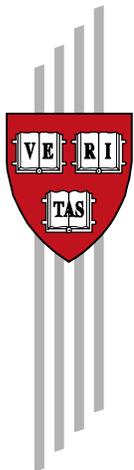


**Beyond Pay-As-You-Go and Full-
Capitalization Pension Systems:
Why Notional Accounts Are a Suitable
Option for Latin America**

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**Beyond Pay-As-You-Go and Full-Capitalization Pension Systems:
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August 19, 2014

Abstract

This paper discusses the viability of three alternative pension systems for Latin America: full-capitalization, pay-as-you-go (PAYG) and notional account systems. Making use of a set of simulations, the pros and cons of each option are discussed for an “average” Latin American country. The results indicate that a system of individual notional accounts should be an attractive option, for several reasons.

With contribution rates constant around 15 percent of wages, the system would be financially sustainable for the “average” Latin American country over the projection period (2015-2065), as it would generate surpluses until the early 2040s, which would be used to finance the subsequent deficit. The pay-as-you-go option (which, on average over the period would require approximately the same contribution effort) would imply frequent increases in contribution rates, which would be politically impracticable, and it would not create strong incentives for individuals to contribute as the notional accounts system. The full-capitalization system requires much lower contribution rates and may create the right incentives for workers to contribute but exposes them to high pension uncertainty. Furthermore, full-capitalization imposes a huge fiscal burden which, under most scenarios, could not be fully covered with the funds accumulated in the individual accounts, and would imply significant income redistribution from taxpayers to workers and pensioners and important transfers from the current to future generations.

Key Words: Pay-as-you-go; full-capitalization pension system; notional account pension system; pension deficit; pension system sustainability.

¹ This paper benefited from previous work by the author prepared at the request of Ricardo Hausmann and the Center for International Development at Harvard to provide advice to the governments of Kazakhstan and Albania. The author acknowledges useful comments and insights by Ricardo Hausmann, Carmen Pagés and participants at seminars at CID and the Inter-American Development Bank.

Beyond Pay-As-You-Go and Full-Capitalization Pension Systems: Why Notional Accounts Are a Suitable Option for Latin America

Eduardo Lora

This paper discusses the viability of alternative pension systems for Latin America, given the challenges facing the current systems.² Making use of a set of simulations that compare full-capitalization, pay-as-you-go (PAYG) and notional account systems, the pros and cons of each option are discussed for an “average” Latin American country.

While contribution-defined full-capitalization and benefit-defined pay-as-you go systems have been the two main options of choice in the region, notional accounts provide a third way which so far remains almost unexplored in Latin America.³ Notional-defined (also called non-financial) contribution schemes, or notional accounts for brevity, are contribution-defined systems (like full-capitalization), where current pensions are paid out of current contributions (like in PAYG). Pensions depend on the history of contributions of individuals and their rate of return, which is not the market rate, but a pre-defined *notional* rate that makes the system sustainable. The term *notional* (or non-financial) refers to the fact that individual accounts are not matched by the amount of funds accumulated.

This document argues that a system of individual notional accounts should be an attractive option for Latin American countries, for several reasons. With contribution rates constant around 15 percent of wages, the system would be financially sustainable for the “average” Latin American country over the projection period (2015-2065), as it would generate surpluses until the early 2040s, which would be used to finance the subsequent deficit. The pay-as-you-go option (which, on average over the period would require approximately the same contribution effort) would imply frequent increases in contribution rates, which would be politically impracticable, and it would not create strong incentives for individuals to contribute as the notional accounts system. The full-capitalization system requires much lower contribution rates and may create the right incentives for workers to contribute but exposes them to high pension uncertainty. Furthermore, full-capitalization imposes a huge fiscal burden which, under most scenarios, could not be fully covered with the funds accumulated in the individual accounts, and would imply significant income redistribution from taxpayers to workers and pensioners and important transfers from the current to future generations.

In spite of these conclusions, the adoption of a notional accounts system requires a clear transition strategy from the current systems in order to phase down their obligations in a way

² For a detailed description of the pension systems in the region see Mesa-Lago, Carmelo (2008). [*Reassembling Social Security: A survey of Pensions and Health Care Reforms in Latin America*](#). Oxford y New York: Oxford University Press. For a concise summary see BID-INDES, [*“El Futuro de los Sistemas de Pensiones”, Curso Virtual La Realidad Latinoamericana, 2012.*](#)

³ Only Brazil has notional accounts as a component of its pension system. Outside Latin America, notional accounts systems have been adopted in Italy, Latvia, Poland and Sweden. For an evaluation of these experiences see

compatible with long-term stability of the new system. It may also be advisable to complement it with a non-contributory universal (basic) pension system, thus eliminating the need for a minimum pension in the notional accounts system. The combination of a non-contributory basic pension with a contribution-defined notional-account pension system would be administratively simple, would reduce fiscal uncertainty, and prevent the major political risks that often make PAYG and (compulsory) full-capitalization systems unsustainable. In addition to these two pillars, a voluntary full-capitalization system may also be considered in order to incentivize savings by high-income earners.

Although notional accounts create good incentives to contribute, such system would certainly not be enough to correct the very low coverage of pension systems in the region, which is a serious social problem in most Latin American countries.⁴ Although this paper does not discuss this important issue, it must be kept in mind that notional accounts are entirely compatible with the main policy proposals put forward to raise pension coverage, in addition to introducing a universal basic pension, such as progressive subsidies to contributions, and innovative mechanisms to enroll self-employed workers.⁵

The main purpose of this document is to illustrate the main features of, and draw comparisons between, three alternative idealized pension systems: full-capitalization of individual accounts, pay-as-you-go, and notional accounts. In practice no country in the world has any of these three systems exclusively, but rather combinations of them in varying proportions. Although the most important parameters in the simulations below have been chosen to reflect an “average” Latin American country, the analysis abstracts from the current situation of the pension systems in the region. The simulations assume a situation where one of these three idealized pension systems is established as of 2015, as if there were no previous system before.

This paper takes an entirely inductive approach, the main conclusions being supported by numeric simulations, not derived from theoretical models. Jargon and technical complexities are avoided in order to make it readable by policy-makers and non-specialists.⁶

⁴ As recently assessed by [Mariano Bosch, Ángel Melguizo and Carmen Pagés, *Mejores Pensiones, Mejores Trabajos: Hacia la Cobertura Universal en América Latina y el Caribe*, Inter-American Development Bank, 2013.](#)

⁵ *Ibidem*, Chapter 5.

