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PROMISED AND ACTUAL BENEFITS IN MEXICAN SOCIAL SECURITY FOR THE TRANSTION GENERATION

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Abstract

This paper provides a set of measurements of the actual benefits and costs of the general old-age retirement plan provided to individuals by the Mexican pension system (MPS), which is necessary to evaluate the decisions by workers to contribute to social security (i.e. work in the formal sector) and to retire. The MPS offers two basic plans. One is a defined benefit plan, available only to those registered before July 1997. The other is a defined contribution plan and is the default mandatory plan for all active workers. We compare benefits and costs under each plan. The "promises" of the original legislation (the benefits under a non-hyperinflationary environment) have resulted in extremely high benefit-cost ratios mainly due to the increase in survival probabilities after retirement (we use the 1951 actuarial evaluation to make the comparison). A consequence is that among workers with the option of receiving the benefits of the new or the old laws, very few will choose the new one under a non-inflationary environment. While inflation has historically reduced the benefits of the old law to a very large degree, the levels of inflation and low interest rates associated to the Great Recession mean that benefits under the old law have become very attractive; for the same reason, the tax on earnings after the mandatory retirement age have become so high that any eligible worker is expected to retire as soon as they legally can. Another variable of significance to determine benefits is the density and timing of contributions over the life-cycle; this feature of the old law (which applies roughly to those retiring until 2042 assuming a potential work history of 45 years) may promote a return to the "formal economy" by workers near retirement age in the following decades, with the purpose of "recovering" entitlement to a pension.

Keywords: economics of the elderly; economics of the handicapped, non-labor market discrimination, Latin America, Caribbean, human resources, human development, income distribution, migration, formal and informal sectors, shadow economy, institutional arrangements.
JEL Classification: J14, N36, O15, O17.

Introduction

The proper evaluation of a national pension system requires the measurement of the effort and profit that workers and their families derive from it. This paper provides a set of measurements of the actual benefits and costs of the general old-age retirement plans provided to individuals by the Mexican pension system (MPS). The MPS offers two basic plans. One is a defined benefit plan (or PAYGO), available only to those registered before July 1997. We compare the systems for the

transition generation. The other is a defined contribution (individual retirement account or IRA) plan and is the mandatory default for all active workers since July 1997. Through our results we identify that under the PAYGO scheme results are affected strongly by inflation, by improved survival probabilities and by the density and timing of contributions along the labor career; the rate of return of this, the old component of the system, are extraordinarily high in the absence of inflation. Benefits under the IRA plan are by construction not higher that what can be obtained through voluntary investments in the market—except for the minimum pension guarantee—and thus, expected rates of replacement of income are below those available in the PAYGO component, except under very high rates of inflation or for those losing all contributions for leaving the labor market before the statutory age of retirement.

We calculate also the "social security wealth" and the "marginal tax on work after becoming eligible for retirement". We follow the model explained by Álvarez, Silva, Forteza, and Rossi (2010) to calculate social security wealth and other related quantities (the reader can find in that paper the employed formulas); their application is for Uruguay. Given very high yields on contributions for retirement under the defined benefit plan, taxes on work after becoming eligible for retirement are also very high for individuals registered before July of 1997.

We study the more general features of the MPS, and we do not include the specialized plans for public sector workers. We study the more general plans mandated by the Federal Constitution and managed by the Mexican Social Security Institute (IMSS), covering all non-public sector workers, as well as workers in state corporations (the only exception is the oil company Pemex).

To measure costs and benefits we follow a strategy of measuring the "promises" of future benefits as well as the results observed historically, and of evaluating the sensitivity of estimates to alternative job careers. Results show that the PAYGO system is inequitable in several dimensions: it provides extremely low rates of return for permanent contributors and extremely high rates of return to opportunistic individuals; large cross-subsidies across generations defined in ways that are random for individuals; and loss of benefits for a substantial share of the population.

The "evaluation of promised benefits" is summarized in two scenarios: the first one (*benchmark*) assumes a fairly stable economic environment, while the second one (*historical*) introduces actual data on salaries and inflation. Historical data are much more variable than the benchmark case, and while in this paper we concentrate in focusing on the result for a cohort born in 1945, we show the ways in which results vary for other cohorts. The MPS is defined by two main Federal Acts, one issued in 1943 and modified in 1973, called the *1973 Law*; and the other enacted in 1997. Our calculations apply to the *1973 Law* and to the *1997 Law*, and thus serve to compare the PAYGO and the IRA features towards which each act applies. It can be noted that each act has substantial PAYGO and IRA components. For the 1943 law, benefits are conditional to a significant extent on variables not defined in the legislation (in particular the rates of interest and inflation), making it impossible to know what the real promise of benefits to workers was when it was issued. Probably, it was expected that inflation would be low and interest rates stable for the foreseeable future.

The measurement of the actual benefits and costs of a pension system is elusive due to the lack of historical information, the impossibility of forecasting even mid-term basic economic variables, and the complexity in rules that arises from relatively frequent changes in legislation. Further, any

comparison across countries or even over time for a given country should be restricted by a criterion of solvency of the schemes, such as a long-term actuarial balance (i. e. a measurement of the increase in contributions or decrease in benefits required to balance the scheme financially), or a measure of the marginal and average cost of fiscal funds required to balance a system (i. e. the deadweight loss of taxation). Very likely some of the changes in rules on social security payroll taxes or benefits are endogenous responses to such restrictions, and can be of an overriding relevance to the degree of affecting the general economic environment of a country, an issue that became painfully evident during the "lost decade" of the eighties in Latin America, or in the European aftermath of the Great Recession that began in 2008. Thus, variables such as inflation, salaries and interest rates can change in response to imbalances in the national pension system, complicating further the interpretation of the calculation of benefits and costs.

To deal with these issues, social scientists have devised methods that aim to measure pension systems under an aggregate restriction. Among them is inter-generational accounting, an approach that combines demographic and fiscal restrictions to measure flows of benefits and cost across generations (see Kotlikoff 1988, and Sales, and Videgaray 1998). Actuarial evaluations of pension plans (the institutional way to measure pension systems financially) usually make assumptions on the future evolution of salaries, interest rates, labor force participation and other variables, and calculate the financial deficit of a plan at a given point in time.[1] Yet significant behavioral issues remain after the use of inter-generational accounting and traditional actuarial models. A main topic for Mexico is the way individuals may adjust opportunistically their participation in the formal economy to improve their social security wealth. Both inter-generational accounting and actuarial methods are aggregated approaches and tend to answer questions of aggregate fiscal sustainability. In this paper our focus is geared towards identifying restrictions on individual behavior, to support behavioral models or labor force participation, contribution and retirement.

Besides the difficult forecasting issues surrounding the rates of salaries, interests and inflation, national pension systems can be manipulated strategically by the population, affecting the assumptions of density of contribution—the share of the potential labor career actually employed in a tax-paying job—in several dimensions. For example, before the 1997 reform, a large share of new retirees contributed only the minimum 500 weeks required to obtain a pension or slightly more (Martinez 1995). Similarly, the Social Security Administration of the USA changed recently a rule that allowed early retirement and the return to the labor force with renewed buildup of periods of contribution after repayment of the benefits earned during the temporary retirement, apparently because individuals were using that facility as a financing mechanism.[2] The design of pension systems recognizes these possibilities and often there are reforms to ameliorate their impact. Nowadays it is more common to see that the calculation of the average salary used to define a pension value depends on the whole career of contribution and not only upon the values in years near retirement age (i.e. to avoid spendthrift salaries near retirement; see CISS 2011), that penalties on pension values for early retirement as well as late-retirement bonuses are closer to actuarial fairness than in the past, and mainly that some—sometimes most—of the responsibility

[1] For the MPS, see http://www.imss.gob.mx/estadisticas/financieras/valuaciones_actuariales.htm.
[2] http://www.socialsecurity.gov/pressoffice/pr/withdrawal-policy-pr.html.

