stylized facts about demographic trends, elderly labor force participation, retirement trends, and public pension coverage across Latin American countries. In the second part, the paper uses regression models, with country level data, to investigate the determinants of elderly labor force participation across countries and over time.

2.2.1 Measurements

The basic measure used in the paper is labor force participation rates by age group. Labor force participation is defined by the International Labor Organization (ILO) as the proportion of individuals of a given age group who are either working or actively seeking work to the total population in the same age group. Labor force participation rate is a useful measure to study the evolution of labor force participation over time and cross countries. The main advantage of using the labor force participation rate, compared to other measures such as hours of work, work tenure, or retirement age, is that it is available in all countries over an extended period of time. Based on the labor force participation rates it is possible to estimate two important summary and comparative measures: unused labor capacity (Gruber and Wise, 1999) and retirement hazard rate (Costa, 1998). Both measures, explained in more detailed later, have important limitations, but are useful to understand trends in labor force participation over time and across countries.

Gruber and Wise (1999) propose the unused productive capacity as a summary measure of the labor force participation of older workers. The measure is calculated by summing up the proportions of individuals out of the labor force between ages 50 and 69 and dividing it by 19 (Similar calculation is made for those between ages 55 and 65, but dividing by 10). The measure is interpreted as follows: Supposing that the unused capacity measure between ages 50 and 69 in a particular year is 50%, it means that a cohort experiencing the labor force participation rates in that year throughout their whole life would work only 50% of their potential lifetime person-working-years (Gruber and Wise, 1999). It is a relative measure, in that it does not consider the fact that everybody in this age range should not be in the labor force and that differences in labor force participation might be related to health conditions and type of jobs at older ages. In the case of developing economies with high unemployment and large informal sectors, it is not correct to assume that all retirees or individuals out of the labor force would be productive whether they remain in the labor force. Thus, this makes the notion of unused labor capacity more complicated in Latin America in comparison to countries included in Gruber and Wise (1999), who mainly focused on developed countries.

The retirement hazard rate is defined as the transition out of the labor force (Costa, 1998). It is calculated by comparing the labor force participation in a given age group compared to its previous (younger) age group. The hazard rate can be thought of as an estimate of the probability of leaving the labor force at a given age, conditional on being in the labor force in the previous year. It can be calculated in a cross-section manner or following a synthetic cohort approach, in case when no panel data are available. The hazard rates do not show the actual retirement experience of individuals. In this paper, it is the percentage decline in the proportion who are economically active between age x and age $x + 1$.

Table 1 shows the dependent and independent variables that are included in the model, data sources, and time periods. The model uses GDP per capita as an indicator of economic well-being and economic development. Economically, a higher national income should be related to a lower labor force participation of the older adults because income effects are higher than substitution effects and because higher income levels might indicate that individuals can afford leaving the workforce (Ehrenberg and Smith, 2016). The increasing income level makes it possible for more and more older people to leave the labor force. However, the national income growth is also related to a higher wage potential and higher opportunity costs to leave work. In addition, a higher level of GDP per capita could also be correlated to better health and skills in more advanced ages, which might be related to more work capacity. In other words, a higher level of GDP per capita might be related to increases in labor force at older ages. Thus, it is possible to observe a shift in the trends in more recent years.

Education is an important determinant of labor supply and retirement (Clark, Young, and Anker, 1999). Education is highly correlated with income, wealth, and type of a job an individual holds. The net effect of education will reflect income and substitution

effects. The former creates incentives to retirement since more educated workers are more able to afford retirement, whereas the latter implies a higher opportunity cost to leave work (Gordo and Skirbekk, 2013). Education is also related to the age that workers enter the labor market. Workers with lower levels of education might invest less in human capital and enter the labor force at younger ages in more physically demanding jobs (Gordo and Skirbekk, 2013). Those elements might affect the decision of staying in or leaving out the labor force.

Occupation might also affect the labor supply of the older adults. Occupation is related not only to the educational level but also to access to social security benefits. Workers in the formal market have more direct access to social security than workers in the informal sector and the self-employed. Employers recruit workers in the formal market in the system, while those in the informal sector should decide on their own whether to join the pension system.

