How much do Latin American pension programs promise to pay back?

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Abstract

We assess the main pension programs in eleven Latin American countries in terms of the pensions they promise to pay back in return for payroll taxes workers and employers pay. We analyze equity, insurance and incentives to work, using the internal rates of return implicit in the flows of contributions and pensions, complemented with the replacement rates. Our results indicate that most programs analyzed are progressive in the sense that, other things equal, they yield higher returns to low than to high income workers. But poor workers often have flat age-earnings profiles and lower life expectancy, which both reduce the rates of return workers get from social security. The Argentinean, Brazilian and (the pre-2008) Uruguayan programs severely punish short contribution careers, providing strong incentives for workers in the programs to continue contributing until they reach minimums that vary between 30 and 35 years of contributions. The counterpart is that these programs do not hedge workers against the risk of having short working careers; quite the opposite, they raise the uncertainty workers face. The very low rates of return that the Argentinean, Brazilian and Uruguayan main pension programs pay to workers with short working careers are likely to impact strongly on low income workers, as they are particularly likely to have interruptions in their working careers. The Chilean and Mexican programs show a better balance between insurance against the risk of short working careers and incentives to work. The defined benefit programs of Argentina, Brazil and Uruguay strongly discourage early retirement; the Chilean and Mexican programs are more neutral. Argentina, Chile and Uruguay passed reforms to their main pension programs in 2008. Unlike the Argentinean reform, the Chilean and Uruguayan 2008 reforms strengthened the social protection programs provide, shifting the balance towards more insurance and less incentives to work.

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1. Introduction

In this paper, we assess several Latin American pension schemes in terms of the payments they promise to make in return to contributions. Our analysis covers the main pension programs in Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Uruguay and Venezuela. We run micro-simulations of lifetime contributions and compute pension rights according to existing norms.

The design of a pension scheme has important implications in terms of equity, insurance and incentives to work. But these effects are difficult to assess because the outcome depends on the interactions between several parameters of the scheme as well as on characteristics of the population and the economy. Two synthetic indicators useful in this assessment are the internal rate of return (IRR) and the replacement rate (RR) implicit in the cash flow of the contributions and benefits that workers should pay and receive from the programs. The IRR measures the benefit workers receive in return for their contributions, in terms of an implicit rate of return of their contributions. The RR is the pension-wage ratio and provides a direct measure of the ability of the scheme to replace the wages workers stop to receive when they retire.2

Our analysis focuses on the design of the schemes and hence on the promises they make rather than on actual performance. This acknowledgment/warning is important in a region in which the gap between de jure and de facto policies is often wide. Most pension administrations cannot strictly abide by the law simply because they do not have the information they need to apply the rules. Also many workers who are legally covered by pension schemes are not covered in practice. Notwithstanding, the analysis of the design of the schemes and their adequacy to the local demographic and economic conditions is an important ingredient of a broader assessment of pension schemes in Latin America.

In the following section, we present the methodology. In section 3 we present the estimated IRRs and RRs for a “representative” individual in each country. In sections 4 and 5 we analyze equity, insurance and incentives using these same indicators with different simulations. Section 6 concludes. The appendix contains a brief description of the pension programs.

2 Robalino (2005) follows a similar strategy to assess incentives, redistribution and sustainability of the pension schemes in the Middle East and North Africa and Dorfman and Forteza (2008) present a similar analysis for the Caribbean.
replacement rates (RRs), i.e. the percentage of wages that is replaced with pensions, mostly to understand what is driving the estimated IRRs, but also to assess the income smoothing goal of pension schemes.

Social security programs involve pretty complex contracts between workers, employers and the social security administrations. Workers and employers are supposed to contribute during several decades in exchange for pensions to be paid until death, and often even beyond death (survivors benefit). Assessing the design of a program is not simple as the impact of each norm on the final result depends on other norms plus some demographic and socio-economic characteristics of the covered population. The IRRs are synthetic indicators that summarize the interactions between all these ingredients and provide basis for meaningful comparisons across programs and time.

We first simulate the cash flows of contributions and pensions of some “representative” individuals and compute their IRRs. Their lifetime average earnings are equal to their countries’ per capita GDP. They have the same age-earnings profile across countries, with real wages growing at 2% per year. The representative workers start working at 30 and contribute without interruptions until they retire at 65 in all countries. Individuals live until they reach the “age of death”, which is 20 plus life expectancy at 20. Life expectancy was taken from WHO (2008), which presents data for the year 2006. The WHO tables represent the whole countries’ population rather than the population that contribute to the social security systems. It is possible that these statistics underestimate the life expectancy of contributors to pension programs because in Latin America the pool of contributors are relatively better off and have higher life expectancy than the excluded. Because of this, the IRRs that actual contributors are receiving might be higher than reported in this study.

The representative workers are single males, who do not generate survivors’ benefits or suffer disability, so the only benefit is the old-age pension. Nevertheless, all workers must by law contribute to the old-age, survival and disability programs. Workers who do generate survivors’ benefits or receive a disability pension would get higher IRRs than our representative workers.

The flows over which we compute the IRRs include both the insured and the employers’ contributions. The rationale for including the employers’ contributions is that in the long run these contributions should impact on after-tax wages. It should be noticed that most pension programs have other sources of funds on top of contributions. Most governments partially finance these programs from general taxes. We made no attempt at computing the general taxes workers pay to indirectly finance pensions. The rate of return workers get from the pension programs are thus likely to be lower than what our simulations suggest. This is particularly true in the case of countries with mature pension programs which usually have deficits governments help to finance. Nevertheless, we think that our analysis of equity, insurance and incentives in the pension programs is robust. If the payroll and general taxes were distributed similarly among workers, the results we got in terms of equity would not differ much from what we would have gotten had we been able to compute all sources of pension funds. In turn, the insurance pensions provide does not
directly depend on general taxes workers pay. Finally, the incentives to work should not hinge too much on general taxes that workers must pay independently on whether they participate in the social security system. Consider for example the case of Uruguay, where part of the value added tax is earmarked to finance pensions. One could argue that the decision to participate in formal labor markets is relatively independent of the decision to pay the value added tax. Things might be less clear in the case of the income tax, for the decision to evade social security contributions could somehow be linked to the decision to evade the income tax.

In the spirit of Whitehouse (2007), we standardized some conditions to make the results more comparable across countries and to focus mainly on design issues. We used the same 3.5 ppa (percent per annum) real interest rate (net of commissions and other costs) across countries and programs. While it is possible that different programs get different real interest rates, we prefer at this stage to explore differences between programs that do not hinge on the different ability of the pension funds to yield different net returns. The insurable wage ceilings, the minimum and maximum pensions and all other system parameters that are set in nominal terms were adjusted according to the inflation rate, which is assumed to be the same in all countries (2.5 ppa). The same adjustment was applied to pensions, except in the case of Uruguay where pensions are adjusted by the wage growth according to current legislation. The indexation is crucial for the results, and not all countries have the same commitment to indexation. Failing to adjust pensions to prices has been a common practice in the region. Nevertheless, we chose in this document to assume that all programs index nominal variables because we are analyzing the design of the programs, not how the programs are being implemented.

All the flows are before taxes, so we computed gross IRRs. All the IRRs we present in the text are real. The basic rules and parameters of each pension scheme were taken from Social Security Administration (2008) and complemented with local sources in most countries. We present a summary of the main provisions in each program in the appendix.

We performed sensitivity analysis in five dimensions, namely (i) the average wage level, (ii) the age earnings profile, (iii) life expectancy, (iv) the enrollment age, and (v) the age of retirement. The average wage along the lifecycle of the simulated worker was set at five different levels, corresponding to 1/4, 1/2, 1, 2, and 4 times the countries’ per capita GDP. The age earnings profile is the profile of earnings along the lifecycle. We generated three profiles setting the rate of growth of the real wage at 1, 2 and 3% per year in real terms. The age of death was set at 20 plus life expectancy at 20 in the base scenario and reduced in 1 and 2 years in other two scenarios. We assessed the impact of the length of the period of contributions on the IRRs simulating different enrollment ages, keeping the retirement ages as in the base scenario. In turn, we analyzed the impact of the age of retirement changing this variable and keeping constant the enrollment age. It should be noticed that this approach implies that the length of the period of contributions is being changed in parallel to the age of retirement.
3. Results for “representative” individuals

The middle column in Table 1 presents the real IRRs we got for our “representative” workers. The table shows much diversity across countries and programs, with IRRs ranging from -4.9 ppa in the Peruvian PAYG pillar to 7.0 ppa in the Venezuelan program.

In the Argentinean PAYG pillar, the representative worker would get a negative IRR, in the order of -1.2 ppa. This worker would earn on average about US$ 6,640 per annum. He would start his working career at 30 paying a contribution of about US$ 1,050 per annum, would continue paying contributions that would gradually increase up to a maximum of US$ 2,050 when he reaches 64, and would receive a pension of US$ 5,200 at 65 until he dies at 73. His initial pension would represent about 64% of his final wage. This pension would be composed of two terms, the basic (US$ 820) and the additional (US$ 4,380) pension. The additional pension is computed as the average wage of the last 10 years times a replacement rate that positively depends on the number of years of contribution (with a minimum of 52.5%). As expected, the representative worker in our simulations would be receiving neither the minimum nor the maximum pension, so the IRR we get for this worker is not driven by these provisions.

Opting for the individual accounts pillar, this same worker would get about 0.7 ppa. With the same contributions as in the PAYG pillar, this worker would get a pension of about US$ 7,430 per annum, composed of the same US$ 820 basic pension plus an annuity of about US$ 6,580. The striking fact about this result is that this IRR is much smaller than the rate of return of the pension funds that we assumed to run these simulations (3.5 ppa). The reason is that only insured contributions go to the pension fund while the employer contributions finance the basic pension. The rate of return of the insured contributions to the accounts is 3.5 ppa in this simulation by assumption, but the rate of return of the employer contributions is negative, so that the total IRR in the pillar turns out to be much smaller than the assumed 3.5 ppa.

The Bolivian representative worker would get an IRR of 3.5 ppa. This worker would earn on average about US$ 1,372 per annum, would start his working career at 30 paying a contribution of about US$ 120 per annum and would continue paying contributions that would gradually increase up to a maximum of US$ 230 when he turned 64. He would receive a pension of US$ 2,840 at 65 until he died at 69. Since this is not the minimum pension, and the individual contribution is not affected by the floor or the ceiling, it isn’t surprising that the IRR is exactly the interest rate assumed to be earned by the pension funds and the insurance companies. The representative worker would not receive any subsidy. The initial pension for this individual would represent about 172% of his final wage.