to generate value in the form of a pension falls on the individual through a framework of individual savings for retirement.[3]

In that regard, at least two major features of individual behavior affect the benefits and costs of a pension system: unemployment and informal work. If these were unforeseeable conditions for the individual, pension systems could deal with them within an insurance framework, and approaches setting aggregated constraints would not be affected by behavioral issues. However, it is apparent that there is state-dependence in the occurrence of unemployment and informality, and it is possible that workers act to optimize the value of their labor income and of their participation in the pension system. Figures 1 and 2 show the shares of salaried among the employed in Mexico and the United States. In both countries there is a continuous decline with age. In Mexico, contributions to social security are mandatory only for the salaried, so the data in Figure 1 is a proxy for the share contributing (no existing survey measures directly the contributions by individuals). Figure 2 shows a similar behavior for the USA, but in that country contributions are mandatory for all money-earners; yet, in Figure 3 we see an increase in the share contributing to social security with age, peaking right before the statutory minimum retirement age. Are these patterns associated to the schedules of cost and benefits of the system? In the United States benefits are more closely related to the history of contributions, and Figure 3 refers to a cross-section of data; still, liquidity constraints may play a role in creating strategic behavior by workers.[4] Will we see the Mexican population moving to something like the behavior in Figure 3, with many near-retirement workers returning to social security to improve the value of their pensions? How much can estimates of fiscal pressure derived from aggregated approaches be affected by behavioral changes in the future?

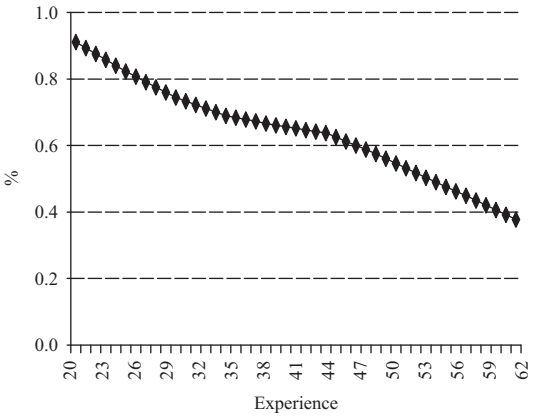
Inflation and survival probabilities are variables with general effects on the population, while the density and timing of contributions are highly variable across workers within and across cohorts. However, the scarcity of information on careers makes it impossible to obtain samples of the distribution of contributions over the life cycle. This paper uses time series on taxable salaries built originally by the author.

The next section describes the regulations being evaluated, and Section 2 describes scenarios to calculate the benefits and costs of the general old-age plan in the MPS.

[3] In Spanish, "salario" denotes a regular payment for work, and "sueldo" is the same but more often for professional work. We use salary that seems to be a more general term, although in English "wage" seems to mean something closer to the payment for manual labor and "salary" for white collar labor. I believe the more common use in Spanish is "salario" and in English "wage", and they are understood as the regular payment for labor of any type. For our application, additionally, the salary includes all the benefits that form the taxable wage: year end compensation, paid vacation, mandatory distribution of benefits to workers and other in-kind benefits to the individual.

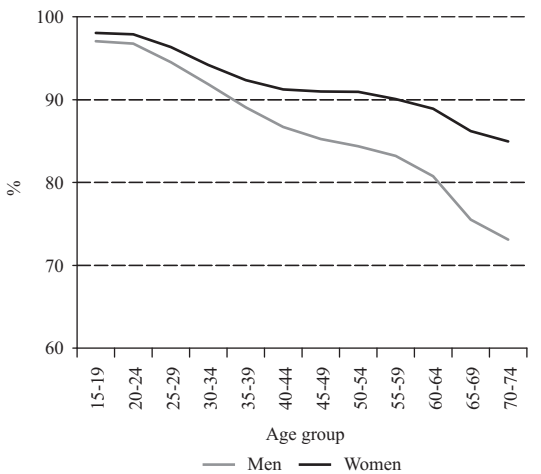
[4] The issue of liquidity constraints and consumption, and the way social security affects behavior is analyzed by Hubbard and Judd (1985).

Figure 1
Share of Employed under Subordinated (salaried) Contracts as a Function of Age, Mexico 2008



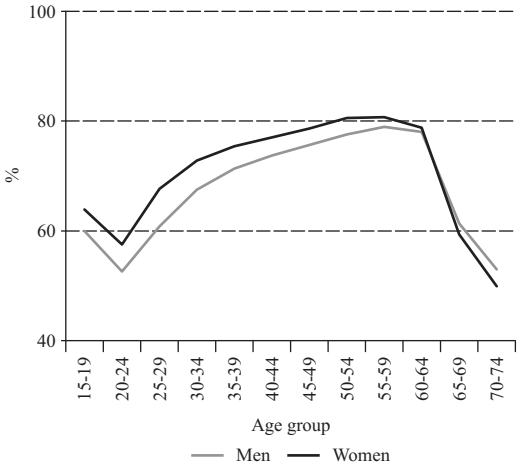
Source: INEGI 2008.

Figure 2
Share of Salaried in Total Occupied, USA 2008



Source: American Community Survey 2009.

Figure 3
Share of Employed Contributing to Social Security in the United States



Source: American Community Survey 2009.

1. Benefits and Contributions

The calculations in Section 2 are based on actual legislation, and it is convenient to describe the mechanisms to calculate contribution and benefit values that apply.

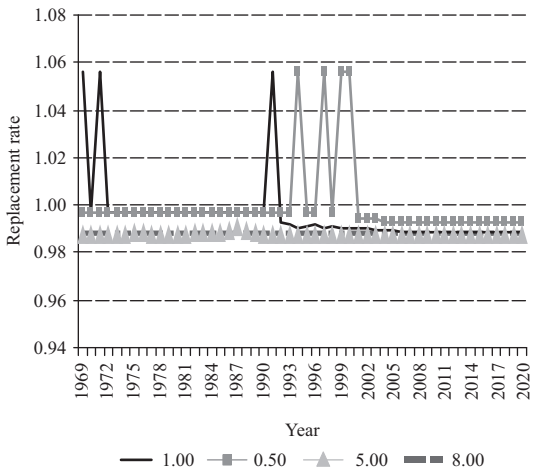
On the contribution side, each act applied exclusively during a period of time, so before July 1997 the *1973 Law* rules applied and the *1997 Law* applied thereafter. On the benefit side, workers with any contribution before that date can opt for the best benefit derived from both cases, so there is a large transition period (an individual entering the market for the first time in June 1997 will retire by July 2042). We apply the taxation rates that applied during each period, and we calculate benefits under the hypothetical possibility of running the 1997 act since 1965. Certainly, nobody knew in 1965 of the *1997 Law*, but we make the calculations to obtain present values of contributions and of hypothetical savings funds that can be compared with the values of annuities derived from the different acts.

To reach a pension value, the *1973 Law* defines a "basic amount" which is a nominal average of the taxable salary during the last 250 weeks of contributions; the basic amount is expressed in multiples of the minimum salary at the time of retirement, and the replacement rate is a function of that ratio plus an increment for each year of contribution above 500 weeks. The basic amount in the *1973 Law* is an average of nominal wages, and is thus affected by inflation (after a pension is granted, it is indexed, but workers are affected by inflation in the years before retirement). The *1997 Law* defines benefits as the annuity that can be financed with the value of the IRA at retirement, given the actuarial tables issued by the National Insurance and Bonds Commission (www.cnsf.gob.mx).

In Figure 4 we see the rate of replacement with relation to the basic amount, for workers retiring between 1969 and 2020 under the *1973 Law*, having worked continuously between ages 20 and 65 at the average taxable salary or multiples of it. Historical variations are minimal. The spikes are related to historical variations in the ratio of average taxable salary to the minimum salary, and we see in Figure 5 that with a level of inflation equal to zero, replacement rates would have been between 99 and 100% for any salary level. Thus, the historical spikes are just minor perturbations due to the spike in Figure 5 (notice they occur only for low-income workers; we find no rationale for the peak in Figure 5).