The existence and the size of pension systems are related to labor force participation rates. For social security, the model considers four different variables: the length of time the system has existed, regular retirement age, coverage of the system in relation to the labor force (ratio of contributors to wage earners), and whether the system is only a PAYGO or has some sort of private account mechanism.

2.2.2 Statistical Methods

In the second part of the analysis, the paper investigates the determinants of elderly labor force participation in the dataset by two approaches. To assess the magnitudes of these effects, this paper estimates a model where changes and variations in elderly labor force participation are driven by demographic characteristics, education, income level, and other covariates. All the data used in the estimation come from a time series for 23 Latin American countries for the period 1990–2010, as described above. Based on the theoretical review, the following model (Equation 1) was specified:

$$LFPR_i = \alpha + \beta X_i + \gamma Z_i + \varepsilon_i \tag{1}$$

The analysis concentrates on country characteristics such as mean years of schooling, participation in the labor market (formal and informal), percentage urban, GDP per capita (in 2005 constant US$), social security characteristics, and a set of control variables. In the model, LFPR represents the labor force participation rates for population aged 55–59, 60–64 and 65–69, while X is the matrix of explanatory variables, Z_i is the matrix of controls, and ε_i is an error term. The analysis was performed using Stata 12 and R.

3 Results

3.1 Descriptive Analysis

3.1.1 Age Profiles of Labor Force Participation

Figure 1 depicts the labor force participation rate (LFPR) by age and sex for study countries. Male labor force participation rate is higher than that of females for all countries. The main result is the rapid rate of withdrawal from the labor force after age 50 and is always lower for those with pension coverage. For example, by age 65 the labor force participation rate ranges from 15% in Uruguay to over 60% in Bolivia and Nicaragua. In Uruguay, the participation rates are as low as observed in developed countries studied by Gruber and Wise (1999; 2004). In the case of Brazil, for instance, at age 60 around 50% of males are already out of the labor force and the rates fall to 30% at age 65. Using a synthetic cohort approach, this result implies that almost half of the males working at age 60 in Brazil would leave the labor force before reaching age 65.
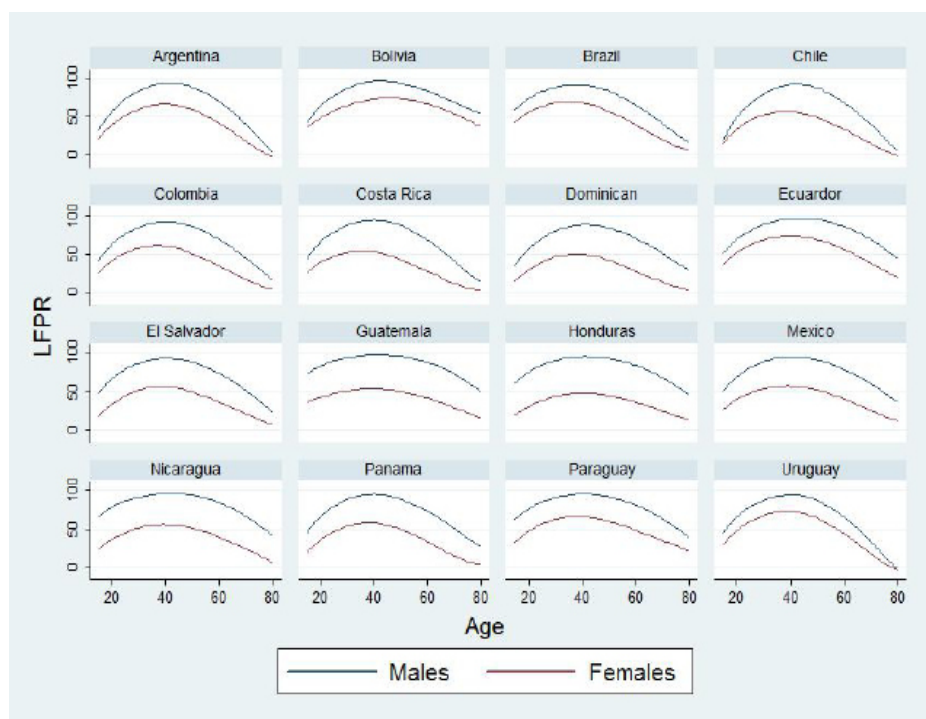
Figure 1. Labor force participation rates (LFPR, %) by age, sex, and country, 2005