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3 The cash flows are expressed in 2007 US dollars.
### Table 1: Internal rates of return and average wages

<table>
<thead>
<tr>
<th>Country</th>
<th>Quarter</th>
<th>Half</th>
<th>Once</th>
<th>Twice</th>
<th>Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina (Ind. Account)</td>
<td>2.1%</td>
<td>1.2%</td>
<td>0.7%</td>
<td>0.4%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Argentina (PAYG)</td>
<td>1.2%</td>
<td>-0.4%</td>
<td>-1.2%</td>
<td>-1.6%</td>
<td>-2.4%</td>
</tr>
<tr>
<td>Bolivia</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Brazil (LOS Pension)</td>
<td>2.9%</td>
<td>3.3%</td>
<td>3.1%</td>
<td>3.1%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Chile b/</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Colombia (Ind. Account)</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Colombia (PAYG)</td>
<td>1.6%</td>
<td>1.6%</td>
<td>1.7%</td>
<td>1.6%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Ecuador</td>
<td>3.4%</td>
<td>3.6%</td>
<td>4.9%</td>
<td>4.9%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Mexico</td>
<td>5.1%</td>
<td>4.4%</td>
<td>4.0%</td>
<td>3.7%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Paraguay</td>
<td>0.9%</td>
<td>0.9%</td>
<td>0.9%</td>
<td>2.4%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Peru (Ind. Account)</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Peru (PAYG)</td>
<td>2.5%</td>
<td>2.2%</td>
<td>2.2%</td>
<td>-1.0%</td>
<td>-4.9%</td>
</tr>
<tr>
<td>Uruguay (opting for mixed DB-DC a/ b/)</td>
<td>3.4%</td>
<td>3.4%</td>
<td>2.9%</td>
<td>0.1%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Uruguay (ordinary regime) a/ b/</td>
<td>-0.2%</td>
<td>-0.6%</td>
<td>-0.5%</td>
<td>0.1%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Venezuela</td>
<td>6.4%</td>
<td>7.0%</td>
<td>6.3%</td>
<td>5.1%</td>
<td>4.4%</td>
</tr>
</tbody>
</table>

a/ Workers earning less than $5,000 of may 1995 per month (approximately US$ 8,900 per annum, in 2007 US dollars) participate only in the PAYG-DB pillar –the “ordinary regime”–, unless they explicitly opt to deposit half of their personal contributions to the savings account pillar.

b/ Computed with current norms, which are in the process of being modified by laws passed in 2008.

Assumptions: Real wages growing at 2% per year, 35 years contributing, retirement at 65, age of death is 20 plus life expectancy at 20, single male.

Sources: Own computations based on Social Security Administration (2008), WHO (2008), World Bank, Brazil Pensions Report, and SAFP

The Brazilian representative worker would get an IRR of about 3.1 ppa. This worker would earn on average about US$ 6,860 per annum. He would start paying a contribution of about US$ 1,500 at the age of 30, would continue paying contributions that would gradually increase up to a maximum of US$ 2,900 when he reaches 64, and would receive a pension of about US$ 23,000 at 65 until he dies at 71. His initial pension would represent as much as 275% of his final wage. This surprisingly high figure stems directly from the parameters in the Brazilian fator previdenciario, i.e. the replacement rate enshrined in the benefit formula.

The Chilean representative worker would earn on average about US$ 9,877 per annum. He would get an IRR of about 3.5 ppa, as he would start paying a contribution of about US$ 870 at the age of 30, would continue paying contributions that would gradually increase up to a maximum of US$ 1,700 when he reaches 64, and would receive a pension of about US$ 8,570 at 65 until he dies at 76. In this case the initial pension would represent around 72% of his final wage. As in the Bolivian case this worker is not being benefited with any subsidy, therefore the IRR equals the interest rate assumed for the individual accounts systems to deliver.

The Colombian representative worker would get an IRR of about 3.5 ppa if he opted for the individual account pillar. This worker would earn about US$ 3,658 per annum. He
would earn the minimum wage (about US$ 2,736) during the first three years of his working career. He would start paying contributions of about US$ 440 at age 30, his maximum contribution would round the US$ 820 when the worker is 64 years old and his first pension would be of about US$ 5,419, which represents 110% of his final wage. This individual would keep receiving this amount of pension until he dies at 73.

The Colombian representative worker would get a worse deal if he opted for the PAYG pillar rather than for the individual accounts pillar. For the same amount of contributions in his lifetime, the individual would get a pension of about US$ 3,658 at age 65, which represents only 74% of his last wage. He would get an IRR of only 1.7 ppa.

The Ecuadorian PAYG system delivers one of the highest IRRs in our sample of countries: the representative worker would get in this case 4.9 ppa. This individual would have an average wage of about US$ 3,310 at 30, would start contributing about US$ 225 per annum and at 64 the contributions would raise up to US$ 440. At age 65 he would receive his first pension of about US$ 4,000 which implies a replacement rate of 94%, until he dies at age 73.

The Mexican representative worker would get 4.0 ppa –i.e. more than the 3.5 ppa assumed rate of return of the pension fund and despite of this program being an individual account system– because of the contributions the Mexican government pay to each individual account, the so called “social contribution” (cuota social). He would earn on average about US$ 8,485 per annum. He would start his working career paying a contribution of about US$ 515 per annum at 30, would continue paying contributions that would gradually increase up to a maximum of US$ 1,010 when he turned 64, and would receive a pension of US$ 6,115 at 65 until he died at 75. His initial pension would represent about 53% of his final wage.

The case of the representative worker in Paraguay is special because GDP per capita (US$ 1,961) is smaller than the minimum wage (US$ 2,910), so we cannot assume that the representative worker’s average wage is equal to the country’s per capita GDP. Since the minimum wage constraint would be binding in this case, we simply assumed that the Paraguayan representative worker earns the minimum wage his entire working career. He would thus contribute the floor of the contributing range (which is about US$ 670) his whole vesting period. He would receive a pension of US$ 2,910 at 65 until he died at 75. His initial pension would represent 110% of his last wage and he would get an IRR of 0.9 ppa.

The Peruvian representative worker would earn about US$ 3,910. Opting for the individual account regime he would get an IRR of 3.5 ppa, as it would be expected since the regime is a pure individual account regime and no subsidies are interfering in the cash flow. He would contribute about US$ 350 at 30, would continue paying contributions that would gradually increase up to a maximum of US$ 680 when he reached 64, and would receive a pension of about US$ 4,070 at 65 until he died at 74.
If he chose the PAYG program the deal would be clearly worse since the contributions are slightly higher and the benefits are clearly lower than in the individual accounts program, and therefore the IRR would be lower (2.2 ppa.). In fact, he would contribute about US$ 355 at 30, would continue paying contributions that would gradually increase up to a maximum of US$ 700 when he turned 64, and would receive a pension of about US$ 3,100 at 65. The comparison is also clear when looking at the replacement rates, since a person in the individual account program replaces 87% and in the PAYG program replaces 66% of his last net wage.

The Uruguayan representative worker may get very different results depending on whether he opts to contribute only to the PAYG or to both the PAYG and the individual accounts pillars. In the Uruguayan program a worker earning less than a certain threshold (of about US$ 8,900 per annum) will by default contribute only to the PAYG pillar, unless he explicitly opts to split his personal contributions between the two pillars. The worker earning the country’s per capita GDP will belong to this category during most of his working career. According to our results, this worker will get a much higher IRR if he opts for the mixed PAYG-individual accounts scheme (2.9 ppa), than if he stays with only the PAYG program (-0.5% ppa). Not surprisingly, most workers opted for the mixed scheme.

In Uruguay, the representative worker would earn on average about US$ 6,856 per annum. He would start his working career at 30 paying a contribution of about US$ 1,090 per annum, and would continue paying contributions that would gradually increase up to a maximum of US$ 2,150 when he turned 64. If he did not choose to contribute to the individual accounts pillar for his first income tier, the representative worker would nevertheless surpass the threshold at 60, so for a short period he would be contributing to both pillars. His pension would hence be composed of two terms, the PAYG pension (US$ 5,685) and a small annuity (US$ 52).

The representative worker would get a much better result if he opted to split his contributions between the two pillars. With the same total amount of contributions as in the other regime (but with a different distribution between pillars), this worker would get a pension of about US$ 11,560 per annum, composed of a DB pension of US$ 7,170 and an annuity of US$ 4,390. No wonder the annuity is larger in this scenario because the worker opted to deposit more contributions to his individual account, but it is in principle surprising that the DB pension is also larger given that this worker opted to reduce his contributions to the PAYG pillar. The explanation is however simple: workers who opt to contribute to the two pillars receive by law a special bonus in their DB pension.

Finally, the Venezuelan representative worker gets the highest IRR of the entire region with 6.3 ppa. The representative worker would earn about US$ 8,300 per annum, would start contributing about US$ 390, and would reach the maximum contribution of about US$ 770 at age 64. At 65 he would receive a pension of about US$ 8,920 until he died at age 74. The first pension would represent about 80% of the final wage net of
contributions. This replacement rate is not unusually large, but the IRRs are nevertheless comparatively high because of the low contribution rates this program charges (less than 7%).

All the simulations were run with the same assumptions about the interest rate earned by the pension funds and the insurance companies and yet only the Bolivian, the Chilean, and the individual account pillars of the Colombian and Peruvian social security systems would yield that rate of return. It is natural that the DB schemes in PAYG pillars and Uruguayan mixed program do not yield the assumed interest rate, but it is less obvious why the individual accounts pillar in Argentina and Mexico yield something different. The reason lies with the non DC ingredients present in these schemes. In the case of Argentina, there is the already mentioned basic pension, financed with the employers’ contributions. Because of this, the Argentinean representative worker earns in the individual accounts pillar much less than the assumed 3.5 ppa. The Mexican representative worker benefits from a government contribution to the individual accounts, the so called “cuota social”. This is a flat amount equal to 5.5% of the daily minimum wage.

4. Equity

Pension schemes generate redistribution, not only in terms of redistributing towards those workers who were negatively affected by shocks, which is the typical insurance function of social security, but also in expected terms. The implicit IRRs indicate the type of redistribution that takes place through the pension system: workers who are being benefited will have higher expected IRRs.

The pension schemes are supposed to be progressive in the sense that workers with low average income should receive higher returns than the well off. But workers with steeper age earnings profiles often receive higher rates of return as well, and these workers tend to have high income. Also workers with high life expectancy tend to benefit from the system, as they tend to receive pensions during longer periods of time than workers with low life expectancy, and poorer workers usually have lower life expectancy. There are winners and losers between generations as well. We summarize in this section the results from some simulations we run to specifically analyze equity issues in the design of the pension schemes.

4.1. The impact of the average wage

The public pension schemes analyzed in this study provide in principle higher IRRs to low than to high income workers. We compared the implicit IRRs paid by the pension schemes to workers whose lifetime average income lies between a quarter and four times the country’s per capita GDP (Table 1). In most simulations in this series, high income workers got lower IRRs than low income workers.
The equalizing redistribution is generally performed in the DB-PAYG programs through minimum and maximum pensions. For example, the Argentinean PAYG pillar has a maximum pension that is about seven times the minimum. The Argentinean system also performs redistributions through the basic pension: it increases as the number of years of contribution increases, but it does not depend on the amount of the contributions. Therefore, the basic pension is pretty flat across income levels. As all workers receive this benefit, provided they comply with some eligibility conditions, this redistributive mechanism operates not only for workers who opted for the public additional (DB) pension but also for those who opted for the individual account pension. This is why the computed IRRs in the Argentinean individual account pillar (second row in Table 1) are decreasing with income levels.