In Figure 6 we move from measuring replacement of the basic amount (an average of nominal salaries) to replacement of the real salary. For this we have historical data on minimum salaries and average taxable salaries.[5] Real values are obtained after adjusting for the consumer price index produced by the Bank of Mexico. Historical inflation means that the roughly 100% replacement rates in Figure 5 have never been achieved and they have been as low as 28%. The low inflation

Figure 4
Rates of Replacement of Basic Amount by Taxable Wage, 1973 Law
(in times the minimum wage at time of retirement and year of exit from the labor market)



[5] We have actual data on minimum salary from the National Commission on Minimum Salaries since 1942 (http://www.conasami.gob.mx/). On average taxable salaries data corresponds to the bimonthly salary of contribution, which is the average of the taxable salary of a worker over two months, and is the variable used by IMSS to define contributions. We have data on taxable salaries only from IMSS' sources since 1975, drawn from the statistical yearbook or *Memoria Estadística* and the "Management Report" or *Reporte de Gestión*; we were able to draw also point observations for 1964-75 of the average taxable wage from the presidential report to Congress (Presidencia de la República, various years); for previous periods, we applied the variation in the average industrial salary to complete the series. Nevertheless, we can point out that the specific scenarios, we use the case of an individual entering the market in 1965, so the backward projections are not used for that purpose. The series on inflation correspond to the consumer price index of the Bank of Mexico (www.banxico.gob.mx).

Figure 5
Replacement Rates with Inflation Equal to Zero, 1973 Law

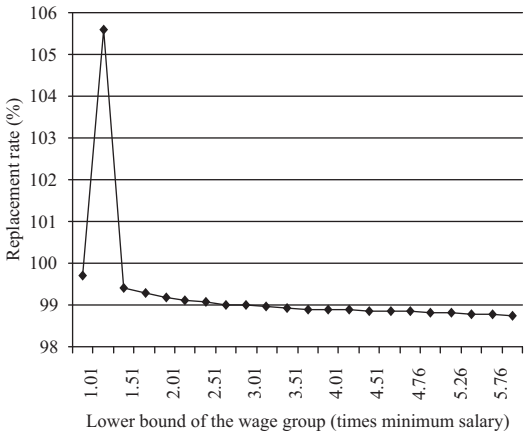
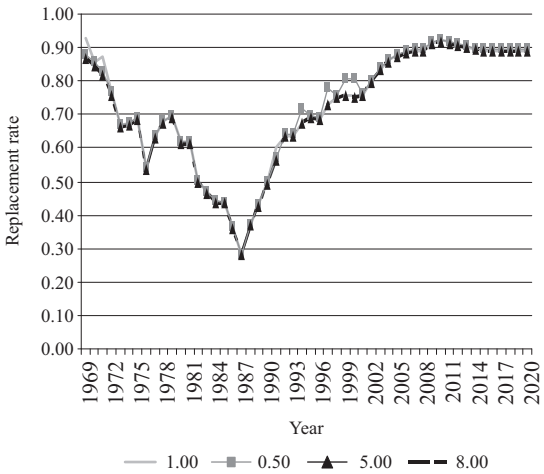


Figure 6
Rate of Replacement of Final Wage by Taxable Wage, 1973 Law
(in times the minimum wage at time of retirement and year of exit of labor market)



environment of the late sixties allowed rates near 90%, which will result again if inflation after 2010 stays at the levels of the last few years. Our review of the 1951 actuarial valuation of IMSS (1954) yields no reference to inflation (although during the fifties inflation was not low, and certainly higher than during the late sixties). Probably, policy makers and actuaries designing the MPS in the forties really expected workers with continuous long-term careers to receive replacement rates around 100%, as in Figure 5. Yet, Figure 6 tells us that history was quite different for workers at any salary level.

We can also mention here the "preservation rule" in the *1973 Law*, because it can affect substantially the behavior of workers who had contributed before July of 1997. Workers have to contribute at least 500 weeks to be eligible to collect an old age benefit, but they lose entitlement if at any point in their careers they do not contribute for a period of duration equal or larger than half of the previously cumulated weeks. So, for example, a worker who contributes from age 20 to 39 (20 years), loses tenure if he does not contribute between ages 40 to 49 (ten years). However, the preservation rule allows recovering lost tenure if the worker contributes for one year. Following with the same example, if that worker contributes at age 64, he can retire with 21 years of recognized periods of contribution. The 1951 actuarial valuation (IMSS 1954) also deviated from empirical evidence on this issue. It was based on a document that had been produced for a plan for public servants in Czechoslovakia and assumed a density of contribution much higher than what was being observed in Mexico. Yet, the statistics that had been produced for that study showed average weeks contributed in a year for each age group that were below 50% for workers at any age and were on average 53%. The lifetime density for individuals was on average smaller, because the statistic referred to samples of those working in a given year. Thus, from very early in history, it should have been recognized that the density of contributions was going to be low.

The contribution rate (the payroll tax sustaining the pension system) includes coverage for old age, unemployment in old age (this is retirement between ages 60 and 64), general disability and health insurance in retirement. Until 1997, these concepts were not separated in the legislation. The rate was 6% until 1991, increased to 7% in 1991 with additional annual increases or 0.2% originally planned to apply annually to reach 8%, but substituted by an 8.5% rate in 1993. With the reform in 1997, the flow was split into a 1.5% rate to finance health insurance for retirees under a PAYGO concept, 2.5% for general disability insurance, and 4.5% for old age and unemployment in old age. Additionally, the *1997 Law*: (1) introduced a social quota equivalent to 5.5% of one minimum wage of 1997 for each day of contribution (over time this has been reformed to introduce a cap on the social quota, which by 2011 has become a subsidy to those contributing at low wage levels); (2) included in the mandated IRA a 2% tax for retirement and 5% of a housing fund. Thus, under the *1997 Law* the cash flow to the IRA is between 11.5% for high-wage workers to 17% for minimum-salary workers.[6]

[6] The impact mentioned of the social quota on the average contribution rate applies to a point in time, but workers typically grow over the lifecycle in their salary level in relation to the minimum. Thus, the reforms to transform the social quota from a non-discriminatory subsidy to a progressive subsidy may not be effective, because the goal is to subsidize workers with low lifetime earnings, not workers with temporarily low salaries.

The separation of rates by benefit did not exist in the *1973 Law* and we face the challenge of deciding what the relevant rate is to apply in our calculations. The values of benefits move in an interdependent way (e.g. obtaining a disability benefit means no old age benefit can be collected), and the original design of the program never precluded the possibility of a separate administration, making it truly inadequate to assume that expectations on pension values were influenced by the possibility of such separation. Even the separation of rates for each benefit after the 1997 reform does not mean that the covariation is eliminated: to be entitled to health insurance the individual must be eligible for a pension, and disability benefits are financed not only with the 2.5% tax on wages, but also with part of the IRA. The baking paste to prepare a pension benefit is further complicated by the possibilities of using the housing fund to pay for a mortgage, and the use of the IRA balance to pay for work insurance benefits. To keep comparisons on the value of contributions manageable, we assume that the full rates were applied to retirement pensions at all periods. For our calculations, we assume that for the "pre-1997 cohorts" the relevant rate of contribution is 8.5% even after 1997, and for the post-1997 cohorts a 13.0% rate applies (the minimum plus an average impact of the social quota of 1.5%). Our calculations do not consider administrative costs, or the possibility of default or extremely low returns of IRA funds.

In the next subsection we present in the results the effect of inflation and mortality, and include the effect of discontinuous careers on pension values.

