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SOCIAL SECURITY PENSIONS AND RETIREMENT DECISIONS IN MEXICO

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Abstract

Using Mexican cohort data for 1991-2000 this article examines the relationship between retirement decisions –the transition from work to labor market inactivity– and social security (contributive) pensions in less developed countries. The available large time series also makes possible to examine how a financial crisis that took place in 1995 has affected retirement incentives. In most Latin American countries social security pensions are non-universal and it may be possible to receive pension benefits and continue working in the informal sector. In an attempt to capture the no-intention to continue working at a given age, the analysis of retirement behavior begins with the construction of a measure of retirement incentives based on the "option value" (Stock and Wise 1990) that accounts for the size of the informal sector to study the role of social security pensions at the economy-wide level. Then, retirement outcomes are regressed on the measure of retirement incentives. The calculations show that the gain of postponing retirement rises with age but increments are reduced dramatically over time for younger cohorts after economic crises. The results indicate that social security pension wealth is important in determining the probability of retirement even in a country with a relatively large informal sector; pension wealth is positively and strongly associated with the propensity to retire.

Keywords: retirement, social security pensions, pension wealth, informality, Mexico.
JEL Classification: J26, H55, J14, O17, N36.

Introduction

Retirement is a particular case of the life cycle labor supply which relates to the decision of whether to remain in the labor market at old-age. The timing of retirement has implications for the economic well-being of households due to changes in saving and consumption decisions as well as for aggregate labor market outcomes (such as labor force participation rates, the aggregate level of output, and the distribution of wages). Therefore, understanding retirement behavior is important to guide pension policy.

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In most Latin American countries studying retirement behavior is not an easy task. Knowing when the elderly withdraw from the labor force may be uncertain; although workers have to leave their formal sector jobs to receive the old age social security pension, the informal sector provides an option to continue working (from a cross-country sample of 12 countries in Latin America, Bertranou (2005) concludes that the main channel to exit from the labor market for males aged 60 or more is having worked in the informal sector).

This paper is aimed at studying retirement and its relation with social security pensions, in a context of non-universal social security coverage. Here, it is believed that if public policies for the elderly are concerned about the well-being of the whole elderly population the study of retirement behavior should include people from both, formal and informal sectors. Notwithstanding, it is valid to focus on the retirement behavior of those in the formal sector only (Aguila 2007), as (fragmented) social security institutions were originally created to provide insurance to specific groups of workers.

The literature on the relationship between retirement and social security in developed countries has found that generous pension systems have led people to choose to retire early (Gruber and Wise 1999, 2004). In developing countries with non-universal pension coverage the role of social security institutions on retirement remains unclear. Using repeated cross-sections of Mexican employment data, the study of retirement behavior begins with the construction of a measure of retirement incentives (see Aguila 2007, Alvarez et al. 2010, Cerda 2005, and Lanza-Quiroz 2006 on the construction of these variables for Brazil, Chile, Mexico and Uruguay) that includes the budget constraint of those in the informal sector. The result is a weighted (by the probabilities of having social security) measure that allows the examination of changes in pension wealth across age and over time for cohorts born between 1911 and 1940 when retirement is postponed. The measure of retirement incentives is based on the option value model (Stock and Wise 1990).

Across cohorts, the gains in pension wealth show considerable reductions over time. Older cohorts have experienced larger gains in pension wealth of postponing retirement. In contrast, younger cohorts born between 1930-1940 have much smaller real gains of postponing retirement than those of their predecessors. Retirement incentives reflect to a large extent how financial crises have affected real wages and pension wealth in Mexico.

Then I look at how institutions affect retirement behavior under non-universal social security coverage using regression analysis. An individual is defined to be retired if he is both, not working and not looking for a job at the moment the survey took place, in an attempt to capture the no-intention of going back to work. The results suggest that social security incentives to retire have a small but positive and very significant effect on the probability of being retired; an increase of $100,000 pesos in the measure of incentives (about 1.16 times the annual wage of an individual with average level of education)[2] increases the probability of retirement by approximately 0.034 percentage points.

These results illustrate that social security provisions can have a moderate but positive effect on retirement in a setting where there are reductions in pension wealth over time and non-universal social security coverage. The paper is structured as follows. Section 1 reviews the literature on retirement and social security; Section 2 describes and presents the characteristics of

[2] The average level of education is equivalent to having less than primary education.

the data. Section 3 focuses on the construction of the measure of retirement incentives accounting for non-universal coverage; Section 4 presents the econometric model and the results, and Section 5 concludes.

1. Review of the Literature on Retirement

The concept of retirement has described different forms of behavior in the literature. It has been defined as a transition from full-time work to complete withdrawal from the labor market; other definitions include the retirement age as start receiving social security pensions (Atkinson 1987, Lazear 1986, Lumsdaine 1996, and Lumsdaine and Mitchell 1999). In a context of limited social insurance and informality complicates the definition of retirement; a person who leaves the current formal sector job to be eligible to claim a social security pension may continue working in the informal sector. Therefore, being a *pensioner* (someone who receives social security benefits) may not be equivalent to being *retired* (out of the labor force), as in many other countries.

The paper by Lumsdaine and Mitchell (1999) motivates the study of retirement by saying that it is an interesting economic phenomenon for two main reasons; i) because being old in the previous centuries meant being in poverty and with poor health; thus, the study of the retirement process may be of great help to assess the extent to which this is true; and ii) because it is a labor supply decision that represents an important aspect of the individuals' behavior.

Economic models are based on the framework that describes a utility maximization process to find the optimal choice of income and leisure. In these models, accrued social security wealth induces a wealth (income) effect but there is a prospective substitution effect arising from the incentive to accrue additional social security wealth. There are static and dynamic models of retirement. In a static framework, one-period models assume perfect capital markets and income certainty. The optimal retirement problem can be represented as the choice of how many years to work. The timing of retirement involves comparing the utility of withdrawing from the labor market with the utility of continuing in paid employment, subject to the individual's budget constraint. The result is that an individual will work until the marginal product of labor falls below the marginal utility of leisure. Some examples of early studies of retirement are Boskin (1977), Boskin and Hurd (1978), Burkhauser (1979, 1980), and Gordon and Blinder (1980).