The Brazilian and Colombian PAYG programs do not look very progressive. According to our simulations, workers earning a quarter of each country’s per capita GDP get slightly higher IRRs than workers earning 16 times that amount. In both countries the minimum pension equals the minimum wage (about US$ 2,375 per annum in Brazil and US$ 2,736 in Colombia in 2007). Also in both countries the average pension wage used in the benefit formula has a ceiling that indirectly imposes an upper limit to the pension (around 24 and 25 times the minimum pension in Brazil and Colombia, respectively).

The Ecuadorian system does not show a clear pattern: workers earning one forth and one half of the country’s per capita GDP get higher IRRs than workers earning four times the country’s per capita GDP, but workers earning the country’s per capita GDP or twice this amount get considerably higher rates. In other words, the IRRs are not monotonically decreasing with average wages. The system has a relatively modest maximum pension, which explains the comparatively low return that the highest income workers get. This is a progressive ingredient in this program. But on the other hand, low income workers in our simulations suffer a negative “final wage effect”. The average wages of only the last five years of contributions are considered for pension computations in Ecuador. Therefore, the age-earnings profile materially impact on pensions: the steeper the profile the larger the pension is. Low income workers in our simulation have a flat profile because they contribute for the minimum wage.

The Peruvian PAYG is the most progressive program in the region, if we measure progressiveness by the difference between the IRRs gotten by the richest and the poorest worker in our simulations. This result is mostly driven by the relatively short distance that exists in this program between minimum and maximum pensions (the maximum is about twice the minimum). Because of this, workers earning two and four times the country’s per capita GDP are both capped by the maximum pension, and the former paid half as much as the latter in contributions. It also contributes to the redistributive nature of this program the fact that, unlike in other programs, the minimum pension is higher than the contributing floor. Workers earning a quarter and a half of per capita GDP receive the same minimum pension even though the former pay lower contributions than the latter.
The Uruguayan pension program has a minimum and a maximum pension in its DB-PAYG pillar. Nevertheless, as the results in Table 1 show, this program may well yield lower IRRs to low than to high income workers. This is because of a composition effect: the annuity (which yields higher return than the DB pension in these simulations) represents a higher share of the total pension for high than for low income workers. In fact, workers whose annual income does not surpass US$ 8,900 will only receive the DB pension, unless they explicitly opt to contribute to both pillars. Because of the negative return in the ordinary DB scheme, low income workers who do not opt make a very bad deal. But if they do opt to contribute to both pillars, their IRRs improve substantially. Since this effect only benefits low income workers, the option turns the scheme progressive.

The Venezuelan system delivers higher IRRs to low than to high income workers for most of the wage range we considered in the simulations. The program has a highly redistributive ingredient in the basic pension which is a flat benefit independent of the insured’s wages. Nevertheless, workers earning a quarter of the country’s per capita GDP get lower return than workers earning twice that amount in our simulations. The explanation lies with the “final wage effect” mentioned in the case of Ecuador. In Venezuela like in Ecuador, the pension is computed on the basis of the last five years of contribution. This short period put individuals with flat age-earnings profiles in an unfavorable situation compared to workers with steeper profiles. The poorest workers in our simulation will be contributing by the minimum wage and hence their age-earnings profile will be flat.

The Bolivian, Chilean, Colombian and Peruvian individual account schemes yield the same IRRs for a wide range of income levels. In fact, in all the simulations presented in Table 1 for these regimes the IRR is the same for all workers. All these programs, save the Peruvian individual accounts pillar, have some redistributive ingredients, but they do not show up in any of the simulations presented in the table. Both the Bolivian and the Colombian programs have minimum pensions. In the Chilean case the government provides a supplement to workers who contributed at least 20 years, but have not accumulated enough funds to self-finance a pension above the “minimum pension guarantee”. This provision obviously departs from actuarial fairness since workers with sufficiently low contributions get IRRs above the assumed (net) rate of return of pension funds and insurance companies. But none of the workers simulated in Table 1 benefit with this minimum.

A reform passed in the Chilean parliament in January 2008 will gradually substitute the “solidarity contribution” (Aporte Previsional Solidario) for the “minimum pension guarantee”. The “solidarity contribution” is designed in such a way that pensions are always increasing functions of individual cumulative contributions (unlike the “minimum pension guarantee”, which provides the same pension to all beneficiaries). Another important difference between the two benefits is that there is no minimum number of periods of contribution required to receive the “solidarity contribution”. The reform will be fully effective in about 15 years. In the reformed system and with the same assumptions used in Table 1, workers earning a half and a quarter of Chile’s per capita
GDP would get IRRs of 3.9 and 4.4 ppa, respectively. The reformed system will thus be more redistributive than the current one.

The Mexican system has a guaranteed minimum pension. It also has, as mentioned above, the singularity of a flat contribution made by the government for every working person. This flat contribution implies a greater subsidy, as a proportion of their own contributions, for people with lower earnings, and this makes the IRRs decreasing with income. The guaranteed minimum pension becomes operative for workers earning a quarter of the country’s per capita GDP and that is why the IRR is remarkably higher in this case.

The practical relevance of these different IRRs may be probably better gauged after noting that one percentage point difference in the IRR represents about 27% difference in the pension, keeping contributions constant. Therefore, with a difference in the IRR like the 3.6 percentage points obtained in the Argentinian PAYG pillar between a worker earning a quarter of and a worker earning four times the country’s per capita GDP the pension-wage ratio of the poorer worker would more than double that of the richest worker in this simulation.

4.2. The impact of the age-earnings profiles

In order to isolate the impact of average earnings, we held other characteristics equal in the set of simulations presented above, but low income workers tend to have flatter age earning profiles than high income workers and this might impact on the IRRs. Many pension schemes provide pensions that depend on the average insured wages during the last years of the working careers. As mentioned before, these pension formulas benefit workers whose earning profiles are steeper along the lifecycle, as they contribute over wages that are on average low relative to the wages used to compute their pension. Because of this effect, the programs might be less redistributive than what the results in Table 1 suggest. We therefore analyzed the sensitivity of the results to the workers age earnings profile.

We simulated in each country three different age earnings profiles, which are associated with three different rates of growth of wages and the same average wage along the lifecycle. In most but not in all cases, the IRR increased with the rate of growth of wages (Table 2).

\[4 \text{ The semi-elasticity of pensions to the IRR depends on the enrollment, retirement and death ages. It is approximately } 27\% \text{ when enrollment is at 30, retirement at 65 and death at 73.}\]
Table 2: Internal rates of return and the age-earnings profile

<table>
<thead>
<tr>
<th>Country</th>
<th>Annual rate of growth of wage</th>
<th>One %</th>
<th>Two %</th>
<th>Three %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina (Ind. Account)</td>
<td>0.8%</td>
<td>0.7%</td>
<td>0.5%</td>
<td></td>
</tr>
<tr>
<td>Argentina (PAYG)</td>
<td>-1.6%</td>
<td>-1.2%</td>
<td>-0.8%</td>
<td></td>
</tr>
<tr>
<td>Bolivia</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td></td>
</tr>
<tr>
<td>Brazil (LOS Pension)</td>
<td>2.9%</td>
<td>3.1%</td>
<td>3.4%</td>
<td></td>
</tr>
<tr>
<td>Chile b/</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td></td>
</tr>
<tr>
<td>Colombia (Ind. Account)</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td></td>
</tr>
<tr>
<td>Colombia (PAYG)</td>
<td>1.1%</td>
<td>1.7%</td>
<td>2.1%</td>
<td></td>
</tr>
<tr>
<td>Ecuador</td>
<td>4.1%</td>
<td>4.9%</td>
<td>5.6%</td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>3.9%</td>
<td>4.0%</td>
<td>4.0%</td>
<td></td>
</tr>
<tr>
<td>Paraguay</td>
<td>0.9%</td>
<td>0.9%</td>
<td>1.1%</td>
<td></td>
</tr>
<tr>
<td>Peru (Ind. Account)</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td></td>
</tr>
<tr>
<td>Peru (PAYG)</td>
<td>1.5%</td>
<td>2.2%</td>
<td>2.5%</td>
<td></td>
</tr>
<tr>
<td>Uruguay (opting for mixed DB-DC) a/ b/</td>
<td>2.7%</td>
<td>2.9%</td>
<td>3.0%</td>
<td></td>
</tr>
<tr>
<td>Uruguay (ordinary regime)</td>
<td>a/ b/</td>
<td>-1.3%</td>
<td>-0.5%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Venezuela</td>
<td>5.7%</td>
<td>6.3%</td>
<td>7.0%</td>
<td></td>
</tr>
</tbody>
</table>

a/ Workers earning less than $5,000 of may 1995 per month (approximately US$ 8,900 per annum, in 2007 US dollars) participate only in the PAYG-DB pillar –the “ordinary regime”–, unless they explicitly opt to deposit half of their personal contributions to the savings account pillar.
b/ Computed with current norms, which are in the process of being modified by laws passed in 2008.

Assumptions: Average wage in the simulation equal to per capita GDP, 35 years contributing, retirement at 65, age of death is 20 plus life expectancy at 20, single male.

Sources: Own computations based on Social Security Administration (2008), WHO (2008), World Bank, Brazil Pensions Report, and SAFP

The Argentinean PAYG pillar displays the typical pattern. The individual whose wage grows faster receives a higher rate of return because the pension is computed on the last 10 years of contribution rather than on the whole working career. The steeper the worker’s age earnings profile, the higher the wages in the last 10 years relative to his own lifetime average and the higher the pension. The same effect is present in all the other PAYG programs in the region. This effect is stronger in programs that use shorter periods of contribution to compute the pension.

The IRRs delivered by purely individual account programs should not depend on the profile of lifetime wages, and this is what our simulations show in the cases of the Bolivian, Chilean, Colombian and Peruvian individual account programs. However, some non-pure individual account programs have non actuarial ingredients that make the return sensitive to the age-earnings profile. The Argentinian individual account pillar, for example, yields lower IRRs the steeper the age earnings profile; i.e. just the opposite as the Argentinean PAYG pillar. This rather unexpected result is due to the impact of the age-earnings profile on the composition of pensions in terms of the annuity and the basic pension. Workers with steeper age-earnings profile have a larger proportion of their final pension served by the basic pension, which yields lower rate of return than the individual accounts. To understand this result, it is important to recall that in this set of simulations, the average wage was kept constant, which means that flatter profiles imply lower wages
at the end but higher at the beginning of the working career. In the individual account pillar, contributions made at the beginning of the working career count much to the final pension because these contributions are being capitalized at a rate of return that surpasses that of the pension program. It is thus important to have relatively good wages from the beginning.