3.1.2 Overview of Pension Programs

It is observed from Figure 1 that in countries with higher income the labor force participation at older ages is lower. This evidence goes in line with the discussion that rising income levels might create incentives to early withdraw from the labor force as it was observed in more developed countries (Melguizo, Bosch, and Pages-Serra, 2017). Table 2 shows summary measures of public pension coverage in major Latin American countries in terms of the ratio of contributors by wage earners and the ratio of beneficiaries by population. Estimates are the simple average from available data from 1990 to 2005. The table also shows the standard deviation (SD), the maximum, and the minimum of each measure for each country over the study period. The first measure shows the ratio of workers contributing to the pension system to the number of wage earners. Results indicate that more developed economies in Latin America (Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, and Uruguay) had a higher percentage of workers contributing to the pension system in most recent years. In general, it is also observed that the percentage of contributors to wage earners was increasing over time. The results also show that a large number of countries had a very low coverage with less than 50% of workers making contributions to their pension systems. The second measure is the ratio between pension beneficiaries to individuals aged 65 and above. The results show that only Brazil, Chile, and Uruguay had over 80% of older adults receiving pension benefits, and for most of Latin American countries, less than 40% of older adults were covered by the system of their home country.

3.2 Unused Labor Capacity, Pensions and Economic Development

Figure 2 shows the unused capacity for 23 Latin American countries around 2005 for age group 50–65. The unused capacity in this age group ranged from 15% in Guatemala to 40% in Uruguay. This means that in Uruguay, individuals aged 50–65 were working only 60% of their potential working life. A wide variation across countries in the region was also observed with the mean of about 30% and the standard deviation of 10.

Table 2. Summary measures of public pension coverage: Ratio of contributors by wage earners and the ratio of beneficiaries by population aged 65 and above, selected Latin American countries, 1990–2005

| Countries	Ratio of Contributors/Wage-Earners				Ratio of Beneficiaries/Population			
	Mean	SD	Max	Min	Mean	SD	Max	Min
Argentina	67.29	8.37	83.00	52.36	74.56	7.05	90.43	58.91
Bolivia	33.98	4.43	40.62	28.21	22.24	7.84	38.08	14.71
Brazil	69.57	2.14	73.27	65.82	79.98	7.34	87.12	56.81
Chile	80.66	3.59	89.84	78.09	65.16	4.65	73.04	57.23
Colombia	51.22	5.47	59.68	42.76	17.30	5.33	23.88	0.39
Costa Rica	78.11	1.81	82.28	75.11	34.13	5.77	43.01	25.30
Dominican Republic	53.91	9.99	66.73	40.37	11.78	1.05	13.72	10.21
Ecuador	50.74	9.55	64.18	39.23	18.43	2.39	22.38	13.68
El Salvador	50.53	2.74	53.94	44.02	13.86	1.27	16.19	11.96
Guatemala	41.01	4.63	46.15	37.18	13.44	2.14	15.41	11.17
Honduras	42.93	0.92	43.87	42.04	4.53	0.64	5.54	3.10
Mexico	52.86	4.61	56.46	38.58	19.40	4.25	25.21	11.46
Nicaragua	37.82	5.10	44.90	32.86	18.72	0.00	18.72	18.72
Panama	72.10	2.11	75.14	70.56	40.21	3.52	44.97	34.16
Paraguay	32.36	3.21	38.52	27.25	21.00	6.88	35.40	12.90
Peru	34.77	3.95	40.93	30.41	27.13	1.78	31.52	24.50
Uruguay	76.99	3.24	83.73	73.10	82.60	9.99	88.53	54.78
Venezuela	65.32	2.94	71.49	61.07	24.07	3.73	31.27	18.78