The main difference between the static and dynamic frameworks is that in the latter retirement is affected by the present value of income streams, instead of the current value of income at the time of retirement. Dynamic models have been mostly used to show the influence of pension schemes on retirement decisions (Burbidge and Robb 1980, Burtless and Moffitt 1984, 1985, Burtless 1986, Fields and Mitchell 1984, Gustman and Steinmeier 1986, 1991, Stock and Wise 1990).

When retirement has been explained within the life-cycle framework the focus is on the possibility of having a pension in the future, which induces changes in the individual budget constraint. Usually, the latter includes the present value of income earned until retirement as well as the present value of pension benefits earned at, and after, retirement. The substitution effect in this framework depends upon the shape of the earnings profile —which may decrease with age due to human capital depreciation and may discourage work after certain age.

Some dynamic models also allow for intertemporal re-optimization as people age. Rust (1989) makes assumptions about the stochastic processes that describe the individual behavior and uses dynamic programming techniques to find the optimal timing of retirement. Similarly, Stock and Wise (1990) develop the option-value model. Within this framework the optimal retirement choice results from comparing changes in the utility obtained from retiring now versus the utility obtained from continued work, as individuals age. The option value also models explicitly the financial incentives to retire that are embedded in pension schemes. The main difference of the option value with Rust's model is that in the latter the optimizing choice focuses on the maximum of the expected values whereas in the option value retirement is based on the expected value of the option with maximum utility.

Another branch of the literature on retirement discusses that in private —employer provided or occupational— schemes pensions' compensation can be backloaded or deferred to reduce unwanted turnover. These pension plans provide incentives for workers to stay in a firm until they receive the deferred compensation, but also provide incentives to discourage postponed retirement. It has been found that in these schemes spikes in pension wealth at certain ages encourage retirement at those ages. (Lazear 1979, 1983, Lazear and Moore 1988, Ippolito 1985).

Comprehensive surveys on the effects of public and private pensions on retirement in developed countries are presented in Atkinson (1987), Lazear (1986), Lumsdaine (1996), and Lumsdaine and Mitchell (1999). Reduced form models which are not explicitly related to the maximization process have also been used to study retirement. One example is the hazard model, which focuses on the waiting time until retirement occurs, which can be either discrete or continuous in time, and has censored information for those who have not retired. Some examples are Meghir and Whitehouse (1997)—which studies transitions in and out of employment in the UK with a multiple spell model controlling for pension benefits out of work —and Siddiqui (1997)—which uses a discrete-time hazard model and the option value as the explanatory variable to look at policy simulations affecting the probability of retirement by changes in the German pension system.

A generalized result in more recent studies that focus on the effects of social security in Organization for Economic Cooperation and Development (OECD) countries is that social security provides strong disincentives to participate in the labor market at old-age (see for example, the studies by Blondal and Scarpetta 1999 and Gruber and Wise 1999, 2004). Studies of this type, however, are very scarce for Latin American countries (see Cerda 2005 and Aguila 2007). Few empirical studies on the determinants of retirement emphasize that retirement decisions may depend not only on the incentives provided by the pension system but also on adverse labor market and unemployment conditions. Peracchi and Welch (1994) and Disney (1998) have pointed at demand-side factors as important determinants of whether jobs are available and its relation with retirement. The relation of social insurance coverage and retirement has been studied in context of the U.S. Having health insurance seems to be associated with job-lock as people may choose not to retire while health insurance is available; for instance, until the age of 65 when entitlement to medicare is universal (Gruber and Madrian 1993a, 1993b).

This paper makes its contribution on the topic of retirement and the role of social security institutions in Latin America by examining a context of non-universal social insurance using Mexican data. On the one hand, lack of additional sources of income[3] other than labor income for

[3] Attanasio and Székely (1999) found that mean saving rates in Mexico between 1984-1996 are very low or even negative for the poorest quintiles.

individuals that are non-eligible to receive social security pensions may force them to work at old-age; on the other hand, those covered by social security[4] can continue working in the informal sector. Thus, it is of interest to know whether and how social security institutions affect the retirement behavior of the population in a situation of non-universal social security.

2. Data Source

The fact that pensioners can take up another job in the informal sector after claiming their pensions means the pensionable age—at which individuals are eligible to claim pension benefits—can be different from the retirement age—at which they actually withdraw from the labor market. In this paper an individual is defined to be retired if is both not working and not looking for a job at the moment the survey took place. With this definition I attempt to capture the individual's intention to remain out of the labor force. Inevitably, if people changed their minds in the future with respect to this decision the analysis of retirement would be more complicated.

I use the *Encuesta Nacional de Empleo* (ENE), it consists on repeated cross-sections for the years 1991, 1993, 1995, 1996, 1997, 1998, 1999, and 2000, which can cover a time-span of 10 years. The data were collected by the *Instituto Nacional de Estadística, Geografía e Informática* (INEGI). At present this survey has been replaced by the *Encuesta Nacional de Ocupaciones y Empleo* (ENOE) to allow comparisons in the definition and measurement of employment and unemployment between Mexico and other OECD countries. The several waves of the employment survey provide fresh data, a large sample size, and additional variation across time, which helps the estimates' consistency.

The ENE has information of household residents aged 12 and more years about occupation, employment conditions, unemployment, educational attainment, family structure, dwelling characteristics, and social security affiliation. The pooled cross-sections make possible to study retirement behavior over time, by following cohorts of individuals. Individuals are classified into three education groups: low (if they have less than primary education), medium (if they have primary education), and high (if they have more than primary education). Cohort sample size varies between n=179 for the oldest cohort (1911) and n=4,893 for cohort 1931. For the youngest cohort, 1940, n=1,734.

3. Measuring Retirement Incentives Accounting for an Informal Sector

At difference with OECD countries for which measures of retirement incentives have been computed, in some countries like Mexico there is an informal sector.[5] Why should we care about retirement of people in the informal sector? Certainly, if those without social security do not pay contributions

[4] Solis and Villagómez (1999) have documented that among Mexican households that received income from pensions in 1984 and 1992, pensions represent more than 90% of total income in the poorest households, and about 60% in the richest households.

[5] For a discussion on the differences between, and characteristics of, the formal and informal sector, see CISS (2005).

they will not be entitled to social security pensions. However, if the aim of social policy is to provide all citizens with at least a minimum pension benefit at old-age, then it is pertinent to look at the influence of the existing institutions on individual behavior including all the elderly.