The IRRs are almost the same for the three age-earnings profiles in Mexico. They are not exactly the same despite of being an individual accounts program, because of the “cuota social”, i.e. the flat contribution the government makes to complement insured and employers’ contributions. Workers with steeper age-earning profiles accumulate less in their accounts because they have smaller contributions early in their working career than other workers who earn the same lifetime average but with flatter profiles. Therefore, the proportion of the pension that is subsidized is greater in the case of workers with steeper age-earnings profiles.

4.3. The impact of life expectancies

Workers who live less get lower IRRs as they receive pensions during fewer periods. This is just to be expected, since the pension schemes provide insurance against the “risk” of living too much. But this insurance function turns into redistribution in expected terms when different groups of workers having different life expectancy are covered under the same rules. In particular, low income workers tend to live on average less than high income workers. Once this factor is brought into the picture, pension systems look less pro-poor than otherwise. Unfortunately, we do not have estimations of life expectancy by income levels in Latin America. Nevertheless, in order to assess the possible magnitude of this effect, we computed the IRRs for the average citizen of the country and for workers who live one and two years less than the average citizen (Table 3). As expected, the IRRs of workers who live less are smaller.
Table 3: Internal rates of return and life expectancy

"Age of death" = 20 + Life expectancy at 20

<table>
<thead>
<tr>
<th>Country</th>
<th>-0</th>
<th>-1</th>
<th>-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina (Ind. Account)</td>
<td>0.7%</td>
<td>0.0%</td>
<td>-0.9%</td>
</tr>
<tr>
<td>Argentina (PAYG)</td>
<td>-1.2%</td>
<td>-2.0%</td>
<td>-3.0%</td>
</tr>
<tr>
<td>Bolivia</td>
<td>3.5%</td>
<td>2.1%</td>
<td>-0.2%</td>
</tr>
<tr>
<td>Brazil (LOS Pension)</td>
<td>3.1%</td>
<td>2.3%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Chile</td>
<td>3.5%</td>
<td>3.2%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Colombia (Ind. Account)</td>
<td>3.5%</td>
<td>3.0%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Colombia (PAYG)</td>
<td>1.7%</td>
<td>1.0%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Ecuador</td>
<td>4.9%</td>
<td>4.4%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Mexico</td>
<td>4.0%</td>
<td>3.6%</td>
<td>3.1%</td>
</tr>
<tr>
<td>Paraguay</td>
<td>2.2%</td>
<td>1.6%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Peru (Ind. Account)</td>
<td>2.9%</td>
<td>2.3%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Peru (PAYG)</td>
<td>2.9%</td>
<td>2.3%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Uruguay (opting for mixed DB-DC)</td>
<td>-0.5%</td>
<td>-1.3%</td>
<td>-2.3%</td>
</tr>
<tr>
<td>Uruguay (ordinary regime)</td>
<td>-0.5%</td>
<td>-1.3%</td>
<td>-2.3%</td>
</tr>
<tr>
<td>Venezuela</td>
<td>6.3%</td>
<td>6.0%</td>
<td>5.5%</td>
</tr>
</tbody>
</table>

a/ Workers earning less than $5,000 of may 1995 per month (approximately US$ 8,900 per annum, in 2007 US dollars) participate only in the PAYG-DB pillar –the “ordinary regime”--, unless they explicitly opt to deposit half of their personal contributions to the savings account pillar.
b/ Computed with current norms, which are in the process of being modified by laws passed in 2008.

Assumptions: Average wage in the simulations equal to per capita GDP, wages growing at 2% per year, 35 years contributing, retirement at 65, single male.
Sources: Own computations based on Social Security Administration (2008), WHO (2008), World Bank, Brazil Pensions Report, and SAFP

5. Insurance and incentives to work

Pension schemes are bound to distort incentives. Contribution rates are taxes that reduce the incentives to work, at least in the formal sector; and pensions reduce the incentives to save. The less than actuarial reduction in benefits that is usually associated to shorter working careers constitutes a hedge against negative shocks in the labor market, but it also generates incentives to choose shorter careers. It protects senior workers who lose their job, but it also opens the window to opportunistic behavior. There are also some characteristics of the design that constitute an invitation to gambling, like the benefit formulas based on the last salaries. Weak enforcement facilitates late enrollment and gambling.

In this section, we use the IRRs to analyze the incentives pension programs provide to work, but also the insurance they provide against shocks that negatively impact on the length of working careers. We separately analyze enrollment and retirement ages, which are two key determinants of the length of working careers. The number and duration of
interruptions in the histories of contributions are also important determinants of the length of working careers (Bucheli, Forteza and Rossi 2008; Forteza et al. 2009). While we do not explicitly model interruptions in this document, the analysis of enrollment ages provides valuable information about this issue: late enrollment works as a proxy for short contribution histories due to interruptions in the periods of contribution.

5.1. Late enrollment

The impact of the enrollment age on the IRRs varies widely across the region (Table 4). A first group of pension programs, composed of the Argentinean, Brazilian and Uruguayan programs, punish individuals who have short histories of contribution as a result of late enrollment. A second group, composed of the DC individual account programs, is neutral, yielding the same IRRs irrespective of the enrollment ages. The Chilean program after the 2008 reform and the Mexican program represent interesting exceptions as these programs are not totally neutral despite of being based on individual accounts. Finally, the third and largest group of programs pays higher IRRs to individuals with short working careers. This group includes the Chilean (after the 2008 reform), Ecuadorian, Mexican, Paraguayan, Peruvian PAYG and Venezuelan programs. We briefly comment on each group in what follows.

Workers participating in the Argentinean PAYG pillar get similar IRRs whether they contribute 30 or 40 years and much less if they contribute less than 30 years. Working 40 rather than 30 years, workers get higher replacement rates (Table 5), which means higher pensions, but they also make more contributions. The tradeoff is approximately actuarially fair in this range, and therefore the IRRs are basically the same. In turn, workers who contribute 25 years or less to this program only have the right to get a pension at 70, i.e. 5 years later than the ordinary pensionable age. They also get lower replacement rates (Table 5) and smaller pensions than workers who contribute 30 years or more. According to the IRRs we get for the last two cases (Table 4), the reduction in benefits is (much) more than actuarially fair, suggesting that the “punishment” for having short contribution histories is too harsh.

In principle, a defined contribution individual accounts pillar should be actuarially fair. Fewer contributions should be balanced by smaller pensions and the IRRs should be the same irrespective of the length of the contribution period. However, the Argentinean individual accounts pillar departs from actuarial fairness, as it seems to punish workers who contribute little. Indeed, as the first row in Table 4 shows, the Argentinean individual accounts pillar yields higher IRRs the longer the contribution period. This is because the replacement rates drop very fast as the number of years of contribution reduce (Table 5). This unexpected result stems from the non actuarial component of this program, i.e. the basic pension which is very sensitive to the number of periods of contribution.
Table 4: Internal rates of return and the length of the contribution period

<table>
<thead>
<tr>
<th>Number of years contributing</th>
<th>40</th>
<th>35</th>
<th>30</th>
<th>25</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Argentina (Ind. Account)</strong></td>
<td>0.9%</td>
<td>0.7%</td>
<td>0.4%</td>
<td>-0.7%</td>
<td>-1.3%</td>
</tr>
<tr>
<td><strong>Argentina (PAYG)</strong></td>
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<td>-1.2%</td>
<td>-1.4%</td>
<td>-10.3%</td>
<td>-10.5%</td>
</tr>
<tr>
<td><strong>Bolivia</strong></td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td><strong>Brazil (LOS Pension)</strong></td>
<td>2.9%</td>
<td>3.1%</td>
<td>-3.1%</td>
<td>-2.5%</td>
<td>-1.5%</td>
</tr>
<tr>
<td><strong>Brazil (Prop Pension)</strong></td>
<td>2.9%</td>
<td>3.1%</td>
<td>1.8%</td>
<td>-2.5%</td>
<td>-1.5%</td>
</tr>
<tr>
<td><strong>Chile. Post 2008</strong></td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.7%</td>
<td>4.5%</td>
</tr>
<tr>
<td><strong>Chile. Pre 2008</strong></td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td><strong>Colombia (Ind. Account)</strong></td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td><strong>Colombia (PAYG)</strong></td>
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<td>1.7%</td>
<td>1.9%</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td><strong>Ecuador</strong></td>
<td>4.4%</td>
<td>4.9%</td>
<td>5.6%</td>
<td>6.6%</td>
<td>8.3%</td>
</tr>
<tr>
<td><strong>Mexico</strong></td>
<td>3.9%</td>
<td>4.0%</td>
<td>4.0%</td>
<td>4.1%</td>
<td>4.2%</td>
</tr>
<tr>
<td><strong>Paraguay</strong></td>
<td>0.3%</td>
<td>0.9%</td>
<td>1.8%</td>
<td>3.1%</td>
<td>a/</td>
</tr>
<tr>
<td><strong>Peru (Ind. Account)</strong></td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td><strong>Peru (PAYG)</strong></td>
<td>1.6%</td>
<td>2.2%</td>
<td>2.0%</td>
<td>1.8%</td>
<td>2.9%</td>
</tr>
<tr>
<td><strong>Uruguay (optional DB-DC). Post 2008</strong></td>
<td>2.4%</td>
<td>2.9%</td>
<td>-0.5%</td>
<td>0.7%</td>
<td>0.7%</td>
</tr>
<tr>
<td><strong>Uruguay (optional DB-DC). Pre 2008</strong></td>
<td>2.4%</td>
<td>2.9%</td>
<td>3.6%</td>
<td>4.0%</td>
<td>0.9%</td>
</tr>
<tr>
<td><strong>Uruguay (ordinary regime). Post 2008</strong></td>
<td>-0.7%</td>
<td>-0.5%</td>
<td>-0.5%</td>
<td>-0.8%</td>
<td>-3.5%</td>
</tr>
<tr>
<td><strong>Uruguay (ordinary regime). Pre 2008</strong></td>
<td>-0.7%</td>
<td>-0.5%</td>
<td>-6.3%</td>
<td>-6.5%</td>
<td>-6.6%</td>
</tr>
<tr>
<td><strong>Venezuela</strong></td>
<td>5.6%</td>
<td>6.3%</td>
<td>7.4%</td>
<td>8.8%</td>
<td>11.2%</td>
</tr>
</tbody>
</table>

a/ Not eligible for pensions.

Assumptions: Average wage in the simulations equal to per capita GDP, real wages growing at 2% per year, retirement at 65, age of death is 20 plus life expectancy at 20, single male.