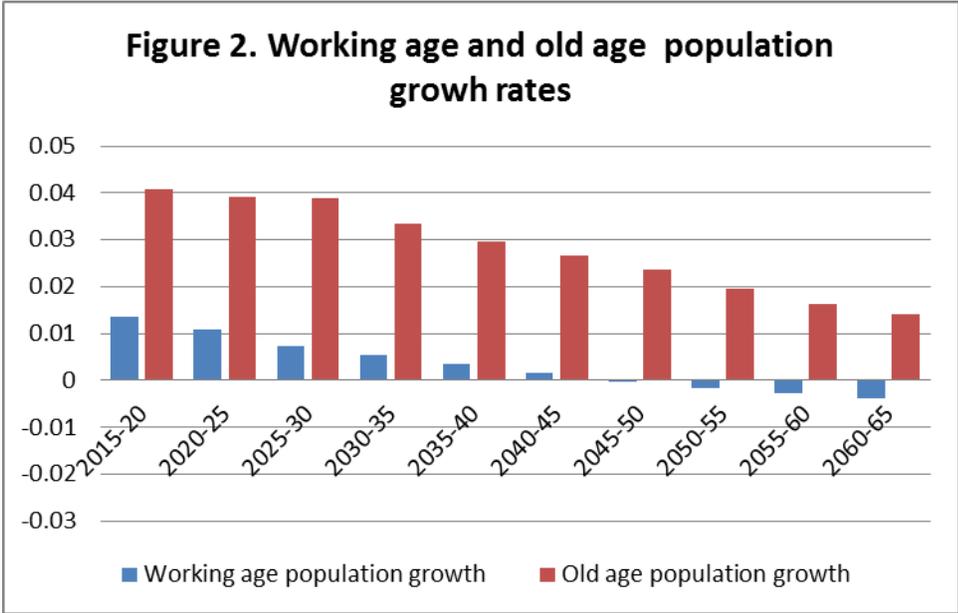
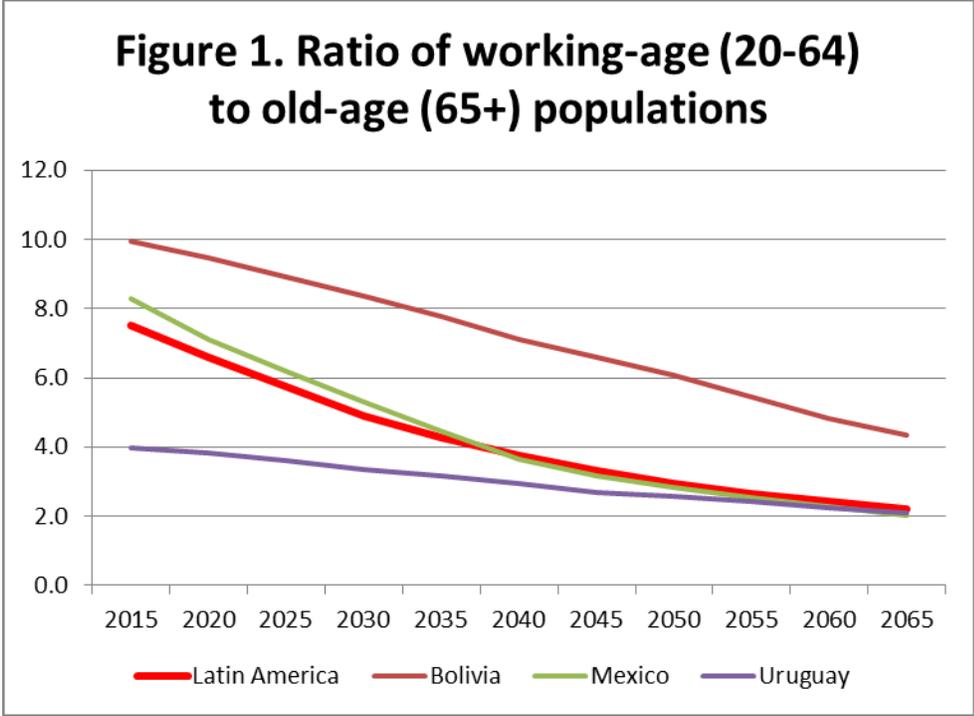
⁶ For a thorough discussion of notional accounts concepts, theoretical underpinnings, issues and experiences until the mid-2000s, see [Robert Holzmann and Edward Palmer \(editors\), *Pension Reform: Issues and Prospects for Non-Financial Defined Contribution \(NDC\) Schemes*, The World Bank, 2006.](#)

Pay-as-you-go System

In a purely PAYG system pensions of current pensioners are paid each year with the contributions of active workers. Since PAYG systems usually operate as defined-benefit pension systems, the key unknown variable is the contribution rate that makes revenues and expenditures equal. At any given point in time, such rate is simply the ratio between the pension bill and the wage bill of the contributors to the system. It can also be seen as the product of two ratios: the ratio between pensioners and contributors, and the ratio between average pensions and average wages. Assuming constant participation rates throughout the individuals' working lives, the first ratio is dictated by the age composition of the population. The ratio between the average pension and the average wage also depends on the age structure because wages are not constant through individuals' lives, but tend to increase with age. Therefore, in order to project the wage and the pension bills we need demographic projections by age group, projections of the age wage profile and a parameter that relates the average pension to the average wage (the so-called replacement ratio).

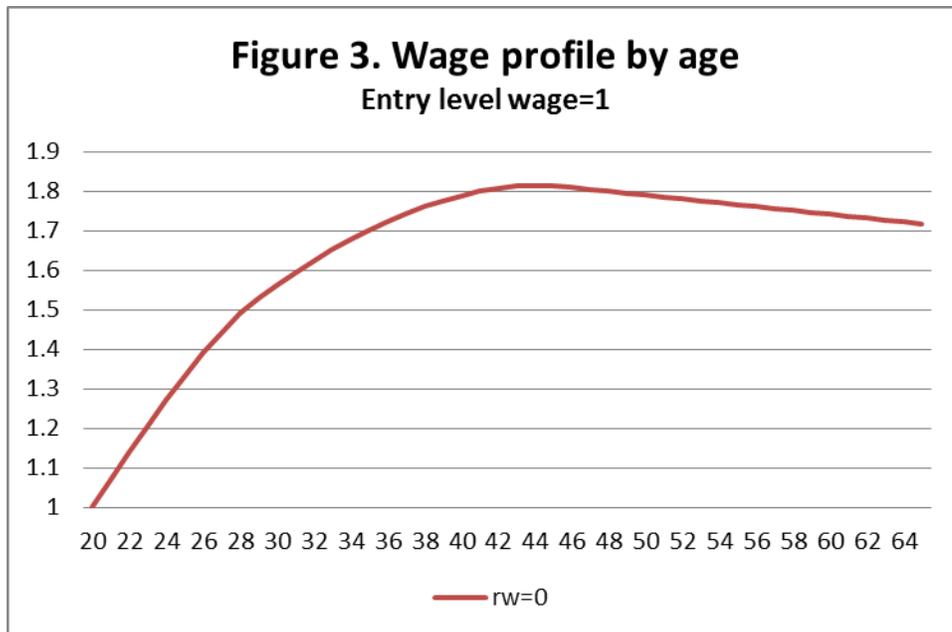
We use demographic projections (by the United Nations) by age group for the whole of Latin America and the Caribbean⁷ until 2065. Initially, we take the U.N. medium-fertility scenario (in a latter section the implications of an alternative scenario are discussed). Since the U.N. demographic projections use 5-year groups, we assume that working lives start at 20 and end at 65, both for men and women. Latin America is still at a favorable stage of the demographic transition, but that will change fast. Figure 1 shows that the ratio between working age population and population in retirement age for the region as a whole falls precipitously from 7.5 in 2015 to 3.9 in 2040 and to just 2.2 in 2065. While Mexico faces a similar trend, Bolivia is nearly two decades behind in its demographic transition process, while Uruguay is more than two decades ahead. As Figure 2 shows for the region, but is also valid for each individual country, throughout the projection period population in working age will grow at a much lower rate than population in retirement age.