Source: Rofman and Carranza (2005)
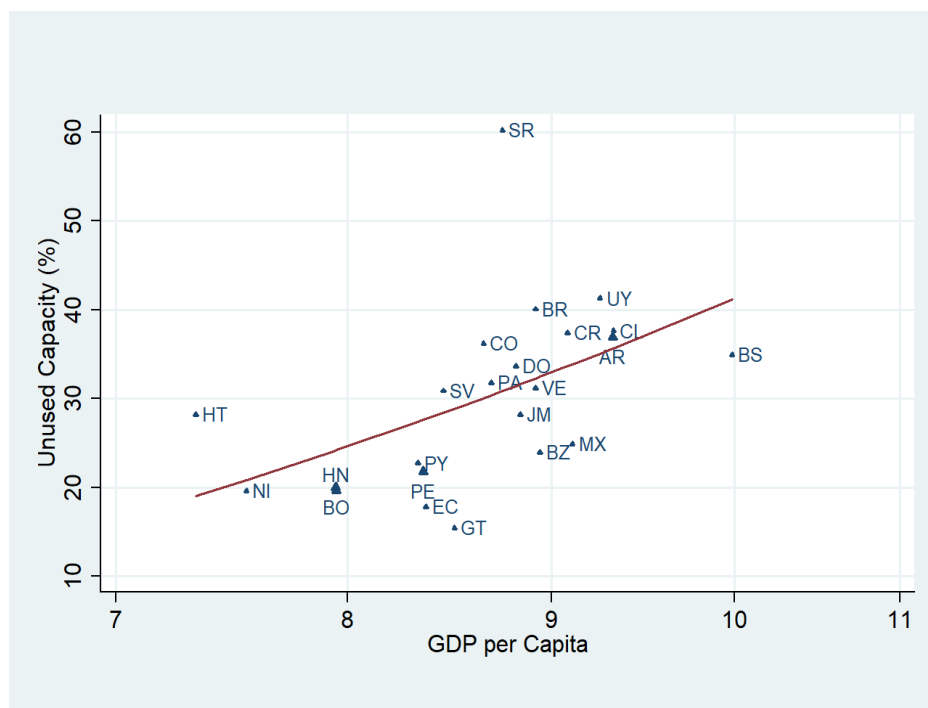
Figure 2. Unused labor capacity and GDP per capita, men, by country, Latin America, 2005

Note: GDP per capita is measured in purchasing power parity (PPP), 2010 US$.

Despite the abovementioned limitations of these measures, it is important to compare Latin American countries with OECD countries from the Gruber and Wise study. As Gruber and Wise (1999) pointed out, there was a wide variation across OECD countries around year 1995 with the unused labor capacity ranging from 22% in Japan to 67% in Belgium for ages 55–65 and the percentage of males out of the labor force at age 59 from 13% in Japan to 58% in Belgium. The unused labor capacity in several Latin American countries (Uruguay, Brazil, Argentina, Chile, Costa Rica, and Colombia) were similar to those observed in the United States (37%) and Sweden (35%). The main conclusion of the Gruber and Wise study is that there was a strong relationship between unused capacity and pension programs incentives to retire in OECD countries in the 1990s. The present paper did not apply the same methodology used by Gruber and Wise, but the descriptive analysis presented here also indicated that a similar behavior was observed in Latin America.

The relation between the unused capacity and GDP per capita is positive. As income increases, the unused capacity also increases. The results indicate that in countries with low income per capita, most individuals remain in the labor force until age 65 or beyond (or until they are not able to work). Relation from Figure 2 indicates that, as the economy develops, there is a change in the composition of employment and emergence of old-age assistance programs, and individuals start to leave the labor force at younger ages. The level of economic development is also associated with demographic transition and an older population age structure.

3.3 Retirement Hazard Rates

Another useful way to focus on timing of retirement and its changes is to calculate retirement hazard rates. The retirement hazard rate shows whether there is a preferable retirement age, and it helps to understand the effects of the social security system in the patterns of retirement. When these rates are being estimated from cross-sectional data, they do not represent the actual labor market transitions of individuals (Gruber and Wise, 1999; Costa, 1998; Hurd, 1990). In most cases of the analyses, the retirement hazard rate is simply the percentage decline in the proportion of individuals in the labor force between age x and $x+1$ in a particular year (Costa, 1998). In this paper, the retirement hazard rate was also estimated using a synthetic cohort approach, namely, by comparing labor force participation rates of individuals aged 50–55 in 1990 to those aged 55–60 in 1995 (i.e., the latter was divided by the former) and following similar procedure for other age groups.