Sources: Own computations based on Social Security Administration (2008), WHO (2008), World Bank, Brazil Pensions Report, and SAFP
Table 5: Replacement rates and the length of the contribution period

<table>
<thead>
<tr>
<th>Number of years contributing</th>
<th>40</th>
<th>35</th>
<th>30</th>
<th>25</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina (Ind. Account)</td>
<td>107%</td>
<td>92%</td>
<td>77%</td>
<td>54%</td>
<td>41%</td>
</tr>
<tr>
<td>Argentina (PAYG)</td>
<td>64%</td>
<td>64%</td>
<td>56%</td>
<td>31%</td>
<td>29%</td>
</tr>
<tr>
<td>Bolivia</td>
<td>204%</td>
<td>172%</td>
<td>141%</td>
<td>113%</td>
<td>87%</td>
</tr>
<tr>
<td>Brazil (LOS Pension)</td>
<td>305%</td>
<td>275%</td>
<td>81%</td>
<td>81%</td>
<td>81%</td>
</tr>
<tr>
<td>Brazil (Prop Pension)</td>
<td>305%</td>
<td>275%</td>
<td>181%</td>
<td>81%</td>
<td>81%</td>
</tr>
<tr>
<td>Chile. Post 2008</td>
<td>86%</td>
<td>72%</td>
<td>60%</td>
<td>50%</td>
<td>42%</td>
</tr>
<tr>
<td>Chile. Pre 2008</td>
<td>86%</td>
<td>72%</td>
<td>60%</td>
<td>48%</td>
<td>37%</td>
</tr>
<tr>
<td>Colombia (Ind. Account)</td>
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<td>77%</td>
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<td>76%</td>
<td>74%</td>
<td>67%</td>
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<td>na</td>
</tr>
<tr>
<td>Ecuador</td>
<td>103%</td>
<td>94%</td>
<td>86%</td>
<td>77%</td>
<td>69%</td>
</tr>
<tr>
<td>Mexico</td>
<td>64%</td>
<td>53%</td>
<td>44%</td>
<td>35%</td>
<td>27%</td>
</tr>
<tr>
<td>Paraguay</td>
<td>110%</td>
<td>110%</td>
<td>110%</td>
<td>110%</td>
<td>a/</td>
</tr>
<tr>
<td>Peru (Ind. Account)</td>
<td>103%</td>
<td>87%</td>
<td>72%</td>
<td>57%</td>
<td>44%</td>
</tr>
<tr>
<td>Peru (PAYG)</td>
<td>67%</td>
<td>66%</td>
<td>55%</td>
<td>44%</td>
<td>42%</td>
</tr>
<tr>
<td>Uruguay (optional DB-DC). Post 2008</td>
<td>149%</td>
<td>142%</td>
<td>137%</td>
<td>117%</td>
<td>28%</td>
</tr>
<tr>
<td>Uruguay (optional DB-DC). Pre 2008</td>
<td>149%</td>
<td>142%</td>
<td>228%</td>
<td>196%</td>
<td>163%</td>
</tr>
<tr>
<td>Uruguay (ordinary regime). Post 2008</td>
<td>74%</td>
<td>71%</td>
<td>65%</td>
<td>54%</td>
<td>51%</td>
</tr>
<tr>
<td>Uruguay (ordinary regime). Pre 2008</td>
<td>74%</td>
<td>71%</td>
<td>62%</td>
<td>57%</td>
<td>52%</td>
</tr>
<tr>
<td>Venezuela</td>
<td>85%</td>
<td>80%</td>
<td>74%</td>
<td>69%</td>
<td>64%</td>
</tr>
</tbody>
</table>

a/ Not eligible for pensions.

Assumptions: Average wage in the simulations equal to per capita GDP, real wages growing at 2% per year, retirement at 65, age of death is 20 plus life expectancy at 20, single male.

Sources: Own computations based on Social Security Administration (2008), WHO (2008), World Bank, Brazil Pensions Report, and SAFP

The Brazilian pension system does not seem to reward—in an actuarial sense—contributions made above the 35 years that are statutory required to get the ordinary pension (the so called “contributory” or length of service pension). Our “representative” worker would get a higher IRR contributing 35 than 40 years. This worker would get a larger pension if he contributed 40 rather than 35 years (Table 5), but this would not suffice to compensate him for the additional 5 years of contributions. In any event, the required 35 years of contributions is an already long period in the Brazilian context, so lacking incentives to contribute more than this threshold does not seem to be an issue. More interesting is to look at the provisions in the Brazilian pension scheme designed to deal with shorter contribution histories.

The “proportional” pension provision loosens the requirement about years of contribution. Workers can retire in this program with 30 rather than the 35 years required in the LOS program. But there is a penalization factor in the “proportional” pension formula that reduces the pension in 5 percentage points for each year that falls short of 35. It turns out, according to our computations, that this penalization more than compensates the system for the fewer number of contributions. As Table 4 shows, our
“representative” worker would suffer a considerable drop in the rate of return he gets from the pension system if he reduced the number of years of contribution from 35 to 30.

There is yet another provision in the Brazilian social security system that facilitates the access to pensions for workers with short contribution histories: the “age” pension. This program requires 65 years of age, but only 15 years of contribution. Hence, workers in the LOS program who do not accumulate 35 years of contribution and in the proportional program who do not accumulate 30 years of contribution receive the “age” pension. The benefit formula in the “age” pension is very different from the ordinary one used in the LOS and proportional pensions, and it turns out that the amount of the pension granted through this mechanism is much smaller (Table 5). As a result, the “age” pension program provides much smaller IRRs than the other two programs (Table 4).

The Uruguayan program before the 2008 reform strongly punished short working careers. As Table 4 shows, the IRRs are much smaller if workers contribute 30 or fewer years than 35 years. Workers who fail to contribute 35 years are not eligible for the ordinary pension, and they have to wait until they are 70 to receive an “advanced-age” pension. The IRRs are smaller basically because they receive the pension for a shorter period and, to a lesser extent, because the PAYG-DB pension is smaller (Table 5). Under these rules, workers who worked 30 years or so in the formal sector would have strong incentives to continue contributing. These high-powered incentives would probably work fine if contributing were just a matter of choice, but these rules look too extreme when contributions depend on chance as well.

The 2008 reform smoothed these characteristics, shifting the balance of the scheme from incentives to insurance. Workers in the ordinary regime do no longer face significant drops in the IRRs when they contribute less than 35 years, unless they fall short of 25. Furthermore, low income workers opting for the mixed regime would even get higher IRRs as they reduced the number of years of contribution, provided they contributed for at least 25 years. Changes in both the ordinary and the “advanced-age” pension programs are behind these results. The minimum number of years of contribution required to access an ordinary pension was reduced from 35 to 30. In turn, the advanced-age pension is now granted at 65 (rather than at 70) with 25 years of contribution. If the worker contributed less than 25 and more than 15, he could still access the advanced-age pension but at more advanced ages: at 66 with 23 years of contribution, at 67 with 21 years of contribution and so on up to age 70 with 15 years of contribution.

The second group is composed of programs that are neutral in the sense that the IRRs are the same irrespective of the enrollment age. The purely DC individual accounts programs conform this group. By their very structure, these programs are actuarially fair so that shorter contribution histories are exactly compensated with lower annuities. In this sense, these programs neither punish nor reward short contribution histories. This group is

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5 The replacement rate workers opting for the mixed program get is higher and yet the IRR is smaller with 30 than 35 years of contribution. This high replacement rate is due to the annuity which increases as the worker with less than 35 years of contribution starts collecting only at 70. This rise of the annuity does not impact on the IRRs though, for the annuity by construction is actuarially fair.
represented in the region by the Bolivian, Chilean (pre 2008 reform), Colombian and Peruvian individual accounts programs.

The third group is composed of programs that provide relatively high IRRs to workers with short working careers. Two interesting cases in this group are the Chilean (post 2008) and Mexican programs, which depart from actuarial fairness despite of being mostly based on individual accounts. The Chilean program after the reform passed in January 2008 be effective will provide a subsidy to workers who cannot self finance a pension above a certain threshold, and hence workers with fewer contributions will get higher IRRs. In turn, the Mexican program has a flat contribution made by the government. This contribution represents a higher proportion of total contributions as the total gets smaller because of shorter contribution periods.

According to our results, the Ecuadorian and Venezuelan programs strongly discourage long working careers, as the IRRs decrease steadily as the careers extend. The same happens in the Colombian and Peruvian PAYG programs, although to a lesser extent. In these programs the replacement rates increase as workers contribute more years, but these increases are not enough to actuarially compensate workers for more years contributing. As mentioned above, in the case of Venezuela the pension formula includes an amount that is granted to all retirees irrespective of their contributions. This provision partially accounts for the insufficient rise in pensions to compensate workers who make a bigger effort increasing contributions. But this is not the only explanation. We performed simulations ignoring this provision and still obtained important differences in IRRs: 8.5 ppa for workers with 20 years of contributions versus 4.7 ppa for workers with 40 years of contribution. In the Colombian case, we could not compute the IRRs for workers contributing less than 26 years.

The Paraguayan program also pays lower IRRs the shorter the contribution careers. But unlike other programs in this group, the Paraguayan program does not have any actuarial compensation for more years of contribution: the pension is exactly the average wage in the last three years, no matter the number of years of contribution. Pensions may still grow as workers contribute more years if wages in the last years are higher than in previous years, but this is a rather indirect and small effect that does not actuarially compensate for the longer period of contributions. The only incentive to contribute seems to be below 25 years, as workers contributing less than 25 years receive no benefits.

In summary, Argentina, Brazil and Uruguay seem to be the countries that provide stronger incentives to pursue long contribution careers. The IRRs are in these countries increasing functions of the length of the contribution periods. The counter side of these strong incentives is that these programs provide weak protection against the risk of having short working careers. In Argentina and Uruguay, the relatively tough pension

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6 The current Chilean program has redistributive non-actuarial ingredients as well. However, our representative worker would not benefit from these ingredients even if he contributed only 20 years.
7 We lack the details of the benefits Colombian workers receive if they contribute less than 26 years. SSA(2008) only says that “If the insured does not meet the contributions qualifying condition at the normal retirement age, a pension is provided.”
eligibility conditions play a significant role in this result, as workers with short contribution histories are not entitled to ordinary pensions and must wait longer to receive smaller pensions. These characteristics are being softened in Uruguay, as the 2008 reform put in place a phased loosening of the eligibility conditions. In Brazil, it is the precipitous drop in the replacement rates when the length of the contribution period shrinks what explains this result. In the other extreme, Ecuador and Venezuela are the countries that, according to our computations, provide weaker incentives to pursue long contribution careers and better protection against the risk of having such short careers. The defined contribution individual account programs present in several Latin American countries (for example Chile and Mexico) tend to be in the middle as they are in principle actuarially neutral. However, as several of the Latin American individual account pillars are not pure individual account schemes, the IRRs are not in all these programs totally inelastic to the length of the contribution period. The Argentinean PAYG pillar is a clear example.

5.2. Retirement ages

Pension programs impact on workers’ decision to stop working. There is a large literature that analyzes the relationship between social security provisions and labor force participation, mostly in developed countries. The main motivation for these studies is the steady decline in labor force participation of senior workers observed in recent decades in most developed countries precisely when life expectancies have risen dramatically. Gruber, Wise and collaborators have documented these trends and systematically explored the relationship between retirement ages and incentives inherent in social security programs in eleven developed countries (Gruber and Wise 1999, 2004 and 2007). They provide evidence that social security systems have contributed to reduce retirement ages in those countries. To the best of our knowledge, there is no comparable systematic effort to analyze the impact of social security programs on retirement in developing countries. While replicating Gruber and Wise’s analysis for the Latin American region is well beyond the scope of the present document, we do provide some systematic comparable analysis of incentives to retire inherent in pension programs in the region using our estimations of internal rates of return.