2. Evaluation of Promises

2.1 Assumptions

To evaluate the "promises and deliveries" of the Mexican pension system we define two scenarios that provide basic metrics such as replacement rates, value of social security wealth and benefit-cost ratio. One scenario is akin to the methodological assumptions in the Organization for Economic Cooperation and Development (OECD 2011) publication *Pensions at a Glance*, and we will call it the benchmark case (low inflation, continuous employment and contribution for 45 years, interest rates of 3.5% above inflation). The second scenario is named historical because it uses information on salaries and inflation. Both model the labor career and the expected retirement of a single person entering the market at 20 years of age in 1965 and retiring in 2010. In each scenario we model 10 cases that vary in the density and timing of contributions over the life-cycle.

Specific cases in each scenario include labor careers with periods on non-contribution, which can be related to unemployment, work in the informal sector or absence from the labor force. There are not surveys or any other source of information on the labor career of Mexican workers over time. We adopt the strategy of assuming careers that are extreme cases for the calculation of benefits: one worker (case #1) contributes for 45 years, while at the other extreme (case #5) the worker contributes only during ages 20 to 29. The first one obtains the highest possible pension, while the later obtains the lowest (actually zero under the *1973 Law*). Cases #2 to #4 represent decreasing densities of contribution with timing of contributions late in life. Cases #5 to #8 represent increasing levels of density with timing of contributions early in life. We add an "opportunist" or "gamer" in case #9: this is a man who contributed early in life for 10 years, but then quit contributing

to social security and came back only to pay the last year to use the preservation rule; thus, he was close from becoming the biggest loser, but found out how to recover his tenure during the last year. Cases #2 to #4 could also be said to be gamers, because they are contributing late in life and obtaining the highest yields. We also add a case #10 who contributes for a long period of time, leaves the market and comes back only during the last year; #10 is not taking advantage of the preservation rule, but his history determines a large negative impact on pension values in periods of high inflation.

The benchmark case assumes a fairly stable economic environment; it follows the strategy adopted by OECD researchers for contemporary systems. Assumptions include a yearly inflation rate of 2%, an interest rate of 3.5%, salary growth of 2%, and that an individual enters the labor market at age 20 and retires after 45 years (because the statutory age for old age retirement in Mexico is 65 years of age). While these can be seen as simplistic assumptions in historical perspective, it is quite impossible to model the actual expectations of policy makers over the past. On the other hand, the benchmark assumptions are quite similar to those used by the IMSS (1954) in 1951. The real value of a benefit depends strongly upon the labor career and the inflation rate, and the law is not at any rate an unbinding contract because it can be changed by Congress. Yet, as in the OECD publication, it is useful to have a plain prospective measurement of those promises that can be compared easily across time, and to avoid variation due to arbitrary changes in assumptions. The historical scenario introduces actual data on salaries and inflation, while keeping the same assumptions on the labor careers.

The labor histories analyzed belong to individuals born in 1945; therefore, they enter the labor market in 1965 and retire in 2010. We have a full history of inflation and salary rate increases only for this first cohort. For subsequent cohorts the salary and inflation histories follow the benchmark scenario beginning in 2011. Thus, the full-density scenario converges to the benchmark scenario and for those born in 1990 or after it is identical. Actually, given the parameters in the *1973 Law*, both scenarios converge in important aspects only five years after the last year of historical data (that is by 2017 in our application).

The calculations apply to a married man with a wife of the same age. This does not affect the calculation of replacement rates under the *1973 Law*, but it affects the calculations of social security wealth under any of both acts, and the value of the annuity under the *1997 Law*.

Table 1 outlines the main features of each act.[7] If we begin our analysis with the 1945 cohort, the oldest cohort spends only 12 years working under the new legislation (and 33 under the old one), while for those born in 1978 or after, only the new legislation is applicable. The 1997 reform provides workers with the option of choosing the best pension value among those produced under the two legislations. We can calculate the preferred legislation by each individual, in each scenario.

Each scenario is run for the 10 individual careers, all starting their careers with the average taxable salary. For the full-density scenarios, salary variation is not important to describe the whole range of possible results of the pension system, the reason being that the replacement rates for workers of any salary level converge to a relatively short range of values. In other words, pension values are roughly linear in salary levels given a density and timing of contributions (for

[7] I have tried to follow the model used by Álvarez, Silva, Forteza, and Rossi (2010) to facilitate comparison in additional research efforts.

a given cohort, all members experience the same history of inflation). This is true for either the 1973 or the 1997 legislations. For the IRA-based 1997 legislation it should be obvious that if the pension value varies across individuals only due to the level of earnings, then pension values are proportional to earnings, except for low income workers that end up collecting the minimum pension (and these are few in the cases of continuous and uninterrupted careers).

Table 1
Description of the Rules on Pension Entitlements: 1973 and 1997 Laws

	1973	1997
General issues	Pay-as-you-go public system (defined benefit).	Individual savings for retirement (defined contribution), managed by private fund managers, with federal guarantee of a minimum pension, public administration of general disability insurance, and private administration of annuities.
Funding	Tripartite: workers, employers, federal government.	Idem 1973 Law with same rates of contribution, plus a "Social Quota" added to IRA as a federal addition for each day of contribution; for those entering after June 1997, contributions to housing fund added to IRA.
Eligibility	1. Old age: 10 years of contribution and 65 years of age. 2. Unemployment in old age: 10 years of contribution and 60 years of age. 3. General disability: 150 weeks of contribution and test of disability (total). 4. Survivor (widow and children up to 14 years of age or 25 years of age if they study).	1. Old age: 65 years of age. 2. Unemployment in old age: 60 years of age. 3. General disability: 150 weeks of contribution and test of disability (total or partial). 4. Survivor: Idem to 1973 Law.
Calculation of benefits	Initial benefit calculated as the product between replacement rate (a) and basic amount. Indexed by minimum salary until 2000, and by CPI thereafter.	The benefit is an annuity paid with IRA balance at retirement, as a fuction of life expectancy and interest rates. For general disability, 40.5% of basic amount plus fa mily allowances.
a	Roughly constant given time of contribution and age at retirement.	Depends upon the regulations on interest rate and survival table issued by the National Insurance and Bonds Commission (CNSF).
Basic amount	Average of monthly taxable salary during the last 250 weeks of contribution (no indexation).	Not applicable.
Upper and lower bounds	Minimum benefit equivalent to 100% of the minimum salary. Contributions capped at the equivalent of 25 minimum salaries (10 until 1997, transition from 15 to 25 from 1998 to2008).	Minimum benefit equivalent to 100% of minimum salary requires 1250 weeks of contribution.

Source: Own construction following the model in Álvarez, Silva, Forteza, and Rossi (2010).

We call the "yield" the difference in present value of benefits and contributions divided by the present value of contributions.

2.2 Results

Our results confirm large impacts on pension values of inflation, of the 1973 rule to weigh only recent wages, and of discontinuities in the labor career of individuals. The comparison between the benchmark and the historical scenarios stress these points. Tables 2 and 3 summarize results for the 10 different participation careers; all have the same earnings-age schedule, but they differ in the share of time worked under social security over time.

The first lines in Tables 2 and 3 show the shares of the interval between ages 20 and 65 spent in a work contributing. Case #1 works 100% of any interval, while case #5 works only 22% of the time, and not al all during the last 5 or 10 years. In a sense, all cases represent very similar persons. They all have the same initial conditions and receive the same salary when working, but for some reason they have different careers of participation in the labor force. Reading these tables may be simplified if we keep in mind that most lines refer to calculations under the *1973 Law*, because the calculation of benefits under the *1997 Law* is quite simple and uses barely one line.