People belonging to the informal sector presumably are not entitled to receive an old-age pension but may also have the choice of not working at old-age. As it is not clear whether some of them contributed for some time to the pension system in the past or if they indirectly receive some benefits from the pension system (via informal transfers from other pensioners, for example), the approach I follow to study retirement incentives in Mexico consists on focusing on all members of a cohort composed by people in the formal and the informal sectors. I develop a semi-aggregate measure of retirement incentives that accounts for the composition of the labor market, which describes changes in the system-wide incentives over time.

There are two relevant aspects to calculate the weighted measure of retirement incentives. First, the differentiation of budget constraints according to entitlement to social security; the budget constraint in the option value model (Stock and Wise 1990) comprises both, the wage and the pension wealth profiles; the measure of incentives developed here is based on this approach. The second aspect is weighting the budget constraints by the probability of being eligible to obtain social security benefits. This weighting procedure is similar to what is discussed in Gruber and Wise (2004) when there are different paths to retirement.[6] In the present case the two existing paths to retirement are "with" and "without" an old-age pension. As in Gruber and Wise, the weights are the probabilities of each option.[7]

3.1 Pension rules

Social security in Mexico is non-universal and fragmented. The major social security institutions are the *Instituto Mexicano de Seguridad Social* (IMSS), which was established in 1943 for workers of the private sector, and the *Instituto de Seguridad Social al Servicio de los Trabajadores del Estado* (ISSSTE), which provides social security to workers of the public sector. There are other much smaller social security institutions such as *Petroleos Mexicanos* (PEMEX) for workers of the oil industry, *Instituto de Seguridad Social de las Fuerzas Armadas* (ISSFAM) for the military, and some very small regional schemes.

As there is no information available on pension wealth for all different pension schemes in Mexico, simulations of this variable will focus on the rules of the general obligatory regime –main social security provider, for private sector workers—by the IMSS. The fact of using IMSS' pension rules to represent retirement incentives of all individuals is debatable; however, the remaining social security providers insure public sector workers who tend to have more generous old age pensions; thus, these calculations can be seen as a lower bound for the accumulated amount of pension wealth. Simulations are based on the old defined benefit scheme because older cohorts in the coming years after the 1997 reform will receive their old age pension using these rules.

[6] For example old-age pensions, disability pensions, and unemployment benefits.

[7] The probability of being covered by social security arises naturally from aggregation of the social security coverage status across individuals that belong to a cohort.

In Mexico, as in Chile, the defined benefit scheme of IMSS was substituted with a defined contribution one, which is managed by private AFORES (*Administradoras de Fondos de Pensiones*). The reform affects the pension wealth of younger generations of workers who enter the labor market after July 1997 and will retire in the coming decades. In contrast, for workers who have contributed to the pension system before the reform pensions are calculated as the maximum between the calculation of the defined benefit pension versus the calculation of the defined contribution pension resulting from the balance in the individual account. As long as the defined benefit pension is higher than the defined contribution pension, the rules of the defined benefit scheme will still apply to calculate pension wealth.

Pension wealth is calculated according to the rules of the defined benefit scheme, which include the final salary, the number of years in service, and the pensionable age. An individual can claim an old-age pension from the age of 65 if he has contributed at least 10 years to the system.[8] The formula to calculate the pension benefits is:

$$P=Sp\,(\beta+\alpha\,(\,number\ of\ contributed\ years-10))$$

Where Sp is the pensionable salary relative to the minimum wage. It is equal to the average salary of the last 5 years with a ceiling of 10 times the minimum wage. β is a constant which takes values between 13 and 80%, it affects the pension in a redistributive way; for example if Sp is equivalent to 1.5 times the minimum wage β is 58.18%, but if it is equivalent to 6 or more times the minimum wage α is equal to 13% (see Table 1). α is a constant which takes values between 0.56 and 2.45%, this factor increases the pension in relation to the number of years that have been contributed to the system in excess of 10. The sources of variation in pension wealth across individuals are the years of contributions, the values of Sp, α, β, and the changes in minimum wages.[9]

3.2 Measures of retirement incentives

The measures of retirement incentives describe the financial gain or loss in pension wealth from continued work, or retirement. In defined benefit schemes pension wealth is computed using a formula. The parameters needed for the calculations generally are the number of years in service, the age at retirement and, a function of the final salary. In general, each extra year of work can increase the pension in two ways. An extra year of work adds to the number of years in service in the formula and, the base salary for the calculation of the pension is increasing if the wage profile rises with age.

[8] 65 is the statutory pensionable age. However, from the age of 60 workers can be entitled to an "early retirement" pension. In this case the pension is reduced 5% per year claimed before the age of 65.

[9] Changes in minimum wages affect pension wealth because pensionable salary is measured as a proportion of the minimum wage.

Table 1
Values for α and β in the Defined Benefit Formula

Pensionable Salary (Sp) /Min Wage	β(%)	α(%)
0.00-1.00	80.00	0.563
1.01-1.25	77.11	0.814
1.26-1.50	58.18	1.780
1.51-1.75	49.23	1.430
1.76-2.00	42.67	1.615
2.01-2.25	37.65	1.756
2.26-2.50	33.68	1.868
2.51-2.75	30.48	1.958
2.76-3.00	27.83	2.033
3.01-3.25	25.60	2.096
3.26-3.50	23.70	2.149
3.51-3.75	22.07	2.195
3.76-4.00	20.65	2.235
4.01-4.25	19.39	2.271
4.26-4.50	18.29	2.302
4.51-4.75	17.30	2.330
4.76-5.00	16.41	2.355
5.01-5.25	15.61	2.377
5.26-5.50	14.88	2.398
5.51-5.75	14.22	2.416
5.76-6.00	13.62	2.433
6.01+	13.00	2.450

Source: Own elaboration.

Several measures of retirement incentives have been used in the literature to asses how social security pensions affect retirement decisions. One basic measure of incentives is the replacement rate, which indicates the proportion that pension benefits represent from the last wage. A second measure is the expected pension wealth, PW_t, which is the present value of future benefits net of the present value of contributions from continued work. Another measure of incentives is the pension wealth accrual, which is the change in the promised social security benefits from working one additional year, $PW_{t+1} - PW_t$.