⁷ This is equivalent to a population weighted, not a simple, average of all the countries.



To construct the age wage profile, we assume that all individuals have identical working lives, starting at 20 and continuing uninterrupted until retirement (no distinction is made between sexes, which would be necessary in a more refined analysis). Wages are assumed to increase 54 percent during the first 10 years of working life, and a further 18 percent during the subsequent 15

years, declining since then by about 5 percent until retirement.⁸ Figure 3 represents the wage profile year by year, where 1 is the entry-level wage. This profile may shift upwards in a growing economy where the productivity of workers is increasing at certain rate, as discussed below.



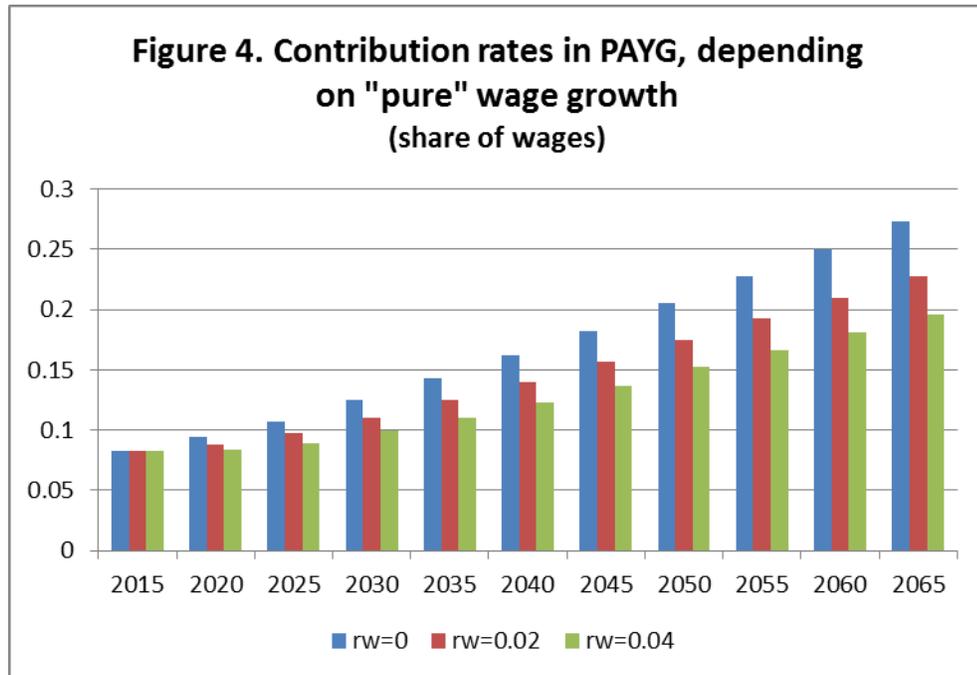
We have fixed the wage replacement ratio at 60.7 percent of (inflation adjusted) average wages of the whole working life of individuals. At this replacement ratio pensions are equal to wages at entry level (which we assume to correspond to 1 “subsistence income”), or 56.6 percent of wages during the last 20 years of working lives.⁹

On this set of assumptions, the contribution rates required to keep the PAYG system in equilibrium are shown in Figure 4. With no real wage increase ($rw=0$), contribution rates increase from 8.3 percent in 2015 to 14.3 percent in 2035 and 27.3 percent in 2065. The results would be the same if both, wages and pensions, increase at the same rate or if both are indexed to the subsistence income, for instance. If pension values remain fixed (in constant prices) for each cohort, while wages do increase, the results would obviously change. As an example, let’s assume that from 2015 onwards real wages increase at an annual rate of 2 percent, and pensions for each cohort of future pensioners are set in order to keep the assumed replacement rate. This, of course, implies that pensions for each cohort are higher than for the previous one. (However, we assume the same pension level for all those already pensioned in 2015). As shown also in Figure 4, in this case, the required contribution rates would go from 8.3 percent in 2015 to 12.4 in 2035 (instead of 14.3) and to 22.8 at the end of the projection period (instead of 27.3). Alternatively, we may assume that real wages and future pensions increase not by 2 percent year, but by 4 percent per year (a rather

⁸ The profile is intended to replicate that of US high-school graduates in the 1980s (Murphy and Welch, 1990: <http://www.terry.uga.edu/~mustard/courses/e8420/Murphy-Welch-Age.pdf>), since it approximately corresponds to the current average level of education in Latin America. Simulations can be easily adjusted to other wage profiles.

⁹ In this way, all our calculations are normalized by the current subsistence income level.

implausible case in a long-run scenario). In this case, the required contribution rate would go from 8.3 percent to 11.1 and 19.5 in 2035 and 2065, respectively. Therefore, the rate of adjustment of pensions (within reasonable limits, and given an initial replacement ratio) does influence contribution rates in PAYG in a significant way.



Although these calculations assume full participation in the system by all individuals in working age, and full pension coverage of all those in retirement age, the results would be the same if both participation and coverage were reduced in similar proportions (for instance, if the labor participation rate and the pension coverage rate are both 70 percent). However if, in addition, those in the labor force do not contribute regularly, the rates of contribution would have to be adjusted proportionally to keep the system in equilibrium. If workers contribute only half of the time, the contribution rate would start at 16.6 in 2015 and reach an astonishing 54.6 in 2065. Obviously, this could be offset, at least in part, by establishing a minimum number of years of contribution as a requisite to get the assumed replacement ratio. In practice, such conditions are complicated to calculate and administer, because they can inadvertently create incentives to contribute regularly only during some working life periods and not others. In general, therefore, benefit-defined PAYG systems may create large fiscal contingencies, as it has already been the case in many Latin American countries. To the extent that such contingencies need to be solved through (initially unplanned) adjustments in contribution rates, PAYG systems are bound to face tough political problems and, eventually, collapse.