Table 3 shows the average retirement hazard rates with the minimum and the maximum for 23 Latin American countries from the cross-sectional analysis for selected years. The means were calculated as an average across all countries and were not weighted by population size. The results indicate that hazard rates out of the labor force increased steeply with age and the relation maintained over time, that is, the older adults in Latin American countries observed a similar transition pattern out of the labor force across countries in 1990–2010, despite the observed changes in the economic, demographic, and social context of the region. The results are very similar

Table 3. Retirement hazard rates (%) for Latin America, males, 1990–2010

Years	Ages 50–55 to ages 55–60			Ages 55–60 to ages 60–65			Ages 60–65 to ages 65–70		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
1990	4.9	0.6	10.9	17.9	0.0	75.7	37.3	15.4	67.4
1995	6.1	2.9	31.2	17.1	0.0	75.3	37.3	18.8	65.4
2000	5.5	1.2	12.2	16.2	0.2	77.9	40.5	21.5	70.5
2005	5.8	0.9	16.3	17.4	2.6	73.1	41.7	22.7	72.0
2010	4.9	0.2	11.5	16.8	5.1	67.9	42.0	24.8	66.9

Note: Data refer to 23 countries listed in Table 2
Source: International Labor Organization – ILOSTAT (2016)

when retirement hazard rates were calculated using a synthetic cohort approach. In the period of analysis, over 35% of older men left the workforce between ages 60 and 65.

One important point in Table 3 is a wide variation in hazard rates. For example, in 2000, on average, 16% of those in the labor force in the age groups 55–60 left the labor force when they reached ages 60–65, but in the country with the highest hazard rate out of the labor force, Suriname, about 77% left the labor force in that period. Contrary to what was observed in other countries (Hurd and Rohwedder, 2011), the results did not indicate a substantial decline in the retirement hazard rates for men in Latin America.

The estimates of retirement hazard rates indicate that in Latin America, most older adults leave the labor force between ages 60 and 65. In addition to public pension programs and other financial and non-financial incentives might play a significant role. These hazard rates can be compared with the rates estimated for OECD countries (Gruber and Wise, 1999). For example, they estimate hazard retirement rates around year 1995 of about 60% at age 60 for France, almost 80% at age 65 in Belgium, 25% at age 65 in the USA, and 55% at age 55 in Germany. One of the striking results in that study is the very high hazard rates of labor force exit at ages in many countries. These high hazard rates are typically observed at ages associated with strong incentives to retire due to features of the retirement system (Gruber and Wise, 1999)

The observed variation in the labor force of older men and in the retirement hazard rates out of the labor force could be explained by a myriad of factors (Coile, 2015), such as income and educational level, percentage of urban population and characteristics of the public pension programs. The statistical analysis performed in the next section tries to shed some light on the relations observed in Latin America.

3.4 Statistical Modeling

3.4.1 Summary Statistics

Table 4 presents the summary statistics for dependent and independent variables for the 23 Latin American and Caribbean countries in our dataset. The table reports the mean, the standard deviation, the maximum, and the minimum of study variables for 1990 and 2010 only. Some points should be highlighted from Table 4. In the period 1990–2010, it was observed that the population age structure was young: on average the percentage of population aged 65 and over went from 5% to almost 7%. However, the percentage of population aged 65 and over ranged from as low as 3% to almost 14% in 1990 and from 4% to 14% in 2010, which was much lower than most of the percentages of the older adult in more developed economies in the same period. The working-age population in Latin American countries, on average, accounted for 60% of the total population in the study period, but reaching over 70% in one country in 2010. There was still a large concentration of the labor force in the informal sector: on average 40% of workers were in the informal sector and most of them are not covered by the public pension system. This could have important impacts on the labor force participation of older adults in Latin America. Lastly, although there have been improvements in educational attainment in Latin American countries in recent years (Levy and Schady, 2013), the region is characterized by low educational levels. On average, workers in Latin America had less than 7.8 years of formal education in 2010, ranging from 4.1 to 9.7 years in 2010, compared to very low levels of 2.7 years of schooling in 1990.