Positive or non-negative values of the pension wealth accrual would be expected when a person works an additional year and thus forgoes a year of benefits, because benefits that will begin one year later may be increased to offset the fact that they are received for one fewer year. If the pension wealth accrual is negative the continuation in the labor force represents a loss in pension benefits, which provides an incentive to stop working. Some of the elements that affect whether the pension wealth accrual is positive are: i) the age at which the person is eligible to receive an old-age pension, and ii) whether pension benefits and additional labor income are taxed.

The pension wealth accrual has been found to be negative in several OECD countries by examining another measure of incentives, the implicit social security tax on work (Gruber and Wise 1999).[10] The implicit social security tax on work is the ratio of the pension wealth accrual (when retirement is postponed one year) to wage earnings[11] during the year of postponement. A negative pension wealth accrual means that what workers' gain in wage earnings is offset by a loss in social security benefits, which discourages continuation in the labor force.

Another two more dynamic measures of incentives that have been widely used to study retirement decisions are the peak value (Coile and Gruber 2000) and the option value (Stock and Wise 1990). The peak value is the difference between the total expected pension wealth that is accumulated by the start of the period and the maximum expected total pension wealth an individual could accumulate looking forward across all future years. This measure of incentives is related to the option value as it will be seen below. The option value is described in more detail since the measure of incentives that is proposed in this paper to account for the presence of an informal sector is based on this model.

3.2.1 The option value model

The option value model[12] provides another measure of incentives to represent the changes in pension wealth related with retirement or continuing work, considering the entire future path of accruals. Continuing work preserves the option of retiring later, hence the terminology "option value" of work. The model explicitly accounts for the fact that wage earnings change over time, and that such changes in turn affect the social security wealth accrual. It combines a "lifetime budget constraint" approach with the time dimension of retirement through variations in age—which not only characterizes retirement but also may affect the desire for it. The model thus allows for updating of information and considers potential compensation many years in the future.

The option value attempts to capture the irreversibility of retirement[13], and focuses on the opportunity cost of retiring, or equivalently, on the value of retaining the option to retire at a later

[10] In Gruber and Wise (1999) it is found that the social security implicit tax on earnings can be equal to 80% or more at certain ages in countries of the OECD. This result is explained in part because benefits are not increased enough if the age of benefit receipt is delayed so that benefits are not "actuarially fair".
[11] After tax.
[12] This subsection is built based on Stock and Wise (1990).
[13] Although it may not be uncommon to work at least part-time, after claiming a pension it is rare to return to the firm from which one has retired.

date. One of the key aspects in the model is that a person will continue to work at any age if the expected present value (in utility units) of continuing work is greater than the expected present value of immediate retirement. Therefore the person compares the best of expected future possibilities with the value of retiring now.[14]

In line with the notation of Stock and Wise, consider a person at the beginning of year t who has not yet retired. Looking ahead he will receive wage income Y_s in year s as long as he continues to work; if he is retired in year s he will receive retirement benefits B_s. Let r denote the first full year of the individual's retirement (when he has no wage earnings). The decision function around the retirement decision is constructed assuming the individual indirectly derives utility $U_w(Y_s) = Y_s^{\gamma}$ from the real income earned while working, and utility $U_r(B_s(r)) = k(B_s(r))^{\gamma}$ from the pension benefits received while retired.[15] With probability equal to one the person dies by year S.

If the individual retires at age r, the discounted value received over the remainder of his life is:

$$V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} E_t(Y_S)^{\gamma} + \sum_{s=r}^{S} \beta^{s-t} E_t(kB_s(r))^{\gamma}$$

Where:

Ys = future wage stream

Bs = social security pension benefits weighted by the probabilities of being alive at each age

β = discount factor

$E(\cdot)$ = individuals' expectations about future circumstances based on information at year t.

The expected gain in year t, from postponing retirement to when he is age r is given by:

$$G_t(r) = V_t(r) - V_t(t)$$

The individual retires at age r^* if there is no expected gain from continued work:

$G_t(r^*) = V_t(r^*) - V_t(t) \leq 0$, where otherwise he postpones retirement.

Thus the gain from postponing retirement to r versus retiring at t is:

$$V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} E_t(Y_S)^{\gamma} + \sum_{s=r}^{S} \beta^{s-t} E_t(kB_s(r))^{\gamma} - \sum_{s=t}^{S} \beta^{s-t} E^t(kB_s(t))^{\gamma}$$

[14] This model is similar to the dynamic programming model of Rust (1989) but with a simpler retirement decision rule.

[15] γ is the parameter of risk aversion and k the utility of a peso of income obtained while retired related to the utility of a peso of income while working.

If r* is the retirement year that gives the maximum expected gain, the option value is equal to the discounted utility of future wages plus, the discounted utility of benefits if retired at r* reduced by the discounted utility of benefits if retired at t:[16, 17]

$$OV_t(r^*) = \sum_{s=t}^{r-1} \beta^{s-t} E_t(Y_S)^\gamma + \left[\sum_{s=r^*}^{S} \beta^{s-t} E_t(kB_S(r^*))^\gamma - \sum_{s=t}^{S} \beta^{s-t} E_t(kB_S(t))^\gamma \right]$$

3.3 A measure of retirement incentives when there is non-universal social security

In this paper it is believed that to the extent that public policies for the elderly are concerned with the well-being of the whole population an analysis of the influence of institutions on individual behavior should focus on both, formal and informal sector workers. Nevertheless, it is completely valid to examine the behavior of those in the formal sector only (see for example Aguila 2007) as fragmented social security institutions are insuring the groups of workers they were created for. At present, in Mexico as in many other countries the very poor elderly workers of the informal sector may be eligible to receive a non-contributory pension (Bertranou et al. 2002); these pensions however are excluded from the analysis as the retirement data from the ENE belongs to the years 1991-2000 when these programs were not operating.

In this section I present a measure of retirement incentives to look at the changes in the gain from postponing retirement[18] across age and over time according to the rules of the Mexican pension system and the composition of the labor market.

Let *i* represent the characteristic of having social security and *j* of not having it. For a given cohort *c*, the proportion of individuals with social security can be represented as *p*; thus 1 - p is the probability of belonging to the informal sector or not having social security in that cohort. A measure of retirement incentives for cohort c at age a, $I_c(a)$, can be approximated as the sum of the retirement incentives for those eligible to receive social security and those non-eligible, weighted by the probability of eligibility.

$$I_c(a) = p\left\{I_c^{\,i}(a)\right\} + (1-p)\left\{I_c^{\,j}(a)\right\}$$

Let n_c^i be the number of individuals in a cohort who are eligible to receive social security pensions, and n_c^j the number of individuals who are not, the cohort size is $N_c = n_c^i + n_c^j$. Thus $p = n_c^i / N_c$ and $1 - p = n_c^j / N_c = 1 - n_c^i / N_c$ are the probabilities that weight retirement incentives according to social security eligibility, which arise naturally when grouping individual data across cohorts.