Full-capitalization System

In a full-capitalization system each individual receives a pension that comes entirely from the capital accumulated in her individual account. The amount of the pension depends, essentially, on the following factors:

1. The wage profile across the working life cycle of the individual. As discussed above, we assume that working lives of all individuals are identical, starting at 20 and continuing uninterrupted until retirement at age 65.
2. The wage replacement ratio, which is assumed equal to be 60.7 percent of (inflation adjusted) average wages of the whole working life of individuals.
3. The rate of contribution, as percent of wages, to the individual accounts. We assume that such rate is constant and unique for all workers during their working lives, but instead of assuming a given rate, we let the simulations determine what would be the rate needed to get the wage replacement ratio assumed in point 2, given other factors. The required rate of contribution would have to be augmented with the administration costs charged by pension funds. We will ignore such costs (but it should be kept in mind that they often represent an additional 1 percent of contribution).
4. Mortality rates since retirement age, which are assumed to remain unchanged in the next 50 years (further, we assume that workers face no mortality risks throughout their working lives).¹⁰
5. The rate of interest, both during the working life of the individual and at the moment of retirement (assuming that pensioners receive a fixed annuity computed at retirement). For simplicity's sake we assume the same real rate of interest for both, at levels between 0 and 6 percent depending on the simulation. As shown below, different interest rates produce dramatically different results. For this reason, it should be kept in mind that real interest rates over the last five decades in developed countries have hovered around a range of 1.6 to 3.9 percent, depending on the country and the instrument considered, and with wide variations from year to year, especially in the case of stock investments (Table 1). Although domestic interest rates may be higher, the difference partly reflects higher repayment risks.

¹⁰ Age-specific mortality rates (weighted averages of men's and women's) have been calculated from data compiled by United Nations for Mexico for 2006 (<http://unstats.un.org/unsd/demographic/products/dyb/dyb2006/Table20.pdf>). As shown below, Mexico's demographic prospects are very close to those of the region as a whole.

Table 1. Real interest rates in developed countries

		Japan	UK	United States			
		Lending	Lending	Lending	Treasuries	Libor	Dow-Jones
1961-1970	Average	0.83	n.a.	2.81	2.11	n.a.	0.27
1971-1980	Average	0.00	-3.31	1.71	0.09	n.a.	-5.01
1981-1990	Average	4.85	4.53	6.78	5.33	5.03	8.24
1991-2000	Average	3.63	4.28	5.70	3.51	2.51	12.28
2001-2012	Average	3.09	0.93	2.70	1.41	-0.03	0.57
1961-2012	Average	2.50	1.64	3.89	2.46	2.29	3.17
	Standard deviation	3.19	3.67	2.30	2.21	2.45	13.31

Notes and sources:

The real lending interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator, calculated by World Bank, WDI.

US Treasuries variable is the market yield on U.S. Treasury securities at 10-year constant maturity, quoted on investment basis, and adjusted for inflation by the CPI index, own calculations.

Libor is the six-month London interbank offered rate, source WEO, and adjusted for inflation by the CPI index, own calculations.

Dow-Jones is the average year-on-year return of the daily values of the Dow-Jones Index, adjusted for inflation by the CPI index, own calculations.

Averages and standard deviations reported are calculated from yearly data.

Taking these factors into account, we can now show some basic simulation results under a full-capitalization system. Figure 5 shows the amount of capital needed at retirement for each 100 dollars of pension to be paid annually, at constant prices, until death, given different real interest rates. (This calculation depends exclusively on factors 4 and 5). As mentioned, the interest rate has an enormous influence on the results. If such rate were zero, the amount of capital needed at retirement would be 17.6 times the value of the annual pension (this is because in our dataset additional life expectancy at retirement is 17.6 years). But if the interest rate is 2 percent, the capital needed would be 14.2 times the pension, and if it were 6 percent (an implausible level over a period of decades), it would be just 9.9 times the value of the pension. That is why, in a fully-capitalized pension system, relatively small changes in financial returns may represent huge changes in pension values and, as a result, very uncertain retirement conditions for individuals. This is a very important source of political risk and a major factor behind the demise (or deep restructuring) of many full-capitalization systems around the world.

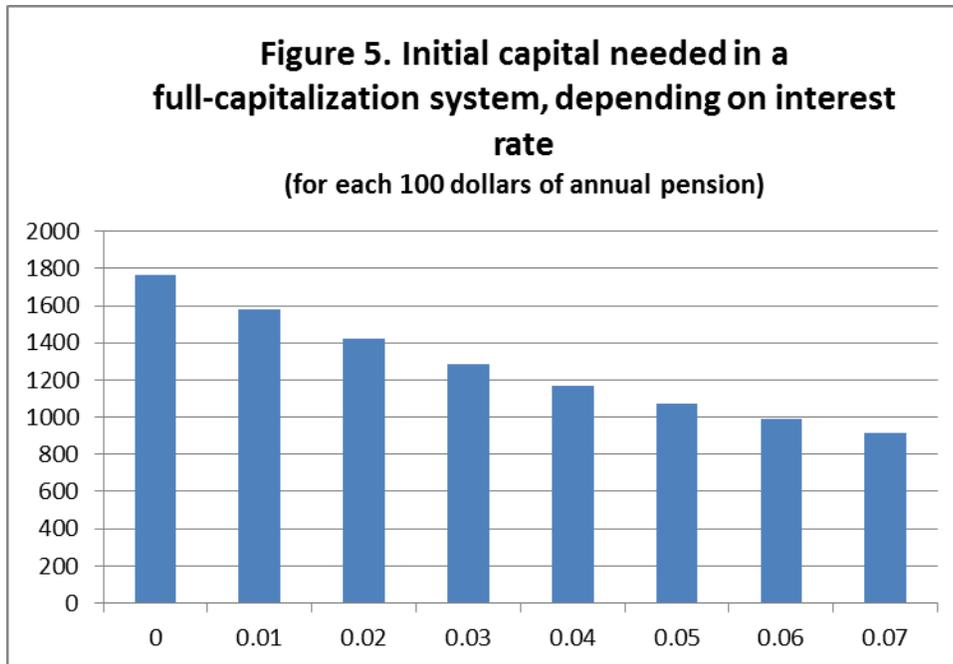
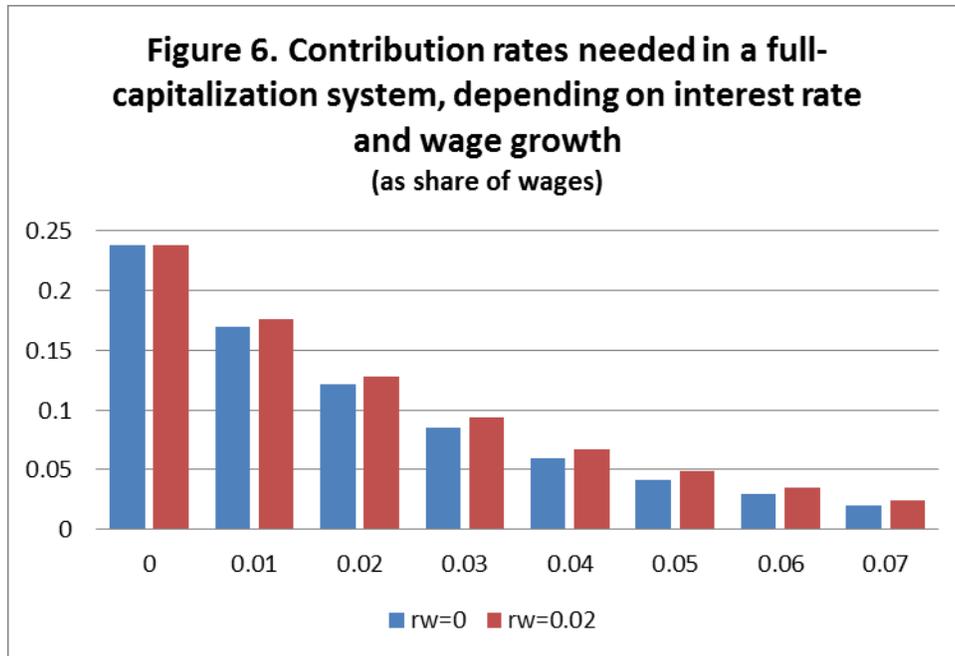