As we have already mentioned, we are not only interested in the analysis of the incentives to retire, but also on the social protection pension programs provide against the risk of short working careers. Programs that provide strong incentives to postpone retirement punish workers who retire early. From an insurance perspective, however, it seems desirable to protect workers who retire at relatively young ages if this happens because of adverse circumstances that are beyond workers choice. We will also use our estimations of the IRRs to discuss the insurance pension programs provide against this risk.

According to our estimations, some Latin American pension programs strongly discourage retirement before pension eligibility ages, but others are relatively neutral. As expected, the defined contribution programs are mostly neutral: they yield basically the same IRR irrespective of the retirement age. This is the case of the Bolivian, Chilean,
Colombian, Mexican and Peruvian individual account programs (Table 6). In turn, the defined benefit programs in Argentina, Brazil, Ecuador, Peru and Uruguay discourage retirement before pension eligibility ages. Some go even further providing incentives to postpone retirement several years after the first eligibility age (Brazil, Uruguay before the 2008 reform).

Even in the simple examples presented in Table 6 there are several forces at work, so the IRRs do not monotonically increase with the retirement age. Other things equal, a worker who retires later contributes more periods. Unless the worker is compensated with a sufficiently larger pension, the extension of the period contributing will obviously reduce the IRR. In principle, the postponement of retirement will also raise the age at which workers start collecting pensions, and this effect will also reduce IRRs (i.e. Colombian PAYG program). However, there are some cases in which the opposite occurs: if the worker has not contributed the minimum number of years required to get an ordinary pension, but is not far from doing it, he may complete the minimum required periods of contribution postponing retirement. By doing so, the worker accesses an ordinary pension rather than an advanced-age pension. In this case, later retirement implies earlier pension claim, which positively impacts on the IRRs (see more on this below in the cases of Argentina and Ecuador). Finally, the benefit formulas usually include rules by which later retirement is rewarded with higher pensions. Whether this is sufficient to compensate for the effort depends on the specific formula and the worker circumstances, but this seems to be the case at least for the workers in the Argentinean, Brazilian and Uruguayan (before the 2008 reform) programs presented in Table 6.

Despite of these general findings, it should be noticed that retirement ages impact on the IRRs through several channels, some of them rather indirect, and hence there is no simple relationship between retirement ages and IRRs. Moreover, it is not retirement per se what impact on the IRRs but the way the retirement decision impact on variables such as the length of the contribution period, the pension eligibility age, the age at which the pension is effectively claimed (if it happens after first eligibility age) and the average wage on which pensions are computed. Because of this, the impact of the retirement age on the IRRs depends on other variables, like the enrollment age and the density of contributions. Someone retiring at 60 in Uruguay, for example, is not eligible for an ordinary pension if he enrolled in the system at 35, but he is eligible if he enrolled at 25 (and contributed without interruptions). The results summarized in Table 6 and Table 7 should be read with these remarks in mind, avoiding the temptation to draw too general conclusions from the few cases presented in these tables. It is therefore useful to analyze some programs with some detail to get more robust conclusions on what is driving our results.

The Argentinean PAYG, the Brazilian and the Uruguayan (particularly before de 2008 reform) programs discourage retirement at early ages and deliver maximum IRRs at comparatively high ages. In the Argentinean PAYG pillar, the pensionable age for males is 65 (with 30 years of contribution and it is more than 65 with fewer years of contribution). Individuals can stop working earlier but they will have to wait until they
turn 65 or more to start collecting. The second row of Table 6 is illustrative of how severe the fall in the rate of return can be for an Argentinian worker retiring before the pensionable age. This fall is due to the drop in the replacement rate and the postponement of the pensionable age that is associated to a shorter period of contributions (Table 7). This case is a clear example of how the impact of retirement ages on the IRRs crucially depends on the enrollment age.

The Brazilian pension system is the only one in our set of simulations in which the representative worker maximizes (within the analyzed range) the IRRs retiring at 70. A Brazilian worker who enrolled in the system at 30 (and contributed every year until retirement) get 3.4 ppa of return if he retires at 70 and 3.1 ppa if he retires at 65 (through the LOS sub-program), but only 1.5 ppa if he retires at 60 (through the proportional pension) and –5.5 ppa if he retires at 55 (through the age pension). This is due to the fator previdenciario used to calculate pensions in both the LOS regime and the Proportional regime. The fator previdenciario rewards late retirement and the extension of the vesting period.

The Uruguayan rules before the reform passed in 2008 severely punish early retirement. Workers who started contributing at 30, retire at 60 and contribute only to the PAYG pillar get –5.4% in return. This IRR is almost 5 percentage points smaller than what they get if they retire at 65. Retiring at 60 workers fail to contribute the 35 years that are required to access to an ordinary pension; hence they will only be entitled to an advanced-age pension when they turn 70. The IRR is very low because both the RR is small (Table 7) and the period collecting pensions is short (the individual starts receiving the pension at 70 and dies at 73). With the same work history the IRRs would be higher if workers opted to direct half of their personal contributions to each pillar, but the fall in the IRR for retiring at 60 rather than 65 would still be large. The unusually high RR that these workers would get (Table 7) is due to the increase in the annuity derived from late retirement: the annuity is large, but only because they are expected to collect for a short period.

The reform passed in 2008 smoothed out the impact of early retirement because the minimum number of years of contribution to access an ordinary pension was reduced to 30 and the eligibility age for the advanced-age pension was reduced from 70 to 65. Now, someone who starts contributing at 30 and retires at 60 accumulates the 30 years of contribution that are required to access an ordinary pension. Even if he gets a smaller pension retiring at 60 than at 65, the IRR is higher because of the combined effect of less years contributing and more years collecting the pension. There is still a punishment to early retirement, but it takes place at a younger age. Under the conditions assumed to run

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8 To receive the pension at 65 they must have at least 30 years of contribution. The pensionable age rises if the number of periods of contribution reduces. For example, the individual who retires at 55 (first column and row in the Table 6) has 25 years of contribution and only get the pension at 70.

9 The extremely high replacement rates we get in Brazil for workers retiring at 70 are due to the actuarial component in the fator previdenciario, combined with the very short period that a worker retiring at 70 is expected to spend collecting pensions.
the simulations presented in Table 6, the fall in the IRR takes place if the worker retires now at 55 rather than at 60.

Table 6: Internal rates of return and the age at which individuals stop working

<table>
<thead>
<tr>
<th></th>
<th>Age of retirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>55</td>
</tr>
<tr>
<td>Argentina (Ind. Account)</td>
<td>0.9%</td>
</tr>
<tr>
<td>Argentina (PAYG)</td>
<td>-6.6%</td>
</tr>
<tr>
<td>Bolivia</td>
<td>3.5%</td>
</tr>
<tr>
<td>Brazil (LOS Pension)</td>
<td>-5.5%</td>
</tr>
<tr>
<td>Brazil (Prop Pension)</td>
<td>-5.5%</td>
</tr>
<tr>
<td>Chile. Post 2008</td>
<td>3.5%</td>
</tr>
<tr>
<td>Chile. Pre 2008</td>
<td>3.5%</td>
</tr>
<tr>
<td>Colombia (Ind. Account)</td>
<td>3.5%</td>
</tr>
<tr>
<td>Colombia (PAYG)</td>
<td>na</td>
</tr>
<tr>
<td>Ecuador</td>
<td>3.3%</td>
</tr>
<tr>
<td>Mexico</td>
<td>3.9%</td>
</tr>
<tr>
<td>Paraguay</td>
<td>3.3%</td>
</tr>
<tr>
<td>Peru (Ind. Account)</td>
<td>3.5%</td>
</tr>
<tr>
<td>Peru (PAYG)</td>
<td>2.7%</td>
</tr>
<tr>
<td>Uruguay (optional DB-DC). Post 2008</td>
<td>2.4%</td>
</tr>
<tr>
<td>Uruguay (optional DB-DC). Pre 2008</td>
<td>0.9%</td>
</tr>
<tr>
<td>Uruguay (ordinary regime). Post 2008</td>
<td>-1.5%</td>
</tr>
<tr>
<td>Uruguay (ordinary regime). Pre 2008</td>
<td>-4.9%</td>
</tr>
<tr>
<td>Venezuela</td>
<td>7.3%</td>
</tr>
</tbody>
</table>

a/ Simulated workers die at 69 in Bolivia.

Assumptions: Average wage in the simulations equal to per capita GDP, real wages growing at 2% per year, age of enrollment is 30, age of death is 20 plus life expectancy at 20, single male.

Sources: Own computations based on Social Security Administration (2008), WHO (2008), World Bank, Brazil Pensions Report, and SAFP

Chile and Mexico are two of the cases in which programs do not seem to provide strong incentives to retire at any definite age. In the Chilean system, workers are entitled to an annuity or to programmed withdrawals at 65, with no requirement about years contributing. Alternatively, workers can have an early-pension at any age if the accumulated funds are enough to finance pensions that surpass both an absolute minimum and certain proportion of their final wages. The 2008 reform did not change these provisions. The Mexican program grants the ordinary pension at 65 with 25 years of contribution. It also provides an early-pension with no requirements of age or contribution, if the accumulated fund is enough to finance a pension that surpasses certain threshold (which is the same for everybody). Our representative workers have enough funds accumulated to retire before 65 in both countries, and because of the actuarial fairness of the schemes, the IRRs are the same for all retirement ages. The Argentinean individual accounts pillar is not completely neutral because of the DB ingredients involved in the basic pension.
Table 7: Replacement rates and the age at which individuals stop working