[16] To calculate the option value OV_t, it is necessary to calculate the gain from postponing retirement to r vs. retiring at t, $V_t(r)$, and find a within-horizon maximum value of retirement at some future r* for each age.

[17] The peak value is the expression within brackets. The difference with the option value is that the peak value does not include the wage component to account for the possibility that wages can be a proxy for differences in the tastes for work. However, to the extent that wages have an important influence on retirement this measure understates retirement incentives (Gruber and Wise 2004).

[18] In Mexico disability pensions are not thought as a major path to retirement as the number (and amount) of granted pensions is low and has diminished over time (CISS 2005). In addition, there is no comprehensive unemployment insurance that could be considered a route to retirement.

If, as in the Stock and Wise model, utility at each age (a) is derived from real income earned while working $Y_c(a)$ and from pension benefits received while retired $B_c(a)$, for those non-eligible to receive social security benefits pension wealth is not an element of the budget constraint, only wages:

$$I_c(Y_c(a),B_c(a)) = \frac{n_c^i(a)}{N_c(a)}\left(I_c^i(Y_c(a),B_c(a))\right) + \left(1-\frac{n_c^i(a)}{N_c(a)}\right)(I_c^j(Y_c(a))$$

Retirement incentives for cohort c at age a represent the gain of postponing retirement to age a, following the Stock and Wise notation, $E_tV_t(a) - E_tV_t(t)$. For those who are eligible to receive social security benefits the first component of $I_c(Y_c(a), B_c(a))$ can be approximated (omitting the cohort subscript) as:

$$I^i(Y(a),B(a)) = \sum_{s=t}^{a-1}\beta^{s-t}E_t(Y_s)^\gamma + \sum_{s=a}^{S}\beta^{s-t}E_t(kB_s(a))^\gamma - \sum_{s=t}^{S}\beta^{s-t}E_t(kB_s(t))^\gamma$$

Where Y_s represents income from wages and B_s represents social security benefits. The second element of the weighted measure of retirement incentives corresponds to those in the informal sector therefore it is only a function of income from wages while working. If retirement occurs age a it is assumed there is no other source of income.

$$I^j(Y(a)) = \sum_{s=t}^{a-1}\beta^{s-t}E_t(Y_s)^\gamma$$

The weighted measure of retirement incentives $I_c(Y_c(a), B_c(a))$ shows the influence of social security institutions on retirement of a cohort, if all members of it retired at age a, accounting for sector composition. This may help understanding the variation in the financial gain from delaying retirement across age and over time.

3.4 Results of the simulations

The measure of retirement incentives represents the difference between the total expected income that is accumulated by the age of 60 and the expected income that is accumulated looking forward across all possible ages, when retirement is postponed. The expected wage and pension wealth profiles are calculated assuming as a base case representative individuals belonging to each cohort, which earn the mean wage in each education group—low, medium and high. As pension wealth depends on labor market histories I assume 10 years of uninterrupted[19] contributions by the age of 60. Social security benefits $B_s(a)$ are adjusted by the probabilities of being alive at age a using mortality tables elaborated by the United Nations-ECLAC.[20] It is also assumed that individuals die with probability 1 at S = 80 and that $\beta = 0.97$—the interest rate equals 3%.[21]

[19] This is a very strong assumption that has been used in the OECD pension models.

[20] Economic Commission for Latin America and the Caribbean.

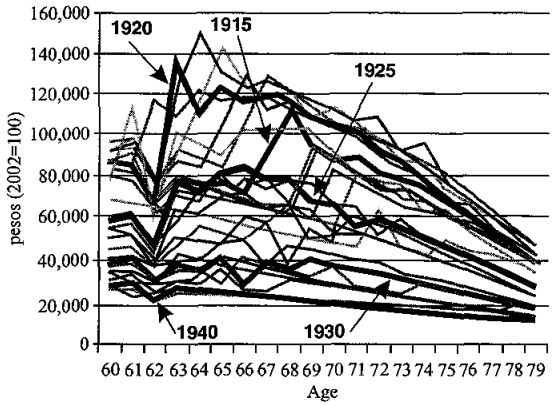
[21] The results are reported using the suggested interest rate of 3% as in many other studies of this type.

A measure of retirement incentives of the option value type can be estimated as in Stock and Wise by maximum likelihood to obtain the parameters γ (the parameter of risk aversion) and k (the utility of a peso of income obtained while retired related to the utility of a peso of income while working—if $k > 1$ a peso of income gives more utility while retired). Since the aim of this exercise is not to calibrate the results with actual data on retirement outcomes (which do not exist) but to simulate the variation in retirement incentives, γ and k have been set equal to 1. The assumption about risk preferences $\gamma = 1$ implies the utility of the expected value equals the expected value of the utility.[22]

Figures 1 to 3 show the changes in $I_c(Y_c(a), B_c(a))$, the measure of retirement incentives, across age and over time, by education level in real prices of 2002. At a given age, as one moves across cohort profiles, changes over time in the gain of postponing retirement can be looked at. Figure 1 shows the incentives' profiles emphazising the behavior of cohorts 1915, 1920, 1925, 1930 and 1940 (bold lines). These reach values between 10,000 and 140,000 pesos (2002=100). For this low-education group retirement-incentives' profiles look concave for the older cohorts, but for the youngest (older cohorts) these become flat.

The age profile of cohort 1915 lies below the one of cohort 1920. This indicates that cohort 1920 has a higher gain from delaying retirement than cohort 1915, between ages 60 and 80. However, the gain decreases for successive cohorts born since 1920 (profiles are shifted downwards). This behavior is also observed in the medium and the high educated groups (below). Reductions in the gain from delaying retirement with age are due to mortality, which increases with age, and also due to contractions in real wages. The youngest cohort shown is 1940; it has the smallest retirement incentives among all cohorts under study.