The means were calculated as an average across all countries and were not weighted by population size. As shown earlier, for one point in time, labor force participation declined with age, on average from 92% for those aged 50–55 to less than 45% for those aged 65+. There is a large variation across Latin American countries, for example, LFPR for males aged 55–60 ranged from 61% (in Brazil, Chile, and Uruguay) to 94% (very high) in countries such as Bolivia and Venezuela. It is important to stress, however, that from 1990 to 2010, on average, changes in labor

force participation of older men were very slow. The large variation in male labor force participation rates is better seen by income group. When countries were divided

Table 4. Descriptive statistics, Latin American countries for 1990 and 2010

Variable	1990 (mean)	Std. Dev.	Min	Max
Male, LFPR (%), ages 50–54	91.90	2.97	85.72	96.14
Male, LFPR (%), ages 55–59	87.47	4.94	77.67	93.96
Male, LFPR (%), ages 60–64	72.18	15.45	20.10	93.26
Male, LFPR (%), ages 65+	46.71	16.93	8.19	70.71
GDP per capita	4632.53	3260.94	1362.17	17052.62
Gini Index	50.33	8.59	40.84	61.04
Percentage urban (%)	61.90	14.92	28.50	89.00
Pop. age 65+ (%)	4.96	2.03	3.21	11.60
Pop. age 15–64 (%)	57.56	3.96	50.93	63.93
Life expectancy	67.84	4.92	55.10	75.70
Years of schooling	5.61	1.64	2.70	8.10
Variable	2010 (mean)	Std. Dev.	Min	Max
Male, LFPR (%), ages 50–54	92.00	2.97	87.53	96.83
Male, LFPR (%), ages 55–59	88.26	3.91	77.57	94.47
Male, LFPR (%), ages 60–64	73.61	12.82	27.04	88.93
Male, LFPR (%), ages 65+	43.61	15.07	12.74	65.50
GDP per capita	9937.99	5762.90	1111.71	25384.04
Gini Index	49.63	4.07	44.49	55.91
Percentage urban (%)	71.08	14.91	48.80	94.00
Pop. age 65+ (%)	6.62	2.27	4.31	13.77
Pop. age 15–64 (%)	63.52	3.80	54.19	70.64
Life expectancy	73.43	3.95	61.80	70.65
Years of schooling	7.76	1.50	4.10	9.70

Note: GDP per capita is measured in purchasing power parity (PPP), 2010 US$.
Sources: International Labor Organization (ILOSTAT, 2016), World Bank Development Data (World Bank, 2016), and World Population Prospects: The 2015 Revision (United Nations, 2015)

in four income levels, poorer countries have much higher participation rates over time than wealthier countries. For example, the participation rates for males aged 55–59 was about 91% in low income countries compared to 85% in wealthier countries; the corresponding figures were 83% and 70% for males aged 60–64 (results not shown).

3.4.2 Statistical Modeling— GDP Per Capita Model

Panel A in Table 5 reports the relation between GDP per capita (natural log) and the male labor force participation rates for four age groups using the pooled data without distinguishing the country-specific effect and Panel B reports the results using the

Table 5. Linear coefficients of male labor force participation rates, estimates of income level effect, Latin America (countries were pooled), 1990–2010

Variable	Panel A: without country-fixed effect				Panel B: with country-fix effect			
Ages	50–55	55–60	60–65	65+	50–55	55–60	60–65	65+
Intercept	99.77***	109.94***	120.52***	158.44***	91.15***	74.79***	55.37***	75.44***
GDP Per Capita (ln)	-0.87 ***	-2.64***	-5.52***	-13.19***	1.16*	1.43	2.04	-3.55***
R^2	0.051	0.126	0.077	0.350	0.051	0.126	0.077	0.350

Notes: GDP per capita is measured in purchasing power parity (PPP), 2010 US$. Labor force participation rate is measured in percentage.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

pooled data with the country fixed effect. These models did not include any other variables. Panel A only provides estimates for intercountry variation.