Figure 6 looks at the same issue from a different angle: it shows the rate of contribution required throughout the working life of an individual to accumulate the amount of capital necessary to get the assumed wage replacement rate of 60.7 percent (or 56.6 of average wages during the last 20 years). As explained, the simulations are performed assuming the same interest rate during the working life period and at the moment of retirement, when the annuity is fixed. With no financial return, the contribution would have to be 23.8 percent of wages. With an interest rate of 2 percent it would need to be 12.1 percent and with a rate of return of 6 percent it would be just 2.9 percent (assuming no labor productivity increases, $rw=0$). This implies that huge changes in contribution rates would be needed to counteract the effect that small variations in the (long term) return of the pension funds would have on pensions. Obviously, such changes would be impractical as they would face stiff opposition by workers and politicians. Perhaps surprisingly, contribution rates would have to be slightly *higher* in a growing economy, as the second set of bars in Figure 6 indicates. For instance, with 2 percent real wage growth and 2 percent interest, the contribution rate would be 12.8 percent instead of 12.1. And with 6 percent of interest, it would need to go up from 2.9 to 3.5 percent. The reason is that in order to get the same replacement ratio of wages during the whole working life, the contributions made by the individual when she was young are relatively low compared with the case where her wages grow much less during her working life. A slightly higher contribution rate is needed to compensate for this. The problem is exacerbated if the replacement rate targeted is defined with respect to a shorter period at the end of the individual's working life. For instance, if the objective is to get the same replacement rate of the last 20 years of working life (56.6%), the contribution rate would have to be raised, not to 12.8 percent, but to 15.6 percent during the *whole* working life of the individual (not just the last 20 years). To the extent that pension expectations are anchored to wage levels at the end of the individuals' working lives, changes in long-term real wage growth rates are a source of instability to (and/or dissatisfaction with) the system.

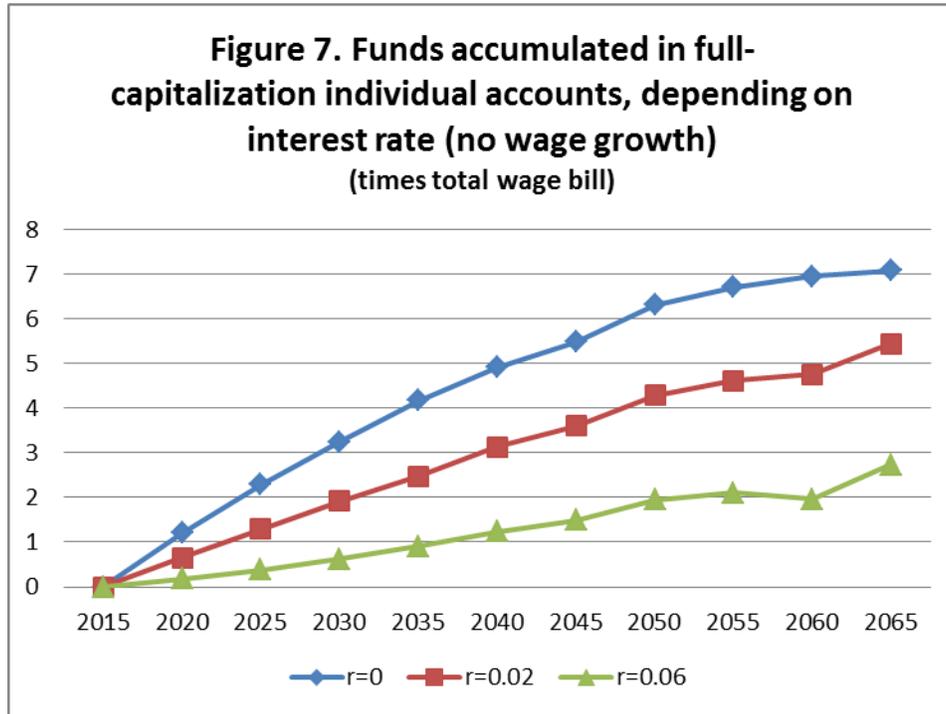


Actual contribution rates would have to take into account the extent to which individuals fail to make regular contributions throughout their lives. For instance, if they skip half of the monthly contributions every year, required contributions rates would have to double to reach the same amount of capital at the end of their working lives. As experiences in many countries indicate, the presence of a guarantee minimum pension probably contributes to the lack of discipline in contributions, though it is hardly the unique (or even the main) factor behind it.

It is important to show the amount of funds that would be cumulated in the individual accounts, since this makes another important difference with the two other systems. For this purpose, we assume alternative interest rates (0, 2, and 6 percent), and the corresponding contribution rates (23.8, 12.1, and 2.9 percent with no real wage growth, $rw=0$), which would be needed to get the same replacement ratio (60.7 percent), according to our previous results. We simply compute the funds that all individuals joining the system since its inception (2015) would have in their individual accounts at different points in time, whether or not they have retired (including, for those retired, the present value of their remaining annuities). For simplicity's sake we assume that the current age wage structure remains unchanged, without productivity increases, and that contributions are made uninterruptedly. We also assume that if an individual's account runs short of funds to cover his or her pension, the government will take charge of the payments (the resulting deficits are discussed below). As it happens, all the cohorts of pensioners during the horizon of the projections (until 2065) have to rely sooner or later on the government to cover their pensions (there is no surprise here, since the parameters of the simulation are set to fit those who contribute since the age of 20).