Figure 1
Changes in Retirement Incentives across Cohorts and Age. Low-educated



[22] *Uw (Ys) = Ys = Et(Ys).*

Figure 2 shows the age profiles of retirement incentives across cohorts for the medium-educated group. For the main cohorts under examination, these reach values between about 25,000 and 480,000 pesos. The age profiles are less concave; they seem to decrease linearly from the age of 68. As previously mentioned, cohort 1920 has higher gains from delaying retirement than cohort 1915; this happens until the age of 72, after this age the gain of postponing retirement of both cohorts is quite similar.

Figure 2
Changes in Retirement Incentives across Cohorts and Age. Medium-educated

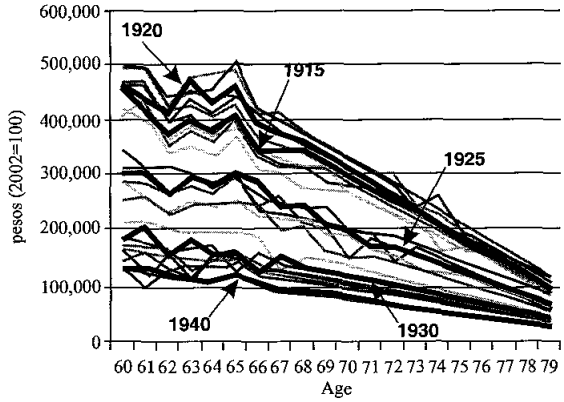


Figure 3
Changes in Retirement Incentives across Cohort and Age. High-educated

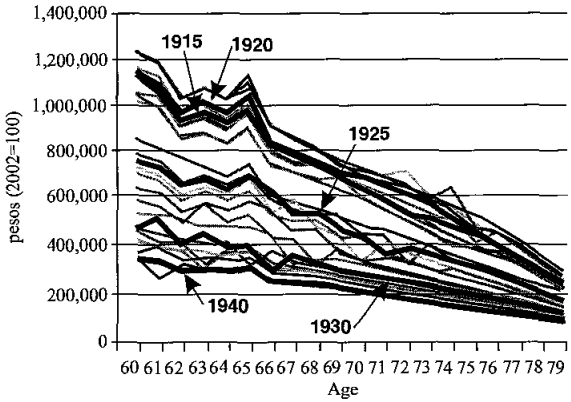


Figure 3 shows the age profiles of retirement incentives across cohorts for the high-educated group. These reach values between about 40,000 and 1,100,000 pesos (2002=100). For the high educated the age profiles of the financial gain of postponing retirement that accounts for social security coverage are much less concave; in fact age profiles for cohorts 1915 and 1920 seem to converge. This also seems to happen for cohorts born between 1930 and 1940, especially as from the age of 68.

As these Figures present the results of weighting the financial gain of delaying retirement for the covered and the uncovered populations within each cohort, it is worth mentioning that in several cases retirement incentives are negative for the covered component of the measure of incentives (those non-covered have no option but decide to work).

These figures show that regardless the level of education, the gain of postponing retirement tends to decrease after around the age of 65, which is the statutory pensionable age in the system. For those with low education, among the younger cohorts there are incentives to retire at 60 as there is no gain of delaying retirement. Older cohorts with low education do have incentives to continue working until around the age of 65; but for all low-educated cohorts incentives tend to diminish after about the age of 70. Something similar is shown for those with medium and high education. There is no much gain of postponing retirement between 60 and 65, especially among the youngest cohorts; after this age the financial incentives to delay retirement tend to diminish. Older cohorts have experienced larger gains of postponing retirement. In contrast, younger cohorts born between 1930-1940 have much smaller real gains of postponing retirement than those of their predecessors.

The very novel contribution of this paper is the possibility to analyze retirement incentives with a large time series. Results like these are very scarce for developing countries. In Mexico, social security old age pensions have been affected by several episodes of financial crises (1976, 1982, 1988, and 1994). This study of retirement incentives reflect to a large extent how financial crises have affected real wages and pension wealth in Latin American countries like Mexico.

The primary intention of this measure of incentives is not to predict retirement outcomes as in the option value model but to provide a way of assessing how social security institutions have influenced retirement when there is an informal sector. One problem with this measure is the aggregation bias due to heterogeneity in tastes and income within cohorts that cannot be accounted for. In spite of these imperfections, the proposed measure of retirement incentives follows the intuition behind the construction of retirement incentives guided by economic theory. The results are useful to provide information that is very scarce in Latin American countries, such as simulations that explain how different cohorts have fared in the pension system under common assumptions.

3.4.1 Sensitivity to variations in assumptions

Sensitivity of the simulated retirement incentives across cohorts when basic assumptions change is examined. The alternative scenarios that are simulated are: 15 years of contributions, 20 years of contributions, interest rate=5%, interest rate=10%, and increased longevity using ECLAC mortality tables 2000-2025. The increase in pension wealth from having contributed for a longer period is not much larger than that obtained when contributions years are only 10. Calculations are sensitive to the use of different interest rates; the larger the interest rate used the smaller the value of the

incentives' measure at a given age. When increased longevity is examined, as later cohorts survive longer the measure of retirement incentives is higher reflecting that cohorts are wealthier, under the basic assumptions.[23]

3.5 Social security contributions, benefits and coverage

For examining the relationship between the obtained measure of retirement incentives and retirement outcomes it is important for the identification strategy to decide whether social insurance coverage is 'limited' simply because it is too costly to the employers/self-employed or whether the 'returns' to social security are so low that employees have an incentive also to remain uncovered. Calculations from a stylized 'money's worth' analysis in which I compare the present value of contributions to the present value of benefits for stylized life-cycle earnings of some of the cohorts under analysis show the generosity of the pension system. Depending on the education group they belong, cohorts receive between 7.6 and 19.6 times as much in benefits as they make in contributions. This shows that social security pensions in Mexico are convenient to employees as they receive more in benefits than what they pay in contributions; this evidence suggests it is an exogenous restriction on coverage.

A natural question that arises after having a measure of retirement incentives is how it relates to retirement outcomes. The constructed measure of retirement incentives is now used in regression analysis to formally look at the influence of the social security pension system on retirement behavior.

4. Analysis of Retirement Behavior

4.1 Econometric issues

The use of individual data in a regression of retirement outcomes on social security incentives has the peculiarity that having social security is endogenous to the retirement decision. To remove such endogeneity one possibility is to find instruments related to the probability of having social security but unrelated to retirement.