<table>
<thead>
<tr>
<th>Age of retirement</th>
<th>55</th>
<th>60</th>
<th>65</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina (Ind. Account)</td>
<td>76%</td>
<td>90%</td>
<td>92%</td>
<td>248%</td>
</tr>
<tr>
<td>Argentina (PAYG)</td>
<td>28%</td>
<td>51%</td>
<td>64%</td>
<td>64%</td>
</tr>
<tr>
<td>Bolivia</td>
<td>74%</td>
<td>78%</td>
<td>172%</td>
<td>a/</td>
</tr>
<tr>
<td>Brazil (LOS Pension)</td>
<td>31%</td>
<td>30%</td>
<td>275%</td>
<td>1884%</td>
</tr>
<tr>
<td>Brazil (Prop Pension)</td>
<td>31%</td>
<td>96%</td>
<td>275%</td>
<td>1884%</td>
</tr>
<tr>
<td>Chile. Post 2008</td>
<td>61%</td>
<td>71%</td>
<td>72%</td>
<td>145%</td>
</tr>
<tr>
<td>Chile. Pre 2008</td>
<td>61%</td>
<td>71%</td>
<td>72%</td>
<td>145%</td>
</tr>
<tr>
<td>Colombia (Ind. Account)</td>
<td>71%</td>
<td>67%</td>
<td>110%</td>
<td>324%</td>
</tr>
<tr>
<td>Colombia (PAYG)</td>
<td>na</td>
<td>64%</td>
<td>74%</td>
<td>76%</td>
</tr>
<tr>
<td>Ecuador</td>
<td>60%</td>
<td>86%</td>
<td>94%</td>
<td>103%</td>
</tr>
<tr>
<td>Mexico</td>
<td>26%</td>
<td>32%</td>
<td>53%</td>
<td>117%</td>
</tr>
<tr>
<td>Paraguay</td>
<td>97%</td>
<td>110%</td>
<td>110%</td>
<td>110%</td>
</tr>
<tr>
<td>Peru (Ind. Account)</td>
<td>47%</td>
<td>55%</td>
<td>87%</td>
<td>214%</td>
</tr>
<tr>
<td>Peru (PAYG)</td>
<td>40%</td>
<td>55%</td>
<td>66%</td>
<td>67%</td>
</tr>
<tr>
<td>Uruguay (optional DB-DC). Post 2008</td>
<td>114%</td>
<td>101%</td>
<td>142%</td>
<td>250%</td>
</tr>
<tr>
<td>Uruguay (optional DB-DC). Pre 2008</td>
<td>222%</td>
<td>243%</td>
<td>142%</td>
<td>250%</td>
</tr>
<tr>
<td>Uruguay (ordinary regime). Post 2008</td>
<td>42%</td>
<td>49%</td>
<td>71%</td>
<td>88%</td>
</tr>
<tr>
<td>Uruguay (ordinary regime). Pre 2008</td>
<td>45%</td>
<td>55%</td>
<td>71%</td>
<td>88%</td>
</tr>
<tr>
<td>Venezuela b/</td>
<td>8%</td>
<td>60%</td>
<td>80%</td>
<td>102%</td>
</tr>
</tbody>
</table>

a/ Simulated workers die at 69 in Bolivia.

b/ Workers enrolling at 30 and retiring at 55 get a very modest old-age grant at 55. They receive this grant five years until they comply with the conditions to access an ordinary pension when they turn 60.

Assumptions: Average wage in the simulations equal to the average insurable wage of the system, real wages growing at 2% per year, age of enrollment is 30, age of death is 20 plus life expectancy at 20, single male.

Sources: Own computations based on Social Security Administration (2008), WHO (2008), World Bank, Brazil Pensions Report, and SAFP

The Colombian PAYG program does not provide incentives for our representative worker to continue working beyond 60 years of age. The IRRs are monotonically decreasing with the retirement ages in the whole analyzed range. He could get a higher pension retiring at 65 or even at 70 than at 60, but this rise in the monthly pension would not suffice to compensate him for more contributions and fewer months receiving the pension. This worker would not be eligible for an ordinary pension if he retired at 55, because he would not accumulate the required 26 years of contribution. According to SSA (2008), this worker would receive an old-age settlement, but the SSA does not provide the details so we could not compute the IRRs in this case.

The Ecuadorian worker presented in Table 6 has strong incentives to work until he turns 60, as the IRRs are considerably smaller if he retires before or after that age. This worker
is assumed to enroll at 30. If he stops working at 55, he will only be eligible for a pension
at 65, but if he continues working until he turns 60, he will be eligible for a pension at 60.
This is because the Ecuadorian program’s eligibility age is 60 if the worker contributed
30 years, but 65 if the worker contributed only 15 years. Contributing five more years
reduces his IRR, but receiving the pension five years earlier increases the IRR. The
second effect dominates the first in this case and the simulated worker benefits
postponing retirement until he turns 60. This is a clear example of how the impact of
postponing retirement on the IRRs depends on the whole history of contributions. If the
worker had enrolled in the system earlier, for example, the retirement age that maximizes
his IRR would likely be smaller.

The Paraguayan program delivers maximum IRRs if the simulated worker retires at 60
years of age, almost the same if he retires at 55, and much less if he retires later. He can
retire at 60 if he accumulated at least 25 years of contribution and at 55 if he accumulated
30 years of contributions. In either case he will be eligible for a pension at 60, since
retiring at 55 he would not be eligible before 60 because he would accumulate only 25
years of contribution (remember this worker is assumed to enrol at 30) which is not
enough to access to an early pension. Retiring at 60 rather than at 55, the worker will
have contributed five more years, but the pension will be higher, so that the IRRs are
basically the same. In turn, workers do not benefit from working more years after age 60,
as pensions do not rise despite of contributing more years and collecting pensions fewer
years. Pensions do not rise because the replacement rate is constant at 100%. This lack of
actuarial adjustment of the pension naturally leads to declining IRRs as workers
contribute more years. Therefore the Paraguayan program provides strong incentives
against contributing beyond the minimum required to access the ordinary pension.

Like their Ecuadorian peers, Peruvian workers in the PAYG system have strong
incentives to retire at 60: the IRR peaks at that age and reduce by more than one
percentage point if workers retire either at 55 or 65. Workers who enrolled at 30 will
have accumulated only 25 years of contributions if they retire at 55. They will not be
eligible for early retirement (55 years of age and 30 of contribution are the qualifying
conditions for this benefit) and will have to wait until they turn 60 to receive the pension.
Hence the eligibility age in this case is the same whether workers choose to retire at 55 or
at 60. Retiring at 60 workers get higher pensions but pay more contributions than retiring
at 55. According to our computations, the first effect dominates and the IRR is
significantly larger retiring at 60 than at 55. In turn, if workers choose to retire at 65
rather than at 60, they get higher pensions, receive pensions during fewer years and pay
contributions during more years. Our simulations show that the rise in pensions do not
suffice to compensate workers for paying more contributions and receiving pensions
during fewer years and hence the IRR is significantly lower if workers retire at 65 rather
than at 60. Similar effects take place if workers postpone retirement even further beyond
65.

The Venezuelan workers have incentives to retire at 60. The IRRs are smaller either if
they retire at 55 or at 65. In the Venezuelan program the ordinary pension requires 60
years of age and 15 of service, but people who retire younger can receive an old-age
grant if they have contributed for at least 2 whole years in the last 4. Workers who enrol at 30 and retire at 55 obtain this grant until they comply with the ordinary pension requirements, which in this case occur when they turn 60. From then on, these workers receive the ordinary pension. Workers retiring at 60 get larger pensions, contribute during more years and receive pensions during fewer years than workers retiring at 55. The first effect dominates the last two and hence the IRR is higher when workers retire at 60 rather than at 55. In turn, postponing retirement even further is not profitable. Even though pensions rise when workers retire at 65 rather than at 60, the combination of more periods contributing and fewer periods receiving pensions make this option unappealing.

In general, the programs do not provide incentives to retire at 70 or later. Only in the Brazilian program, the IRRs are a bit higher retiring at 70 than at 65, and it is very unlikely that these returns provide incentives enough to retire at so advanced ages. In the DC programs the IRRs do not vary with the retirement age and in the PAYG and mixed schemes the IRRs are much smaller when workers retire at 70 than at 65.

6. Concluding Remarks

We present in this paper estimations of the internal rates of return (IRR) and replacement rates (RR) that formal workers in eleven Latin American countries get from social security. We first use these indicators to assess the programs in terms of the return “representative” workers get for contributions. We then move to the analysis of diversity: we want to know how the programs treat both different individuals and the same individuals in different circumstances. Analyzing the return of different individuals we assess equity issues in social security. Analyzing the return of individuals in different circumstances we assess insurance and incentives.

Our analysis of equity is based on simulations run for hypothetical workers who differ in terms of (i) wage level, (ii) age-earning profiles and (iii) life expectancy. All the defined benefit programs analyzed in this study are in principle progressive in the sense that they provide higher returns to low than to high income workers. This result should be qualified however because several of these programs yield higher IRRs to workers with steeper age-earning profiles, which are usually the better off, and all of these programs yield lower IRRs to workers living less, and low income workers are likely to live less.

In Argentina, Brazil and Uruguay, pension programs punish short contribution careers with very low IRRs. This is probably an intended result: the idea is to provide incentives for making contributions. But many workers might be having short contribution careers because of bad luck and these pension programs compound the income loss they suffered. While it is perfectly natural for an insurance program to look at the incentives it provides, our results suggest that these programs went too far sacrificing the insurance service too much.

In the absence of moral hazard, i.e. if short contribution histories were just the result of bad luck, the optimal insurance would be to provide full protection against the risk of
short working careers. Full insurance in this case means that pensions should be independent of the number of periods of contribution. But as individuals can materially modify the probability of getting a job in the formal sector making choices that the social security administrations do not observe, a full insurance program would severely distort incentives. Individuals would in this case avoid contributions. The standard solution to moral hazard in the insurance industry is to provide partial insurance. In pension programs, this means that pensions cannot be held constant irrespective of the number of periods of contribution. The optimal degree of risk the individual should be facing depends on parameters that are not directly observable, so we cannot easily determine such a rule, but an actuarially fair reduction of the pension in response to shorter contribution histories looks as a sensible choice. It might still be too harsh, as workers would not be getting any insurance against the risk of short contribution careers, but the observed designs that reduce pensions by more than that look unnecessarily harsh. Rather than providing insurance, these programs create risk.

In Chile (after the 2008 reform be fully operational) and Mexico, pension programs provide some insurance against the risk of short contribution careers, as individuals with few years of contributions get larger IRRs than individuals with long contribution histories. The RRs are nevertheless increasing functions of the length of the contribution period, i.e. workers with short contribution histories get low replacement rates in both countries. Therefore, these programs provide some protection against the risk of short working career and also take care of incentives as they provide only partial insurance against this risk.

The Ecuadorian and Venezuelan pension programs also deliver larger IRRs to workers with short contribution careers, but they seem to go much further than the Chilean and Mexican programs in that direction. While in Chile and Mexico our representative workers would lose 1 and 0.3 percentage points per annum respectively if they contributed 40 rather than 20 years, in Ecuador and Venezuela workers would lose as much as 3.9 and 5.6 percentage points per annum respectively if they contributed 40 rather than 20 years. Like in other countries, the RRs are increasing functions of the length of the contribution period in Ecuador and Venezuela, and so these programs do not provide full insurance against the risk of short working careers. But the striking loses in the rates of return that Ecuadorian and Venezuelan workers suffer if they continue contributing beyond 20 years suggest that the incentives to contribute are too weak in these cases.

While we cannot say what the optimal insurance contract in each country should look like, our results suggest that the Chilean (after the 2008 reform) and Mexican programs engineered a better balance between insurance and incentives than the other programs discussed above. While the Argentinean (PAYG), the Brazilian and the Uruguayan programs seem to have shifted the balance too much towards incentives submitting workers to excessive risk, the Ecuadorian and Venezuelan programs are probably providing too weak incentives to contribute.
Our results about the return workers with short contribution careers get from social security also have a bearing on the equity issue. Low wage workers have more frequent and durable interruptions in their contribution histories than high wage workers (Bucheli, Forteza and Rossi 2008; Forteza et al. 2009). The very low IRRs that the Argentinean, Brazilian and Uruguayan pension programs yield to workers with short contribution histories impact thus primarily on low income workers. Ironically, two of the programs that provide better protection against this risk that is highly prevalent among the poor are built on individual savings accounts—the Chilean and the Mexican programs—and the three programs that impose very negative results on workers who do not manage to keep contributing long enough are totally (Brazil) or to a large extent (Argentina and Uruguay) based on “intergenerational solidarity”.