The amount of funds that would be accumulated in the individual accounts would be truly massive, as shown in Figure 7. In the mid-case scenario (where interest rate is 2 percent), funds in the system would exceed the value of the wage bill by 2025, and would be more than four times the wage bill after

2050. Even with an implausible interest rate of 6 percent, the accumulation of funds would exceed the wage bill by 2040 and reach more than twice the wage bill after 2050.



To some extent, these massive funds reflect the deficits incurred by the government during the first decades of the system, since workers older than 20 at the inception of the system are unable to accumulate the full amount of the capital needed to get the targeted pension. Figure 8 shows pension deficits depending on interest rate (in all cases assuming no real wage growth). Initially, all pensions are covered by the government, as no funds are accumulated by those 65 or older. By 2045, in the scenarios where interest rates are either 2 or 4 percent, nearly 86 percent of the pension bill still has to be paid by the government. Importantly, the debt incurred by the government may exceed the massive funds accumulated in the individual accounts. When interest rate is 2 percent, this occurs after 2045, and when interest rate is 4 percent (or higher) public pension debt is always higher than total funds in individual accounts.

Therefore, full-capitalization imposes huge financial uncertainties both on workers and the government. As we have seen, small changes in the interest rate projected over the long term would require large adjustments in the contribution rate. Except at very low interest rates (and high contribution rates) the resulting accumulation of funds would not match the borrowing needs of the government to cover the pension deficits, implying that the government would have to resort to other sources of revenue of finance.

Figure 8. Pension deficits in full capitalization systems, depending on interest rate (share of total pensions)

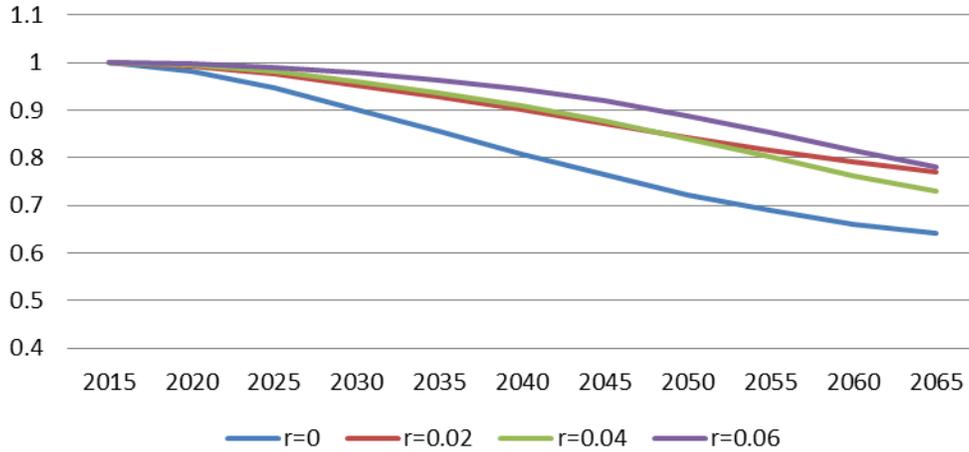
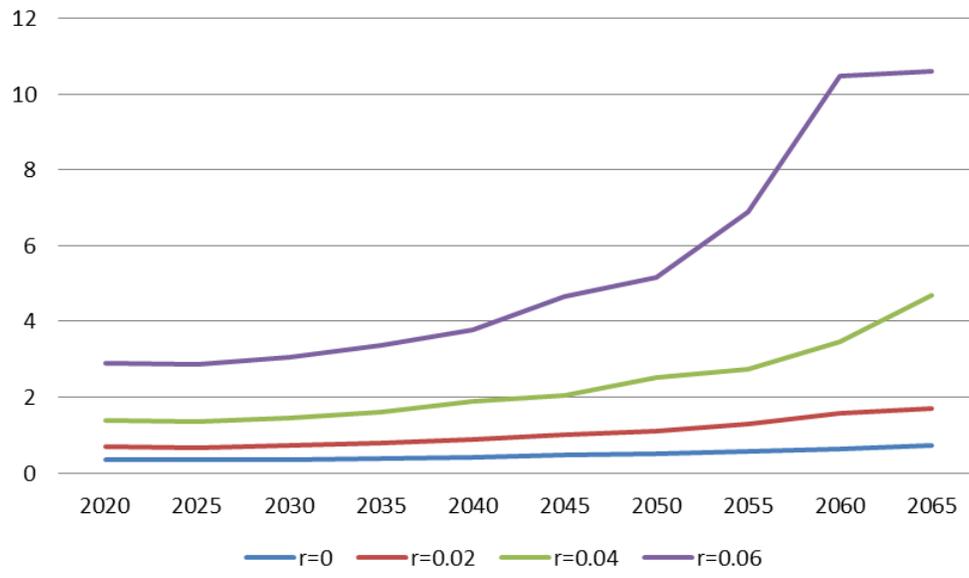


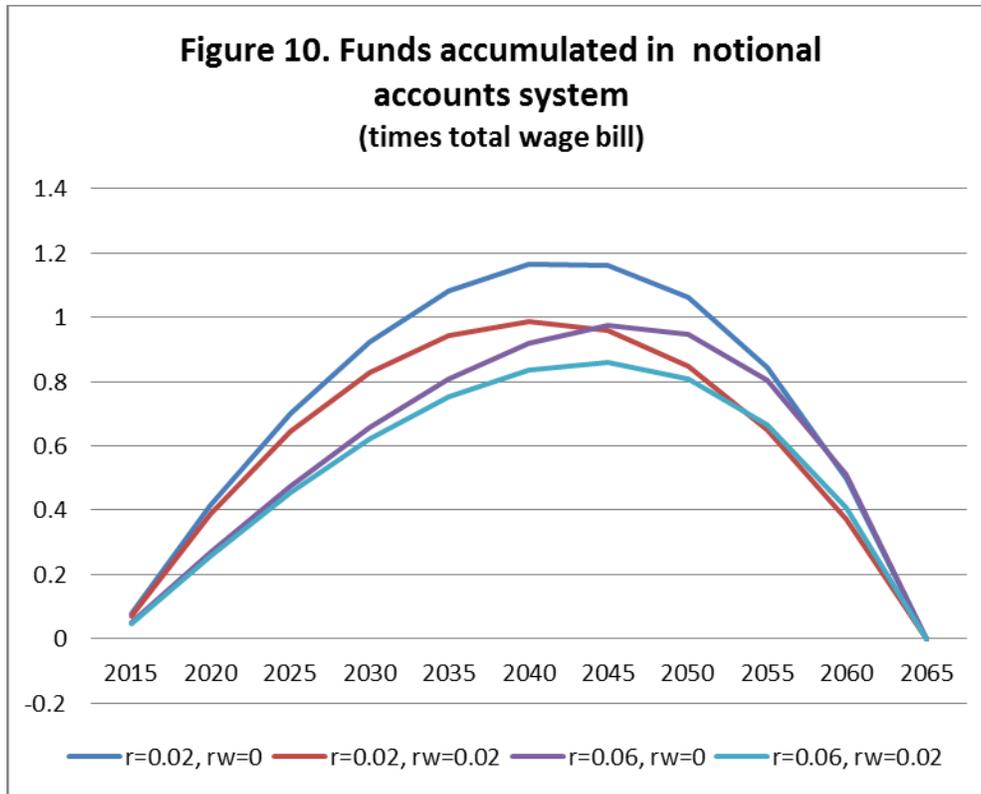
Figure 9. Pension debt in full-capitalization systems, depending on interest rate (times funds held in accounts)