Another option would be the use of longitudinal individual data including labor market and social security histories. These data would also allow the use of microsimulation techniques to calculate several individual measures of retirement incentives according to the Mexican pension rules, which then could be related to individual retirement outcomes. Examples of such studies can be found in the books edited by Gruber and Wise, in which micro-data are used. These studies match individual data with data from social security registries to predict ex-ante the effects of pension system reforms on retirement.

[23] Life expectancy is higher for higher income individuals, this is not accounted for. See, for example, Attanasio and Hoynes (2000).

An interesting study on the effects of pensions on individual behavior is Attanasio and Rohwedder (2003). It uses a pension reform in the UK as a natural experiment to look at the effects of pension wealth on saving behavior. The policy intervention potentially provides credible identifying variation for different groups of people. Ideally the availability of repeated cross-sections combined with a natural experiment would provide an opportunity to look how a policy intervention affects the retirement of different people differently. Unfortunately, neither individual longitudinal data of the elderly nor natural experiments are currently available for Mexico (the Mexican pension system reform of 1997 does not constitute a natural experiment, as it does not affect the pension wealth of older generations).

A straightforward way of looking at the relationship between social security institutions and retirement in Mexico is by using cohort data from the pooled cross-sectional data to relate the constructed measure of retirement incentives to the propensity to retire. The pooled cross-sections make possible to study retirement behavior over time by following cohorts of individuals. As more cohorts enter the sample each available year the use of cohort data to track semi-aggregate data has properties comparable to those of panel data, but may be less susceptible to measurement error than panels because the quantities tracked over time involve averaging.[24] Cohort techniques can be seen as instrumental variable methods, where the instruments are grouping variables whose application averages out measurement error and other sources of omitted variable bias. However, with cohort data there is an underlying aggregation bias; to recover the parameter of interest I assume homogeneous tastes across cohorts of individuals.

4.2 Sample characteristics

According to the employment survey, 1991-2000, average characteristics for the sample of males have been calculated over all observations (75,952) in Table 2. The proportion of retired individuals in the sample is 0.46 (0.49).[25] The mean age is 67.6 (5.70) years. The average year of birth (defined as cohort-1900) is 29.46 (6.29). The average measure of retirement incentives is (in Mexican pesos of 2002) 49,936.2 (32,958.1) for the low-educated, 188,685 (128,216.97) for the medium-educated, and 419,973.05 (289,465.86) for the high-educated.

[24] Which nearly always reduces the effects of measurement error.
[25] Standard errors in parenthesis.

Table 2
Summary Statistics of the Sample

	Mean	sd
Retired (%)	0.46	0.49
Age	67.6	5.70
Cohort	29.46	6.24
Incentives' measure	219,531.41	239,499.32
Low	49,936.19	32,958.08
Medium	188,685.01	128,216.97
High	419,973.05	289,465.86
No. Observations	75,952	
Low	47,037	
Medium	15,716	
High	13,199	

Notes: Average cohort=29.46; low, medium and high refer to education.

4.3 The model

The key goal of the regression is to identify the effect of the social security incentives on the probability of being retired. The reduced form equation to be estimated with cohort data is:

$$R_i = \beta_0 + \beta_1 C_i + \beta_2 A_i + \beta_3 SSI_c + u_i$$

Where:

$R_i = 1$, if the individual is retired[26]

C_i = year of birth

A_i = age

SSI_c = retirement incentives for cohort c at age a, which represent the gain of postponing retirement[27] to age a.

A probit regression is used to relate retirement decisions with the measure of social security incentives. The retirement incentives represent the financial gain of delaying retirement an extra year based on the mean pension wealth and wages when accounting for the sector, formal and

[26] In this context this means the individual does not work and does not look for a job.
[27] From the age of 60.

informal, composition of each cohort. The increases in social security wealth affect retirement in two ways. First, through the income effect that reduces the retirement age. Second, through the substitution effect that induces individuals to delay retirement.

In the probit model retirement incentives are constrained to be the same across individuals belonging to a cohort by education group. It has been shown that they exhibit considerable variation across age and over time. Identification of this equation requires having independent variation in social security incentives, in addition to age and cohort variation. Additional sources of variation are education and pension rules.

There have been discussions on the convenience of including a wage-earnings covariate in this type of regression. To the extent that wages are a proxy of tastes for work the measures of incentives based on the option-value may reflect in part this wage differences more than financial incentives. However, to the extent that wages are an important influence on retirement, incentives measured through other measures (such as the peak value) are understated. This weighted measure of retirement incentives in Mexico is based on the option value for its convenience to differentiate the budget constraint of those in the formal and informal sectors.

The solution of weighting the measure according to eligibility and non eligibility to socials security pensions has also been used in several other studies as an instrumental variable approach (Gruber and Wise 2004, pp. 37-39): "In some instances, administrative provisions limit the universe of persons who might be eligible, but which persons are eligible is unknown. Thus, the incentives facing a given individual must be estimated probabilistically. We would like to have the probability that each person is eligible for each program. Suppose that the incentives measure under each possible program is calculated for each person at each possible age. Then for each age these probabilities could be used to obtain a weighted incentive measure, in which the weights are the probabilities that the person is eligible for each program. This is essentially an instrumental variable approach."

The life-cycle variables age and cohort are included in the probit regression. Cohort effects may be important determinants of retirement status as younger and older cohorts may differ in terms of their size or skills. It has been argued that individual attributes may influence retirement; for example, persons are more likely to prefer retirement to work with age. A linear age variable can potentially capture this effect, but only if preferences for leisure evolve linearly with age. Including other determinants of the probability of being retired such as health outcomes (see Van Gameren 2010) and total wealth of the individuals would be desirable, but this kind of information is not available in the employment data.

4.4 Regression results

Table 3 presents the results of the probit regression for a binary random variable that represents the decision to retire. The model is first adjusted only on the main explanatory variable of interest, the measure of the gain from delaying retirement. In this model the measure of incentives is positive and highly significant. Then life cycle variables were included allowing the age variable to enter both linearly and with indicator variables to see whether there is a differential impact as people get older. Among the specifications searched, cohort effects are adjusted linearly. Controlling for education showed no main differences in the models.