To begin with the worker who enters the market at age 20 and leaves only until retirement (case #1, a "full density" worker), under the 1973 legislation and the benchmark scenario, 45 years of work yield a 106% replacement rate with respect to the basic amount (the average of the salary during the last five years), 97% with respect to the last salary, and 145% with respect to the average lifetime taxable salary. The first of these figures is an additional point in Figure 4, while the second is lower due to inflation during the years when the worker is between 60 and 65 years of age. Even the historically unbearably mild inflation rates of the benchmark scenario have an impact of 9 percent points on the value of the pension. Salary growth determines the differences between the three measures of replacement rate mentioned: weighing only recent salaries, the *1973 Law* defines a basic amount well above the average lifetime real salary. Under historical assumptions, replacement rates are 99% of the basic amount, 92% of last taxable salary, and 105% of lifetime average real taxable salary. Thus, an average historical result is a replacement rate 40 points below the benchmark scenario, which in turn is very similar in inflation and wage growth assumptions to the 1951 actuarial valuation of the IMSS (1954).

Small changes in inflation affect the calculation of the initial pension for all salary levels in a homogenous way, conditional on the history of participation. However, the guarantee of a minimum pension defines a floor to the impact of inflation. A key result arising from variations in our benchmark scenario is that even with historically mild rates of inflation, a large share of individuals of the pre-1997 cohorts will end up collecting only the minimum pension. In Table 2, only cases #8 and #9 use the minimum pension facility because thy have discontinuous careers and do not work much during the last 5 or 10 years. A small increase in inflation, from 2.5 to 5%, reduces the replacement rate of case #1 (the full density worker) from 97 to 92%, and pushes cases #7 and #10 to the minimum; with an inflation rate of 15.5%, all cases hit the backstop and collect only the minimum pension. This is a significant result, because most workers have salaries below the average. To gauge the impact of inflation on the pension of high-salary workers, we modified the

benchmark scenario to base it on a worker with a salary three times the average. In this case, an inflation rate of 86% is necessary to send all to the minimum pension. To put this in perspective, the full density worker at this salary level obtains a pension that replaces 91% of the last salary, which in turn is 4.5 times the minimum pension, so when he gets the minimum he is losing 78%.

In the calculations of benefits corresponding to the *1997 Law* we need a survival table, linking age with probability of death at each year. Under the *1973 Law* the survival table is not needed to calculate benefits, but we use it to calculate social security wealth. We use in general the survival table issued for 2010 by the National Insurance and Bonds Commission (CNSF), and we also present calculations using the 1951 IMSS (1954) table. It can be mentioned that actual mortality rates issued by the National Population Council (www.conapo.gob.mx) show a life expectancy at age 60 of 84, approximately the same value that obtains from the CNSF tables. Forecasting the future impact of medical technology and lifestyle on mortality is not feasible, so this does not seem to be relevant policy variable, or a feature of current regulation that could be improved in a simple way.

While we do not calculate a total fiscal account, we can say that for the 1997, IRA-based legislation, the system can produce only a fiscal deficit due to the provisions on private property of contributions and the State guarantee of minimum pension. For the 1973 PAYGO legislation, the low inflation scenario yields a large deficit due the low contribution rates and the *ex post* largesse in the promises of the law. However, inflation and partial careers play havoc with the value of pensions and workers may end up on the losing side of the equation; we do not research where the money goes when the government is a winner, but it may go to finance other programs (such as health insurance) or dissipate as a subsidy to finance the government.

Two main calculations are the social security wealth (SSW) and the implicit tax to continue working. The SSW is the present value of the benefits a retired worker expects to receive, and the implicit tax is a measure of how much he losses if he keeps working after being eligible for retirement. Under the *1973 Law* workers become eligible for retirement at age 60, and the SSW and the tax are calculated for each year from age 60 to age 74, and discounted at age 65. Early retirees lose the yearly gain in real salary growth and the addition to the pension for an extra year of work defined in the law, and their pension is permanently lower on that account, but they win the payments during an extra year.

In the benchmark scenario we begin with the minimum salary (540 old pesos or 43 dollars of 1965) and the average taxable salary (856 old pesos) of January 1965. Any "benchmark assumptions" scenario that begins at any time before the late nineties results in values that are swamped in comparison to those produced historically due to inflation and it becomes difficult to get an intuitive hold. For example, the 1965 minimum salary (540 old pesos, or $0.54 cents) projected by those assumptions results in a 2010 value of $4,005 compared with a value of $2,535 x 10^3 that would result simply from indexing the 1965 minimum salary by the CPI, or the actual 2010 value of $1,695.[8]

[8] The Mexican peso lost three zeros in 1991, and for some time the term *new peso* was used.

Table 2
Benchmark Scenario

Share of potential time of work spent in a work contributing	Case #1	Case #2	Case #3	Case #4	Case #5	Case #6	Case #7	Case #8	Case #9	Case #10
Share worked of last 5 years	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.20	0.20	0.20
Share worked of last 10 years	1.00	1.00	1.00	1.00	0.00	0.00	0.40	0.10	0.10	0.50
Share worked in life	1.00	0.78	0.33	0.22	0.22	0.64	0.87	0.24	0.67	0.89
Main results (peso results valued in 2010)										
Basic amount in times minimum wages	1.39	1.39	1.39	1.39	0.29	0.68	1.06	0.54	0.86	1.17
Basic amount (*cuantía*)	5,561	5,561	5,561	5,561	1,172	2,729	4,258	2,171	3,444	4,694
Pension (monthly before determining eligibility)	5,873	5,420	4,515	4,288	4,005	4,005	4,102	4,005	4,005	4,548
Actual initial pension (monthly)	5,873	5,420	4,515	4,288	-	-	4,102	4,005	4,005	4,548
Replacement of last taxable wage	0.97	0.89	0.74	0.71	0.00	0.00	0.88	0.66	0.66	0.75
Average real taxable wage (monthly)	4,055	4,420	5,301	5,559	2,780	3,396	3,791	3,078	3,485	3,847
Replacement of average real taxable wage: 45 years of contribution	1.45	1.34	1.11	1.06	0.00	0.00	1.01	0.99	0.99	1.12
PV[1/] of contributions (at age 65)	315,803	236,398	105,107	67,485	79,405	203,853	276,499	85,719	210,167	282,813
NPV[2/] at age 65 (PV of pension less PV of contribution)	718,866	718,515	690,294	688,038	79,405	203,853	423,822	598,099	473,651	493,689
Yield (NPV/PV of contributions)	2.28	3.04	6.57	10.20	1.00	1.00	1.53	6.98	2.25	1.75
Monthly pension from individual fund	1,012	758	337	216	254	653	886	275	673	906
Ratio of annuity to 1973 Law pension	17.2%	14.0%	7.5%	5.0%	-	-	21.6%	6.9%	16.8%	19.9%

Notes: 1/ PV: Present Value. 2/ NPV: Net Present Value.

Table 3
Historical Scenario

Share of potential time of work spent in a work contributing	Case #1	Case #2	Case #3	Case #4	Case #5	Case #6	Case #7	Case #8	Case #9	Case #10
Share worked of last 5 years	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.20	0.20	0.20
Share worked of last 10 years	1.00	1.00	1.00	1.00	0.00	0.00	0.40	0.10	0.10	0.50
Share worked in life	1.00	0.78	0.33	0.22	0.22	0.64	0.87	0.24	0.67	0.89
Main results										
Basic amount in times minimum wages	1.60	1.60	1.60	1.60	0.00	0.24	1.10	0.35	0.56	1.27
Basic amount (*cuantía*)	6,403	6,403	6,403	6,403	2	960	4,419	1,392	2,230	5,105
Pension (monthly before determining eligibility)	6,365	5,611	4,103	4,005	4,005	4,005	4,256	4,005	4,005	5,183
Actual initial pension (monthly)	6,365	5,611	4,103	4,005	-	-	4,256	4,005	4,005	5,183
Replacement of last taxable wage	0.92	0.81	0.59	0.58	0.00	0.00	0.82	0.58	0.58	0.75
Average real taxable wage (monthly)	6,075	5,847	6,180	6,737	6,874	6,048	5,939	6,881	6,078	5,964
Replacement of average real taxable wage	1.05	0.96	0.66	0.59	0.00	0.00	0.72	0.58	0.66	0.87
Pv[1/] of contributions (at age 65)	551,986	119,868	102,555	75,079	100	13,924	74,888	7,335	21,159	82,123
NPV[2/] at age 65 (PV of pension less PV of contribution)	623,041	915,920	654,753	664,265	100	13,924	651,780	676,483	662,659	831,047
Yield (NPV/PV of contributions)	1.13	7.64	6.38	8.85	1.00	1.00	8.70	92.23	31.32	10.12
Monthly pension from individual fund	1769	384	329	241	0	45	240	24	68	263
Ratio of annuity to 1973 Law pension	27.8%	6.8%	8.0%	6.0%	-	-	5.6%	0.6%	1.7%	5.1%