Notional Accounts System

In a notional accounts system, pensions depend on the history of contributions of individuals and their rate of return, like in conventional fully-capitalization systems. However, the parameters of the system are established so that, over a certain horizon, revenues from contributions are equal to pension payments, like in a PAYG system. This is so because, unlike in a full-capitalization system, pensions are paid out of current contributions, like in PAYG. Therefore, the stability of the system depends on the full set of factors listed in the two previous sections, with one important difference: the rate of return of the *notional* accounts is not the market rate, but a pre-defined *notional* rate. The term *notional* refers to the fact that individual accounts are not matched by the amount of funds accumulated. The whole system may have sizable stabilizing funds as we will show, but they are not intended to correspond to the notional values in the individual accounts.

In order to simulate how the system would operate we have assumed that some positive stabilizing funds need be kept at all times (eventually becoming zero in 2065), and that the (minimum) contribution rate to achieve that result is kept unchanged throughout the whole 50 years of projection of the system. Obviously, the results depend on the market rate of interest at which the stabilizing funds are held (which is not necessarily the notional interest rate used to compute notional individual balances) and the rate at which average wages grow. Let's assume initially that the market real interest rate is 2 percent and there is no average wage growth (aside from that due to changes in the age composition of the working population). Under these initial assumptions, the required contribution rate is 16.1 percent (slightly lower than 16.8, the *average* contribution in PAYG during the whole period). The actual funds held by the system would reach a maximum (in 2035) of 1.2 times the wage bill (see Figure 10). By way of comparison, recall that in the full-capitalization system, under the same assumptions, the required contribution rate was 12.1 percent, and funds accumulated in the system would grow continuously to reach a maximum in 2065 of 5.5 times the wage bill (as already shown in Figure 7; see a summary in Table 2, simulation 4). Even with a market rate of interest of 6 percent, where the rate of contribution necessary for full-capitalization of individual accounts would be just 2.9 percent (compared with 12.5 percent in notional accounts), funds accumulated in the system would reach a maximum of 2.7 times the wage bill, compared with an amount equivalent to one year of pensions in the case of notional accounts under the same assumptions (see simulation number 10 in Table 2).



Compared with full-capitalization, notional accounts require higher contribution rates (except when the interest rate is below certain threshold close to zero). However, as shown, full capitalization always requires many times larger funds accumulated. Since pension payments are by construction identical in the three systems (for each assumed real wage growth, irrespective of the interest rate), the magnitude of the funds under full capitalization is partly a reflection of the transition costs that the national government must incur, due to the fact that it must still pay the pensions of those not (fully) covered by the new system, but it does not receive the contributions (which go to the individual accounts), whereas in PAYG and in notional accounts all pensions are paid from current contributions. What often occurs in practice in countries with full-capitalization systems is that the government simply borrows from the private pension funds most of the resources that they have accumulated in order to pay the pensions of the retirees that were not able to accumulate enough funds in their individual accounts. This operation is not free of costs and risks for all the parties involved, including the affiliates to the new system, but especially the government. As we have seen, it is not unlikely that the pension debt accumulated by government amply exceeds the funds of the individual accounts, implying that the government must tap other sources of finance to cover the deficit. To the extent that the deficit is paid by higher taxes, the result is a redistribution of income from taxpayers at large to workers, who contribute less than in PAYG or notional accounts. This transfer may or may not be progressive depending on the tax structure and the relative position of (formal) wage workers with respect to taxpayers. From an intergenerational point of view, the adoption of full-capitalization implies a transfer from current to future generations, once the transition costs are fully paid.

In comparison to PAYG, where no funds are accumulated, the contribution rate required in the notional accounts system is very similar (though slightly higher for low market interest rates and slightly lower for high interest rates). As mentioned, when the market interest rate and real wage growth are both 2 percent, contribution rates are *on average* about the same in both systems (remember that in PAYG contribution rates are assumed to change every period in order to balance contribution revenues and pension payments, and the system does not hold any funds).

It must be stressed that a key difference between notional accounts and PAYG is that the former are *not* benefit-defined. Each individual's pension depends, not on meeting certain conditions, but on the whole history of her contributions and the notional return, which does not necessarily correspond to the market rate of interest, thus eliminating this major source of uncertainty for individuals (which is a major drawback of full-capitalization). Importantly, the notional rate of return that equilibrates the system varies little across simulations (between 0.9 percent and 2.1 percent depending on the simulation; see Table 2). In simulation number 5, where the market interest rate and real wage growth are both 2 percent, the notional interest rate is 1.4 percent. To recall, the notional interest rate is the return to the notional funds accumulated by individuals that would allow an average individual who contributes uninterruptedly to the system throughout her working life to receive a pension equal to 60.7 percent her average wage during her working life (equivalent to one subsistence income, under the assumption that entry-level wage at age 20 corresponds to one subsistence income and average real wage growth is nil).

Table 2. Comparison of Main Parameters in the Three Basic Pension Systems

Simulation number	Alternative assumptions		Simulation results						
			Contribution rate			Notional interest rate	Maximum funds held (times total wage bill) ^a		Outstanding public debt (times funds held) ^b
	Market interest rate	Real wage growth	PAYG (average over period)	Full-capitalization	Notional accouts	Notional accouts	Full-capitalization	Notional accouts	Full-capitalization
1	0	0	0.168	0.238	0.177	0.009	7.1	1.2	0.7
2	0	0.02	0.146	0.238	0.165	0.011	...	1.0	...
3	0	0.04	0.129	0.238	0.154	0.014	...	0.8	...
4	0.02	0	0.168	0.121	0.161	0.012	5.5	1.2	1.7
5	0.02	0.02	0.146	0.128	0.153	0.014	...	1.0	...
6	0.02	0.04	0.129	0.136	0.145	0.016	...	0.8	...
7	0.04	0	0.168	0.060	0.147	0.014	3.3	1.1	4.7
8	0.04	0.02	0.146	0.068	0.140	0.016	...	0.9	...
9	0.04	0.04	0.129	0.076	0.134	0.019	...	0.8	...
10	0.06	0	0.168	0.029	0.135	0.017	2.7	1.0	10.6
11	0.06	0.02	0.146	0.035	0.129	0.019	...	0.9	...
12	0.06	0.04	0.129	0.041	0.125	0.021	...	0.8	...