The models are comparable in terms of the pseudo-R^2. The coefficients in the models are highly significant at the 5% level. The results indicate that the incentives to retire provided by social security have a small but very significant role in explaining retirement. The positive sign of the incentives variable indicates that reductions in the gain of pension wealth induce a reduction in the propensity to retire. This sign is contrary to what has been found for OECD countries, but is not surprising. In these studies the sign in the relationship (using retirement age as independent variable) is negative suggesting that that generous pensions lead to early retirement. For the country under study although pensions are not very high, increases in pension wealth lead to more people choosing not to work. The significance is high, z-statistics are 21.63 in the model with age dummies and 21.51 in the model with linear age.

As coefficients of a probit regression are difficult to interpret, Table 4 presents the marginal effects—the change in the probability of retirement when the incentives measure changes infinitesimally. A change of $100,000 (pesos) in the measure of incentives increases the probability of retirement by approximately 0.034 in the specifications including life cycle effects, and by about 0.023 when only retirement incentives enter in the model. To have a better idea of this magnitude the effects are examined in terms of average wages of each education group. A $100,000 pesos increase in retirement incentives is equivalent to an increase of about 0,58 times the (average annual) wage of the high educated group, 1.16 times the wage of the medium educated group, and 2.9 times the wage of the low educated group.

The estimates of the age effect show that the propensity to retire increases with age. In the model with dummies all of them have very significant coefficients. This shows that the age effect of the gain in pension wealth on the propensity to retire is different at different stages of the life cycle. Cohort effects are very significant, showing that older and younger cohorts differ linearly in terms of retirement outcomes—some of the origins of these cohort effects are changes in labor market institutions and changes in education policy, which may affect the accumulated sources of retirement income. The model describes that the propensity to retire decreases over time.

Table 3
Probit Estimates

	Incetives Only			Age Dummies			Linear Age		
	Coefficient	std error	z-stat	Coefficient	std error	z-stat	Coefficient	std error	z-s
Age							0.05320	0.00191	27.
61				0.19957	0.02430	8.2			
62				0.23406	0.02434	9.6			
63				0.33813	0.02448	13.8			
64				0.35477	0.02559	13.9			
65				0.35586	0.02576	13.8			
66				0.41995	0.02785	15.1			
67				0.49843	0.02925	17.0			
68				0.52099	0.03015	17.3			
69				0.61095	0.03277	18.6			
70				0.56470	0.03183	17.7			
71				0.73079	0.03595	20.3			
72				0.70836	0.03625	19.5			
73				0.76904	0.03771	20.4			
74				0.86333	0.03957	21.8			
75				0.87137	0.03980	21.9			
76				0.93658	0.04271	21.9			
77				1.01722	0.04590	22.2			
78				1.01864	0.04593	22.2			
79				1.16303	0.05038	23.1			
80				1.26020	0.04999	25.2			
Cohort				-0.00008	0.00003	-2.67	-0.00009	0.00003	-2.
r_incentives	0.05784	0.00374	15.47	0.08577	0.00396	21.63	0.08449	0.00393	21.
Constant	-0.16604	0.00631	-26.32	-0.63478	0.04671	-13.59	-3.71645	0.15550	-2
Pseudo-R2	0.0023			0.0513			0.0502		
Log-likelihood	-52291.399			-49723.084			-49778.896		
No. Obs.	75952			75952			75952		

Note: The reference category in the model with age dummies is A=60.

Table 4
Marginal Effects

	Incetives Only			Age Dummies			Linear Age		
	dF/dx	std error	z-stat	dF/dx	std error	z-stat	dF/dx	std error	z-stat
Age							0.02111	0.00076	27.89
61				0.07947	0.00966	8.21			
62				0.09316	0.00965	9.61			
63				0.13413	0.00956	13.81			
64				0.14061	0.00996	13.86			
65				0.14105	0.01003	13.82			
66				0.16575	0.01067	15.08			
67				0.19542	0.10937	17.04			
68				0.20383	0.01119	17.28			
69				0.23636	0.01169	18.64			
70				0.21998	0.01164	17.74			
71				0.27768	0.01206	20.33			
72				0.27024	0.01233	19.54			
73				0.29040	0.01238	20.39			
74				0.32015	0.01221	21.82			
75				0.32296	0.01226	21.89			
76				0.34180	0.01246	21.93			
77				0.36379	0.01247	22.16			
78				0.36446	0.01250	22.18			
79				0.40012	0.01191	23.08			
80				0.42288	0.01080	25.21			
Cohort				-0.00003	0.00001	-2.67	-0.00004	0.00001	-2.91
r_incentives	0.02296	0.00148	15.47	0.03404	0.00157	21.63	0.03353	0.00156	21.51
Pseudo-R2	0.0023			0.0513			0.0502		
Log-likelihood	-52291.399			-49723.084			-49778.896		
No. Obs.	75952			75952			75952		
Observed P	0.460712			0.460712			0.460712		
Predicted P	0.45900(at x-bar)			0.45900			0.45900		

: The reference category in the model with age dummies is A=60.

5. Conclusions

In this paper a positive relationship between the benefits provided by social security institutions and the probability of being retired is found, using cohort data from the Mexican employment survey. The analysis is carried out for the whole elderly population, examining the retirement behavior of people who belong to the formal and informal sectors of the economy. It is also found that people tend to retire less over time as younger cohorts of elderly males have a lower probability of being retired than their predecessors.

Grouping by cohorts averages out the idiosyncratic unobservable components which may be correlated with formal/informal sector choice; this can also help to average out additive measurement error arising by random miss classification into the informal sector. However, the measure of retirement incentives that is used has an inherent aggregation bias as it is not possible to yield conclusions about the gain from postponing retirement within cohorts.

The incentives' measure is based on the comparison of the expected present value of continuing work versus the expected present value of retirement, following the option value approach. This constructed measure of retirement incentives is then used in regression analysis in an attempt to formally look at the influence of the social security pension system on labor force participation behavior. Some econometric issues should be addressed in the future with more suitable data, such as aggregation bias in the measure of retirement incentives, and the inclusion of other determinants of retirement such as health status and total wealth.

The study of this topic is essential for understanding how labor force participation rates evolve, and the influence of the institutional arrangements. If the probability of retirement is decreasing over time, as it has been shown, questions about how these persons will deal with poverty arise. Fortunately, as it would have been expected, at present in Mexico the use of non-contributory pensions for the poorest elderly has grown. However, this is not a guarantee for thinking that the elderly in Mexico has enough income resources to face retirement.

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