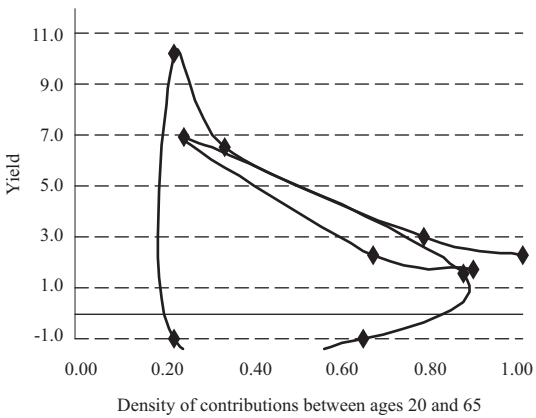
Notes: 1/ PV: Present Value. 2/ NPV: Net Present Value.

To read Figures 7 to 9, notice that the horizontal axis is the share of time between ages 20 and 64 when the individual made contributions to social security. Not shown in the graph is the timing of these contributions, but contributing only late in life moves points to the northwest (highest yields), and contributing only early in life moves points to the bottom (loss of benefits); the full density case is the point to the extreme right and all other cases are intermediate. All these graphs have the same form, and they are only inflated or deflated by inflation and life expectancy.

In the benchmark scenario we index the 1965 minimum and taxable salaries by the same schedule, so their ratio is constant. Instead of using money values, we can show more fruitfully the returns on contributions for the 10 labor histories we are using as reference. The return on the contributions under the *1973 Law* would have been extraordinarily high under the scenario of low inflation and sustained salary growth. In Figure 7 (or Table 2) we can see that for an individual working 45 continuous years since age 20, the return would have been 228% (i. e. for case #1, the value of pensions paid would have been 2.28 times the value of contributions); the yield would be negative only for those losing entitlement altogether (i.e. contributors only early in life); and finally, for those with short careers the yield would be as high as 1,020% (case #4, who works little and only late in life). These yields can be compared with the 254% a full density worker would obtain in an IRA under the assumption of a 3.5% real interest rate, and the 41% that would be obtained by a worker contributing only during the last ten years of his eligible life. Thus, the system would not be sustainable except if all workers had full densities and no other benefits were paid with the contribution (i.e. disability pensions and medical insurance of retirees).

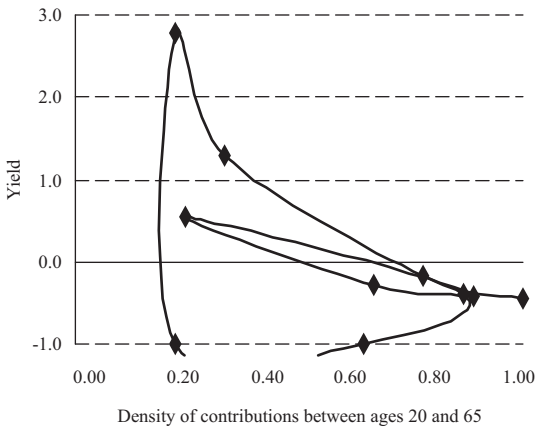
Two main factors provide the pathway to move from the explosive yields in Figure 7 to actual benefits paid, which inevitably have had to conform to economic restrictions: inflation and probabilities of death.

Figure 7
Yield of Contributions Given Share of Time Spent in the Formal Sector-Benchmark Assumptions



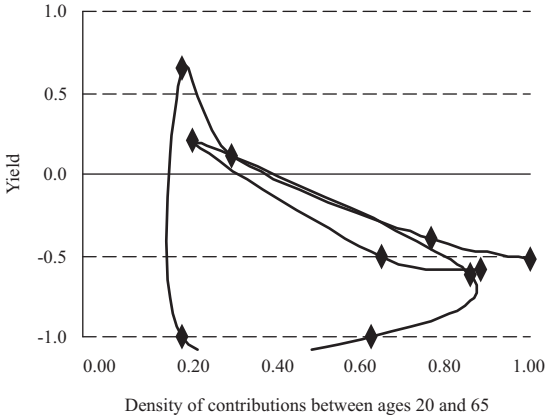
To evaluate the impact of inflation, in Figure 8 we show a modification to the benchmark scenario with an assumption of a 21% annual inflation rate—the average of 1965-2010—and zero salary growth. The yield for the always-contributor is down to minus 45%; for the gamers, returns are still in the order of several hundreds up to more than 278%. Thus, with inflation at historical levels, the *1973 Law* takes away money from regular tax payers, and for them, even a relatively modest 9% inflation rate sends yields to zero. Allowing the historical inflation of 21% and the benchmark 2% annual real wage growth, results in a yield of 15% for the full density case. Still, Figure 8 shows that for low density workers return are still high; case #4, who works only 22% of the time but during the ages 55 to 64, ends up with a yield of 278%, while case #10, who works 89% of the time but only one during the last five and half of the last ten ends up with a yield of minus 41%.

Figure 8
Yield of Contributions Given Share of Time Spent in the Formal Sector-Average Historical Inflation, Zero Wage Growth



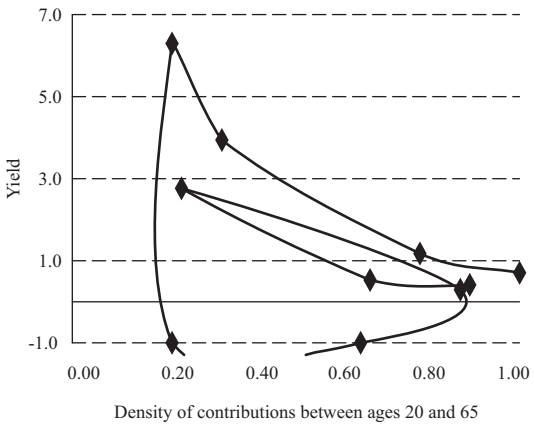
To asses the impact of the improvements in survival probabilities, Figure 9 shows a graph using a table of survival probabilities associated with a life-expectancy of 67 years; now, yields are negative for anyone working 60% of the time or more. Only for the most opportunistic case is the yield above what could be obtained in an IRA investment. Thus, with inflation and wage growth at the benchmark—assumptions very similar to the OECD (2011) or the IMSS (1954) first actuarial valuation—the 1973 Law program would be very feasible under the original survival table. Certainly, we cannot state that policy makers and actuaries working in 1951 were promising the graph in Figure 7 or 9, but given the information available, we can say that Figure 9 is not far from the best assessment of the future of benefits by the early fifties.

Figure 9
Yield of Contributions Given Share of Time Spent in the Formal Sector-Life Expectancy at Age 60 of 67 years, Benchmark Inflation and Wage Growth



The high yields in previous graphs result also from the low rates of contribution that applied historically (Figure 10). We calculated results using a rate of contribution of 13% that would be approximate average under the *1997 Law*. Yields under the old legislation fall simply because benefits are independent of contributions, and for the full density case the result is a low 70%, while the more favored case is still at a high 632%.