Source: simulations of pension systems for the period 2015-2065 to get in all cases pensions equivalent to 0.607 times the average wages during individuals' working lives.

Notes: ^a No funds are held in PAYG. ^b In 2065. There is no outstanding public debt in PAYG or in notional accounts.

Since benefits are not defined in a notional system, actual pensions will depend on the contributions effectively made by the individual, which implies that the system will not produce fiscal contingencies on this account. Contingencies may still appear if, over the long run, the basic parameters turn out to be misaligned with respect to actual trends. However, as the simulations in Table 2 clearly suggest, deviations from a projected trend in notional accounts require relatively minor adjustments in contribution and notional interest rates. This is the most important advantage with respect to the other systems, which may be subject to large changes in contribution rates as market interest rates or wage growth rates change or deviate from their projected values.

So far, the analysis has assumed a single demographic scenario. How sensitive are our results to alternative demographic scenarios? Table 3 compares the results of the “medium-fertility” scenario discussed so far with a “low-fertility” scenario also taken from U.N. projections. As expected, the contribution rates in the latter are higher, because the younger cohorts of workers are smaller than in the medium-fertility scenario. However, the differences in contribution rates are moderate (between 0.8 and 1.7 percent points, depending on the alternative interest rates and wage growth rates). Notional interest rates would require even smaller changes, never exceeding 0.4 percent points. Still, it is important to keep in mind that the projections cover until 2065 only. Assuring financial sustainability over a longer period would necessarily require higher contribution rates and lower notional interest rates given the demographic trends facing most Latin American countries.

Table 3. Sensibility of Parameters in Notional Accounts to Demographics

Simulation number	Alternative assumptions		Simulation results			
			Contribution rate		Notional interest rate	
	Market interest rate	Real wage growth	Medium fertility scenario	Low fertility scenario	Medium fertility scenario	Low fertility scenario
1	0	0	0.177	0.189	0.009	0.007
2	0	0.02	0.165	0.180	0.011	0.008
3	0	0.04	0.154	0.171	0.014	0.010
4	0.02	0	0.161	0.169	0.012	0.010
5	0.02	0.02	0.153	0.163	0.014	0.012
6	0.02	0.04	0.145	0.158	0.016	0.013
7	0.04	0	0.147	0.152	0.014	0.014
8	0.04	0.02	0.140	0.147	0.016	0.015
9	0.04	0.04	0.134	0.144	0.019	0.016
10	0.06	0	0.135	0.138	0.017	0.016
11	0.06	0.02	0.129	0.134	0.019	0.018
12	0.06	0.04	0.125	0.131	0.021	0.020

Source: simulations for the period 2015-2065 to get in all cases pensions equivalent to 0.607 times the average wages during individuals' working lives, using alternative population projections by United Nations, 2013.

Conclusion and Final Comments

A pension system based on full-capitalization looks attractive for the “average” Latin American country because, at almost any positive real rate of return, it allows to keep contribution rates at lower levels than in PAYG or in notional accounts. While required contributions rates under full-capitalization are extremely sensitive to changes in long-term interest rates, they are lower than the more stable contribution rates required under PAYG or notional accounts at any plausible combination of positive interest and real wage growth rates. (It should be kept in mind that these comparisons assume that individuals contribute regularly throughout their whole working lives, from 20 to 64 years of age).

Since substantial increases of the contribution rate are bound to face strong political opposition, setting the contribution rate at a higher level than required to reach the targeted replacement ratio is a good hedge against that risk. However, that hedge does not eliminate the uncertainty workers have to face under full-capitalization because pensions, which are defined at the moment of retirement, are very sensitive to the market interest rate at that moment. Furthermore, to the extent that pension

expectations depend much more on the wage level of the individual at the end of his working life, in a fast growing economy contribution rates need to be higher than in a low growing economy.

Beyond these considerations, full-capitalization is a risky proposition mainly because adopting such system implies huge transition costs over several decades, which put substantial fiscal pressure on the government, while private funds accumulate massive resources. As abundant international experience indicates, this carries important political risks to manipulate the system in order to reduce those transition costs and/or grab the resources held in the individual accounts.

A pension system based on individual accounts is desirable, however, as long as it incentivizes workers to contribute regularly, minimizes their uncertainty about their future pensions and does not create fiscal contingencies. This seems to be entirely possible under notional accounts, as the simulations presented in this document indicate. Assuming real wage growth of 2 percent, a contribution rate near 15 percent and a *notional* interest rate about 1.5 percent, such system can accommodate swings in market real interest rates within the range of 0 to 6 percent without experiencing serious disruptions. Revenue from contributions would be used partly to cover pensions of retirees that (strictly on account of their age) have not accumulated enough notional funds since the inception of the system, and partly to create a stabilizing fund that will reach its peak during the first half of the 2030s, eventually disappearing towards 2065.

To be sure, similar contribution rates would be, on average, required in a PAYG system, and such a system could be also complemented with a similar stabilizing fund. The main difference with respect to PAYG is that in notional accounts benefits are not pre-defined, but depend on the history of each individual's contributions. Fiscal contingencies from notional accounts may still appear if a minimum pension is established which would be paid to those who have not made regular contributions since the inception of the system. Although politically attractive, that idea must be resisted as it weakens incentives and breaks the consistency of the system, making it financially vulnerable. In its place, a basic pension for all individuals in retirement age could be established. The simulations presented are based on the presumption that a worker that regularly contributes to the system during his whole working life should be entitled to a pension about 60 percent his average (real) wage throughout his life. However, this replacement ratio would be lower if the individual fails to make fully regular contributions. Assuming that he contributes only two thirds of the time, the actual replacement ratio would be 40 percent. Under these assumptions, a basic pension equivalent to 60 percent subsistence incomes would then be required to prevent destitution of the lowest wage workers in the old age. Such basic pension would not create significant disincentives to work or to contribute to the pension system, but it would have to be paid for from fiscal sources other than labor taxes or contributions.

A final caveat must be kept in mind: the results presented in this note may differ for any specific country due to the simplified nature of the simulations. Although more refined exercises will not affect the basic comparisons across the three idealized pension systems discussed, the exact parameters will undoubtedly be affected, especially for those countries facing demographic trends substantially different from the assumed "average" Latin American country.