For older men aged 65 and above, the result indicates that a 10% increase in GDP per capita would lead to a 1.26% reduction in the labor force participation in (Panel A). The trend was also observed for younger age groups, but with a much smaller magnitude. For the older age group, a larger proportion of the variation was also explained by the variation in income level. The results were very similar to what Clark *et al.* (1999) showed for a larger sample of countries in the 1990s. This indicates that the labor force participation rates of the older adults in Latin American countries tends to be lower as income level rises.

Panel B shows the results for the fixed-effects model. The results are not statistically significant except for age group 65 and above. The results indicate that, for the age group 65 and above, an increase of 10% in per capita GDP level would reduce the labor force participation by 0.34%. The fixed effect results indicate that the impact of income level on the labor force participation was smaller compared to the cross-country variation. That is, the pace of change observed in the analytical period was slower than what one could conclude from analyzing only cross-sectional estimate. The GDP per capita regression model explained a significant portion of the observed variation, especially for older workers, but it is important to consider other variables related to economic development, demographic and labor market changes, and the structure of old-age pension programs.

3.4.3 Statistical Modeling – Full Model

Table 6 shows the results of using the pooled data for all countries, all periods, and four different age groups, controlling for other covariates noted earlier. The results indicate that the labor force participation rates of males aged 60 and above in countries with a relatively matured pension system (measured by the time they exist) declined in 1990–2010, and that the labor force participation rate of males aged 55–59 in countries with a relatively matured system was higher than that in countries where the systems were less matured. The results also indicate that in more urbanized countries, older males' labor force participation rates were lower than those in less urbanized countries. This is probably related to the composition of the industry, with greater concentration of workers in the industry and services for more urbanized countries. Along these lines, results show that as the share of workers in the informal sector increased, the labor force participation of older males also increased. In general, those workers are not covered by the public pension system and need to remain in the labor force for longer periods of time to accumulate sufficient fund for their retirement life. Finally, results indicate that the age structure of the population played an important role in the overall rate of labor force participation of older males. An increase in the share of working-age population significantly reduced the labor force participation of older males. For example, for males aged 60–64, a 1% increase in the share of the working age population reduced the labor force participation rate of that group by 1.16 percentage points.

In the fixed-effect model, all variables lost statistical significance and some changed the direction. Only for age groups 60–65 and 65 and above the coefficient of the degree of coverage of the public pension program was statistically significant. This result indicates that countries with a relatively mature public pension program might be creating incentives and opportunities for workers to leave the labor force at earlier ages, whereas in countries with small pension programs, older adults need to remain in the labor force until very old ages. This indicates that unobserved country characteristics might play a significant role on determining elderly labor force participation.

In summary, the multivariable analyses on the determinants of labor force participation rates of older males in Latin America in the period 1990–2010 show that economic development, population aging, and variables related to the structure of the old-age pension system had important impacts on older males' labor force participation

in the region. It is important to stress, however, that the impacts were much stronger for the cross-countries variations (pooled data without country-fixed effect) than for the within country variation over time. The relationships between economic development, population aging, development of public pension programs, and labor

Table 6. Linear coefficients of male labor force participation rates, Latin America (countries were pooled), 1990–2010

Panel A: without country-fixed effect				
Variables	Ages 50–54	Ages 55–59	Ages 60–64	Ages 65+
Contributors per worker	-0.056	-0.081 *	-0.20 **	-0.31 ***
% Pop. ages 15–64	-0.39 *	-0.76 **	-0.91 **	-0.89 **
GDP per capita (*ln*)	0.26	1.57	4.64 *	4.47
% Urban pop.	0.02	-0.92 *	-0.21 **	-0.24 **
Schooling (years)	0.87 ***	0.93 *	0.62	-1.17 *
% Self-employed	0.05	-0.02	0.14 **	0.42 ***
Intercept	107.18	124.54	104.79	86.07
R^2	47.56	56.66	76.94	85.35
Panel B: with country-fixed effect				
Variables	**Ages 50–54**	**Ages 55–59**	**Ages 60–64**	**Ages 65 +**
Contributors per worker	0.04	-0.08	-0.29 **	-0.23 *
% Pop. ages 15–64	0.09	-0.34	-1.32 **	-0.04
GDP per capita (*ln*)	2.77	4.57	8.42 *	-2.14
% Urban pop.	0.33	0.09	0.19	-0.39
Schooling (years)	-2.45	-1.33	-0.79	-1.24
% Self-employed	-0.03	-0.05	0.01	0.02
Intercept	55.46	76.47	88.62	113.71
R^2	23.37	28.90	38.91	65.25

Notes: GDP per capita is measured in purchasing power parity (PPP), 2010 US$. Labor force participation rate is measured in percentage.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

force participation of older adults are not simple, as well as complicated and nonlinear. This line of research is important and further analysis should be conducted in order to better understand the responses of the labor supply of the elderly to those variables in less developed economies.