Figure 10
Yield of Contributions Given Share of Time Spent in the Formal Sector-Benchmark Assumptions and 13% Contribution Rate

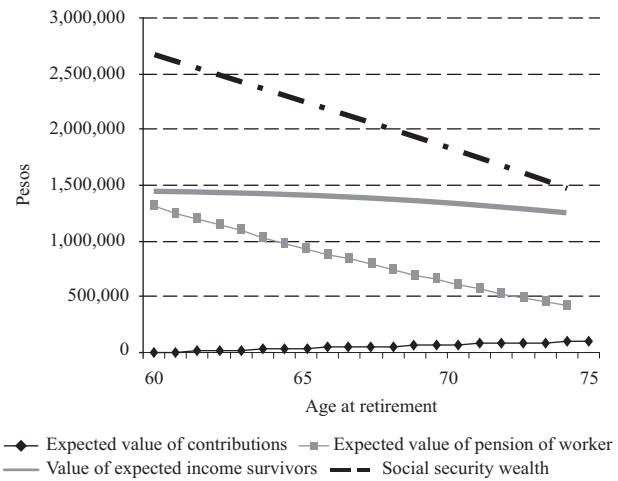


What about benefit under the *1997 Law*? By construction, rates of return are assumed to be 3.5% above inflation. New law benefits in relation to old law benefits under the benchmark case are between 5 and 22%, a direct result of the high yields shown in Figure 7. With a 13% rate of contribution, the interval moves to between 8 and 43%. This is a result of not only historical relevance because it is a comparison to be made by all workers belonging to pre-1997 cohorts, who at retirement can choose among the two benefits.[9] For reasons explained above, mainly the high yields of the old law and the legal reforms to index pensions to inflation, it is very hard to think of realistic scenario with many workers choosing the new law for the retirement benefit. A mix of substantial inflation (above 15%) and high real interest rates (5% or more) would motivate high-density workers to choose the benefit of the new law. While those conditions held during the nineties, during the last years inflation has been below 10% and real interest rates are near zero. An example of the results under the *1997 Law* is that the full-density case can expect a replacement rate with respect to the last taxable salary of 32% in the benchmark scenario, already considering a total contribution to the IRA fund of 13% of the salary.

These results do not represent a negative evaluation of the 1997 reform, but they say that: (i) the fiscal savings of the reform become substantial only a few decades into the 21st century (the more immediate fiscal saving is the elimination of opportunistic behavior for anyone entering the system after June 1997, a benefit for public finance since 2007); and (ii) the impact of the increased life expectancy is so large, that saving rate have to be substantially higher or retirement age substantially older to financially balance the system and if replacement rate above, say, 50% are to be achieved.

Figures 11 and 12 compare the values of social security wealth under the 2010 survival table, and a table that yields a life expectancy of 67 years (the 1951 table). The change is dramatic, with

Figure 11
Social Security Wealth by Age at Retirement, Full Density Case (#1), 2010 Life Expectancy



[9] The comparison is even less favorable for the new Law because of transitory provisions that give pre-1997 cohorts the resources of the housing fund and those corresponding to the old 2% retirement contribution in addition to the guarantee of the *1973 Law* benefit.

social security wealth cut to one third. Figure 13 summarizes the impact of the change in survival probabilities given each career path, while Figure 14 compares an expression of the tables of survival probabilities used by social security in 1951 and in 2010: in 1951, few were expected to be alive after age 65 (the issue is actually larger because in 1951 many more were expected not to reach age 60).

Figure 12
Social Security Wealth by Age at Retirement, Full Density Case (case #1), 1965 Life Expectancy

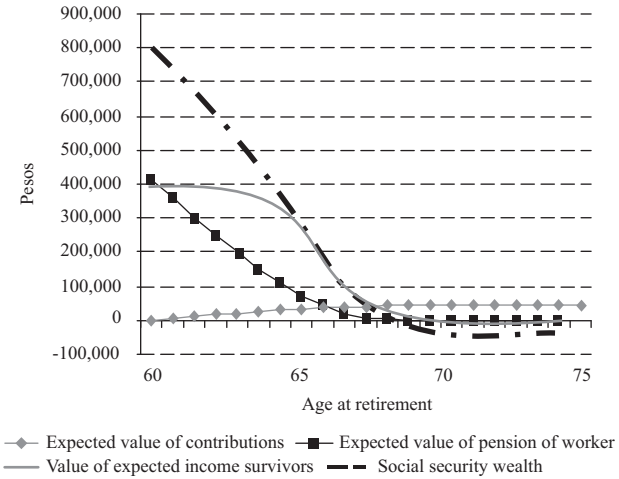


Figure 13
Yield in 1973 Pension System by Share of Life with Contributions and Survival Table

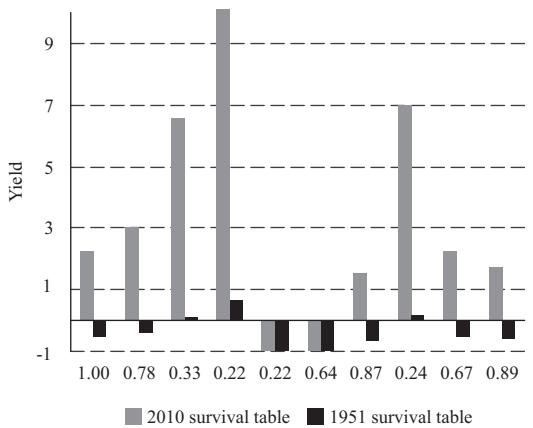
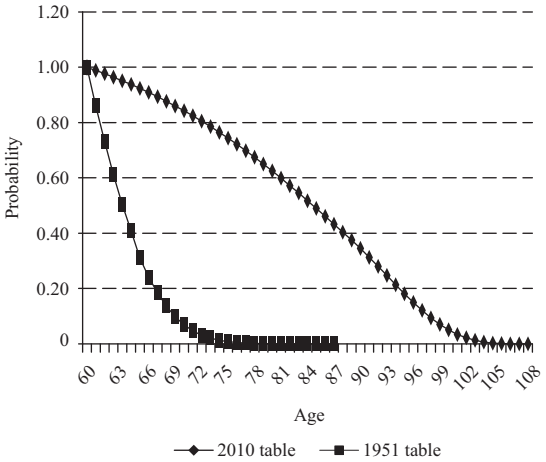


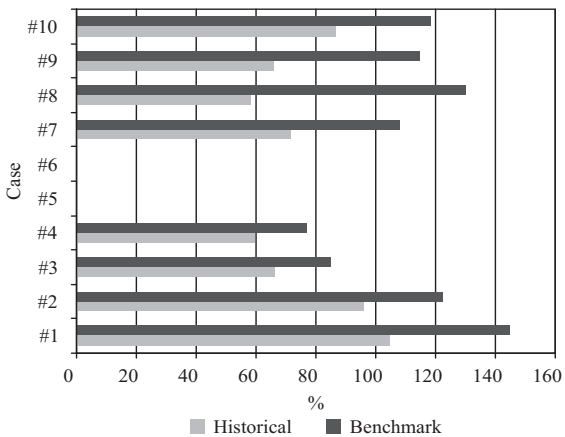
Figure 14
Probability of Being Alive at Given *t* Given that Alive at 60



Source: For 2010 table, Comisión Nacional de Seguros y Finanzas; for 1951, IMSS (1952).

Figure 15 shows the rates of replacement for each labor career under the benchmark and the historical assumptions. Those related to historical data are lower mainly because of inflation.

Figure 15
Rates of Replacement of Average Real Taxable Salary



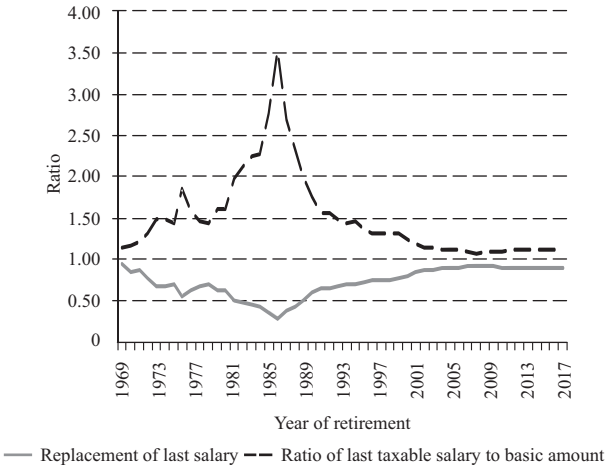
In Figure 16 we show the replacement rate with respect to the last salary of full-career individuals contributing the historical average taxable salary, and the ratio of the last salary to the basic amount used by the law to calculate the pension (under the old law). The horizontal index refers to the year of retirement, so 1969 corresponds to a person born in 1924. This graph does not require data on inflation directly, although that variable affects salary values. This case corresponds to the first in the ten cases we study in each scenario, and while previous results are specific to the 1945 cohort, this graph refers to the 1924-1975 cohorts. The benefits in the old law are approximate linear in the continuous line in Figure 16, so we can say that the previous results refer to the most lucky cohort in history so far (namely, anyone retiring before 2010 10 has been worst off in terms of yield). The replacement rate never reaches a value of 1, while in the low inflation-high salary growth scenario of previous section it was 160%. The value peaks at 93% in 1969 and bottoms at 28% in 1987 (when inflation reaches 150%); the most recent peak is 2010, at 92%. Recalling Figure 5 above, the late sixties and the very recent pensioners put the *1973 Law* as close as ever from fulfilling its original promise.

Summarizing, the "promise" of the *1973 Law* could have been sustained by large enough inflation rates or by limited gains in survival probabilities. A counterfactual statement on this is that given an exogenous increase in survival probabilities, the Mexican pension system could have found a way out of the extremely high promised rates of return only through inflation. That was in fact the solution and inflation has been above the 21% average used in Figures 8 and 9 during most five-year intervals since the eighties. The inflation faced by individuals to calculate the basic amount of the pension is even higher because of discontinuity in the labor career (to that effect the *1973 Law* uses a nominal average of the taxable salary during the last 250 weeks of contribution).

Is inflation enough to balance the system? In the past it was, in the future, it will not. The reason is that since the late eighties—surely after social pressure to compensate the big losses produced by the hyper-inflation of the eighties—the rules to correct for inflation have been improved, and the minimum pension has been defined through automatic adjustments. By 2001, the only relevant variable not adjusted by inflation was the basic amount, so producing high inflation the government can only affect the value of new pensions. Additionally, inflation affects mainly high-density/high-salary individuals, but a majority of workers are not in that case. The results in the previous graphs point out that the effect of increased survival probabilities is so large, that only a hyper-inflation could make a difference.

To close this section, we can say that disability insurance can create a whole new set of opportunistic behaviors, but we do not deal with that program here. Just to mention an example, we calculate relatively low replacement rates for old age pensions under the *1997 Law*, but the corresponding value for disability insurance has a floor of 40.5%, a relation that can motivate workers to apply for disability benefits when they approach age 60 in future decades.

Figure 16
Ratio of Last Taxable Salary to Basic Amount and Replacement Rate with Respect to Last Salary
(full career, historical average wage and inflation)



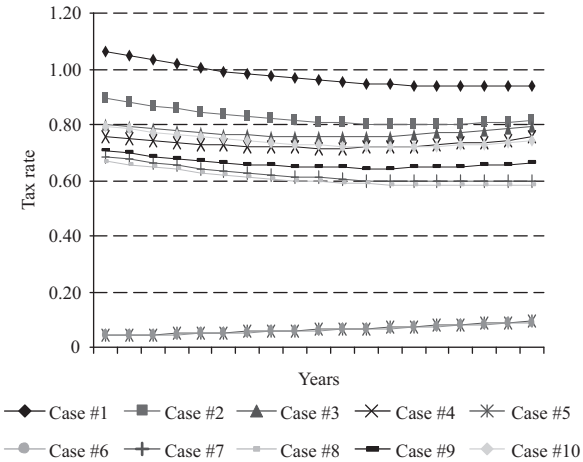
2.3 Tax on additional work

A main question in the analysis of social insurance and labor markets is the extent towards which rules on early and late retirement affect individual decisions. Following the framework defined by Alvarez, da Silva, Forteza, and Rossi (2010), we calculate the social security wealth, the accrual and the tax rates for working after the statutory retirement age. This is seen in Figure 17 for 10 cases in the benchmark scenario, under the *1973 Law*. The general analysis has told us that the rates of return of the MPS are very high for any worker; an equivalent statement is that pension values are very high with respect to contributions. Thus, individuals are motivated to retire as early as possible. The reader may notice that Figure 17 starts at age 60 (the "unemployment in old age" option), and not at 65 (the unrestricted old age option to retire). Early retirement requires involuntary unemployment to define eligibility; however, workers obtaining a separation from a job for any cause starting at age 60 can claim benefits. The regulations are not clear on this issue, but it seems that the only restriction they face is not to work with the same employer.

The Great Recession horizon brings about an interesting question. Inflation rates have been near or below 5% since 2008, interest rates have been also very low (negative in real terms for a large share of the Mexican public debt held by pension funds), and most individuals in the 1973 Law-cohorts are still waiting to retire (it includes anyone who was 14 or older and had contributed by July, 1997). With the huge yields that will result from the *1973 Law* if these conditions hold on, few if any will choose the *1997 Law* and the fiscal cost will be larger.

To close this section, we can say that disability insurance can create a whole new set of opportunistic behaviors, but we do not deal with that program here. Just to mention an example, we calculate relatively low replacement rates for old age pensions under the *1997 Law*, but the corresponding value for disability insurance has a floor of 40.5%, a relation that can motivate workers to apply for disability benefits when they approach age 60 in future decades.

Figure 17
Tax on Marginal Labor Income After Statutory Age of Retirement, Benchmark



3. Conclusions

Inflation shattered the expectations on the benefits the MPS would provide, summarized in the 1951 actuarial valuation of IMSS (1954). Increased survival probabilities shattered the expectation of financial balance of the system. Currently, workers who were enrolled at anytime before July 1997 can become eligible for a pension under the *1973 Law*, and it is very unlikely that any of them will opt for the benefits provided by the *1997 Law* (this refers only to old-age pensions, and this paper does not discuss the case of general disability).

On the other hand, the new legislation eliminates the space for opportunistic behavior open under the old law. The direct policy variables to adjust the system towards higher replacement rates are only age at retirement and contribution rates.

The table of survival probabilities by age should not be a candidate for political manipulation. The actuarial table in use defines that workers retiring currently pay for annuities using a life expectancy at age 65 of 84 years, while the observed value of national life expectancy is 75.4 years (Mendoza and Colocia 2010). However, the insured population is healthier than the non-insured, the relevant life expectancy is conditional on survival to age 65, and the Mexican population still lags in life expectancy in comparison with other countries.

Contribution rates are the same since the nineties, and in any funding framework (PAYGO or IRA), they would need to be higher to pay for improved benefits after age 65. Rates of return on financial assets in general are not a policy variable, and the statutory age at retirement is not directly a policy variable in the defined contribution scheme of the *1997 Law.*

The 1951 actuarial valuation of IMSS (1954) ignored inflation and did not consider the problem of low densities of contribution that were already observed then. A critical variable to measure the pension system in Mexico is the decision to contribute to social security or to work an informal job. 1951 data suggest that it should not be presumed that the market will become more formal in the future. The labor market was pretty informal during the foundational years of the system, it remains pretty informal, and probably it will remain that way. We understand very little about these lifetime decisions, and existing surveys have also almost no information on the labor histories of individuals. It is not difficult to think how to use the results presented here in a traditional actuarial study assuming distributions of density and wages by age group and cohort, but we have seen that the possibility of strategic behavior and the impact of labor careers on benefits is so large under the *1973 Law*, that any of the existing calculations should be read with caution, because future behavior near retirement ages of the pre-1997 cohorts can differ substantially from the historical.

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