4 Concluding Remarks

This paper examined the relationship between older men's labor force participation for four different age groups and the observed changes in the country for 23 Latin American countries from 1990 to 2010. The results show that the labor force participation of older men in Latin American countries witnessed a steady decline in the period 1990–2010 and that in lower-income Latin American countries, most men remained in the labor force until age 65 or beyond. In general, although there were widespread differences across countries in Latin America, the percentage of the older males in the labor force in the region was higher than in more developed countries of the world over 1990–2010. Within Latin America, most males remained in the labor market until age 65 or beyond in economically poorer countries. For relatively developed economies in the region, the labor force participation of older workers witnessed a decline with age and over time in countries with an older population age structure and countries where old-age support systems were already in place. Overall, urbanization, economic growth, population aging, and changes in the labor market, such as increasing formal labor relations and reduction of agricultural work, were

related to the reduction of the labor force participation rates of older males in Latin American countries. The results observed here went in a similar direction as observed elsewhere (Clark and Anker, 1990; 1993; Clark, Young, and Anker, 1999; Nava-Bolaños and Ham-Chande, 2014).

Given that increases in GDP per capita usually mean economic growth, urbanization, population aging and more matured public pension programs, thus when GDP per capita increases, the labor force participation rates of older males, even those aged 55–59, start to decline. However, even if economic development and public pension programs could explain the decline in labor force participation to a large extent, they might not be the best explanatory factors for ages 50–54 and ages 55–59, because health status of the older workers may explain these declines as well. However, due to unavailability of data on whether those leaving the labor force were because they retired from work, lose their jobs and decided not to look for another job, or because their health conditions forced them to retreat from labor force, we were not able to investigate root causes of decline in labor force participation. Our findings should also be interpreted with caution because education level and income level are not completely exogenous to the labor force participation of older adults. The regression of labor force participation on income level (or education) likely introduced some econometric problems. For example, estimated coefficients could be capturing differences between countries, which may cause unobserved heterogeneity.

The rapid process of population aging will have huge impacts on the public old-age support system for the older population in Latin America. The increase in old age dependency ratio means that a larger number of potential beneficiaries will depend on a smaller number of workers. The results also suggest, for Latin America, that as economic grows and pension systems become universal and more generous, the labor force participation at older ages tend to decline more rapidly (Bloom and McKinnon, 2010). The importance of old-age support systems throughout the world is unquestionable, and the well-being of the older population depends heavily on the provision of income from such programs (Melguizo, Bosch, and Pages-Serra, 2017). However, the necessity to adjust such programs to population aging is clear and fundamental. One of the main questions in this discussion is how the reform, and in some cases the implementation of the programs, should take place, and which generations will afford for the burden of the reform. Further research should focus on country-specific studies, such as the coordinated study by Gruber and Wise (1999) to better understand the relation to elderly labor force and retirement behavior in less developed economies. The results aggregated to the regional level in Latin America raises the importance of country-specific studies following research for Mexico (Aguila, 2014) and for Brazil (Queiroz, 2008).

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Ethics Approval

Not applicable as this study used secondary aggregated data from publicly available sources.

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Appendix

List of countries under study

No.	Countries	No.	Countries
1	Argentina	13	Nicaragua
2	Bolivia	14	Panama
3	Brazil	15	Paraguay
4	Chile	16	Peru
5	Colombia	17	Uruguay
6	Costa Rica	18	Venezuela
7	Dominican Republic	19	Bahamas
8	Ecuador	20	Belize
9	El Salvador	21	Haiti
10	Guatemala	22	Jamaica
11	Honduras	23	Suriname
12	Mexico		