Argentina, Chile and Uruguay passed in 2008 reforms to their main pension programs. The Argentinean reform basically eliminates the individual accounts pillar, so the results we present for the existing PAYG pillar would still hold. In turn, the Chilean and Uruguayan reforms are parametric, in the sense that they change parameters but do not modify the basic architecture of the programs. According to our simulations, the Chilean and Uruguayan reforms reinforced social protection as the balance shifted towards insurance and away from incentives.

This document is an intermediate product of a research line that is still in progress. Future steps involve the inclusion of more countries, the development of a more formal and explicit analytical framework and the presentation of a wider range of simulations. While the first point requires no justification, the other two merit a few remarks. Regarding the analytics, we have borrowed some basic concepts from agency theory to illuminate our discussion of the empirical results in this paper. But we have made no attempt to present a formal elaboration of these concepts. At this stage of our research, we feel that we would greatly benefit from a more systematic integration of the rich and powerful concepts of agency theory in our analysis. Regarding the set of simulations, we would like to explore several extensions of our current work. An obvious one is to include both genders, as the results in the present document refer exclusively to men. Other important extensions are the inclusion of disability and survivors benefits. It is also tempting to repeat the analysis in different scenarios to get more insights since this may not look very demanding once the basic programming has been done. However, the returns to such endeavors are often rapidly decreasing and a dimensionality problem immediately makes apparent. Nevertheless, in this case the complexity of the systems suggests that running some more simulations is advisable to confirm the robustness of some results. Consider for example the analysis of the impact of retirement ages on the IRRs. Since the IRRs depend on the whole histories of contribution, postponing retirement one year may have quite different impact on the IRRs depending on the enrollment age, the densities of contribution, the average wage and the age-earnings profile. Also, as the impact of the retirement age on the IRRs is a non-monotone relationship, choosing only two or three points in each dimension may not be enough to fully characterize these functions. A problem of dimensionality immediately arises. Therefore, a thorough understanding of the nature of these programs educated with a more systematic use of formal analytical
tools seems necessary to pin down the appropriate set of simulation scenarios in future research.

References


Forteza, A.; I. Apella; E. Fajnzylber; C. Grushka; I. Rossi and G. Sanroman (2009). Work Histories and Pension Entitlements in Argentina, Chile and Uruguay.


SAFP: http://www.safp.cl/573/propertyvalue-2474.html


World Bank Brazil Pension Report (Reference to be completed once the report is made publicly available).
Annex: Description of systems

Argentina

<table>
<thead>
<tr>
<th>Individual Account</th>
<th>Additional</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source of funds:</strong> 11% of covered earnings (Insured Person)</td>
<td><strong>Source of funds:</strong> 11% of covered earnings (Insured Person)</td>
</tr>
<tr>
<td><strong>Qualifying Conditions:</strong></td>
<td><strong>Qualifying Conditions:</strong></td>
</tr>
<tr>
<td>a) “Ordinary”: Age 65</td>
<td>a) “Ordinary”: Age 65 with 30 years of service. The insured may substitute 2 years of age after the retirement age for 1 year of contributions.</td>
</tr>
<tr>
<td>b) “Advanced Age”: Age 70 with 10 years of service</td>
<td>b) “Advanced Age”: Age 70 with 10 years of service</td>
</tr>
<tr>
<td>c) “Early Retirement”: the annuity surpasses 50% of the average pension wages (SBJ).</td>
<td>c) “Early Retirement”: (Age 60 and 30 years of service. This program is being phased out since April of 2007)</td>
</tr>
<tr>
<td><strong>Benefits:</strong></td>
<td><strong>Benefits:</strong></td>
</tr>
<tr>
<td>a) “Ordinary” = annuity</td>
<td>a) “Ordinary” = (1.5/100) * average wages * t, where t= min(length of service, 35).(^\text{10})</td>
</tr>
<tr>
<td>b) “Advanced Age” = 70% of the ordinary annuity</td>
<td>Minimum pension (Additional + UBP) = US$ 173.</td>
</tr>
<tr>
<td>c) “Early Retirement” = annuity</td>
<td>Maximum pension (Additional + UBP) = US$ 1,267.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Universal Basic Pension</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source of funds:</strong> 10.17 or 12.71% for private workers and 16% for civil servants (employers contributions)</td>
</tr>
<tr>
<td><strong>Qualifying Conditions:</strong></td>
</tr>
<tr>
<td>a) “Ordinary”: Age 65 with 30 years of service</td>
</tr>
<tr>
<td>b) “Advanced Age”: Age 70 with 10 years of service</td>
</tr>
<tr>
<td><strong>Benefits:</strong></td>
</tr>
</tbody>
</table>

\(^{10}\) The ordinary pension was \((0.85/100)\)*SBJ*t until the 2007 reform.
- covered earnings = 3*MOPRE < wage < 75 * MOPRE.
- average wages= average wages of the last 10 years.

Options: By default, the worker is covered by UBP + Individual Account. He may choose for the Additional at the beginning, and being there he can change pillars but with no return.
All nominal variables are adjusted by the CPI.
### Bolivia

<table>
<thead>
<tr>
<th>Individual Account</th>
</tr>
</thead>
</table>

**Source of founds:**
- Insured person: 12.21% of covered earnings
- Employer: None
- Government: None.

floor = minimum wage  
ceiling=60 * minimum wage  
with minimum wage = US$ 65.5

**Qualifying Conditions:**
- a) “Ordinary” = At age 65 or at any age if the accumulated capital in the individual account, plus accrued interest, is sufficient to finance a monthly pension equal to 70% of the insured’s average covered earnings in the last 5 years.

**Benefits** = individual account annuity.

Min: 70% of the insured’s average covered earnings in the last 5 years.

All nominal variables are adjusted by the CPI.
### Brazil

<table>
<thead>
<tr>
<th>Proportional pension</th>
<th>Contributory Pension (Length of Service)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source of funds:</strong></td>
<td><strong>Source of funds:</strong></td>
</tr>
<tr>
<td>Insured Person:</td>
<td>Insured Person:</td>
</tr>
<tr>
<td>8% of wage if wage &lt; US$ 452</td>
<td>8% of wage if wage &lt; US$ 452</td>
</tr>
<tr>
<td>9% of wage if US$ 452 &lt; wage &lt; US$ 754</td>
<td>9% of wage if US$ 452 &lt; wage &lt; US$ 754</td>
</tr>
<tr>
<td>11% of wage if wage &gt; US$ 754</td>
<td>11% of wage if wage &gt; US$ 754</td>
</tr>
<tr>
<td>floor= minimum wage = US$198</td>
<td>floor= minimum wage = US$198</td>
</tr>
<tr>
<td>ceiling= US$ 1,507</td>
<td>ceiling= US$ 1,507</td>
</tr>
<tr>
<td>Employer: 20% of payroll</td>
<td>Employer: 20% of payroll</td>
</tr>
<tr>
<td><strong>Qualifying Conditions</strong></td>
<td><strong>Qualifying Conditions</strong></td>
</tr>
<tr>
<td>a) “Ordinary”: Age 53 and 30 years of service</td>
<td>a) “Ordinary”: 35 years of service</td>
</tr>
<tr>
<td>b) “Advanced Age”: Age 65 with 15 years of service</td>
<td>b) “Advanced Age”: Age 65 with 15 years of service</td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td><strong>Benefits</strong></td>
</tr>
<tr>
<td>a) “Ordinary” = average wages * fator previdenciario * penalization</td>
<td>a) “Ordinary” = average wages * fator previdenciario</td>
</tr>
<tr>
<td>b) “Advanced Age” = 0.7 * average wages * (1+0.01*(length of service))</td>
<td>b) “Advanced Age” = 0.7 * average wages * (1+0.01*(length of service))</td>
</tr>
<tr>
<td>Max average wage = US$ 1,507</td>
<td>Max average wage = US$ 1,390</td>
</tr>
</tbody>
</table>

where:
- average wages = average of the 80% highest (updated) wages.
- fator previdenciario = (0.31 * (length of service) / life expectancy) * ((1 + (0.31 * (length of service) + retirement age) / 100).
- penalization = min (1, (1 - 0.05 * max (0, (35 - length of service)))).

The Proportional Pension Pillar is being phased out, however, 55 percent of new beneficiaries in 2004 still retired under this option. All nominal variables are adjusted by the CPI.
Chile

**Pre 2008 reform system**

<table>
<thead>
<tr>
<th>Individual Account</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source of funds:</strong> 12.55% of covered wages (Insured Person).</td>
</tr>
<tr>
<td>Floor = US$ 274.23 (if 18 ≤ age &lt; 65) or US$ 204.74 (if 65 ≤ age)</td>
</tr>
<tr>
<td>Ceiling = 60*UF; where UF = US$ 35.46</td>
</tr>
</tbody>
</table>

**Qualifying Conditions:**

a) “Ordinary”: Age 65
b) “Early Retirement”: if individual account annuity surpasses the 70% of the average wage of the last 10 years and also surpasses the 150% of the minimum pension.
c) “Guaranteed minimum pension”: Age 65 with 20 years of service if annuity is less than a minimum pension

**Benefits:**

a) “Ordinary”=individual account annuity.
b) “Early Retirement” = individual account annuity.
c) “Guaranteed minimum pension”= US$170.85 if age<70 or US$186.82 if age≥70

**PAYG**

We haven’t analyzed this pillar because it is being phased out since 1981.

All nominal variables are adjusted by the CPI.
<table>
<thead>
<tr>
<th><strong>Post 2008 reform system</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual Account</strong></td>
</tr>
<tr>
<td>Source of funds: 12.55% of covered wages (Insured Person).</td>
</tr>
<tr>
<td>Floor = US$ 274 (if 18 ≤ age &lt; 65) o US$ 204 (if 65 ≤ age)</td>
</tr>
<tr>
<td>Ceiling = 60*UF; UF = US$ 35</td>
</tr>
</tbody>
</table>

**Qualifying Conditions:**
- a) “Ordinary”: Age 65
- b) “Early Retirement”: if annuity surpasses 70% of the average wage of the last 10 years and also surpasses the 150% of the minimum pension.

**Benefits:**
- a) “Ordinary” = individual account annuity.
- b) “Early Retirement” = individual account annuity.

<table>
<thead>
<tr>
<th><strong>Solidarity</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of funds:</td>
</tr>
<tr>
<td>a) “BSP-Advanced Age” (Basic Solidarity Pension): financed by the government</td>
</tr>
<tr>
<td>b) “Elderly-PSC” (Previsional Solidarity Contribution): financed by the government</td>
</tr>
</tbody>
</table>

**Qualifying Conditions:**
- a) “BSP-Advanced Age”: Age 65, no right to receive other pensions, and being a member of a low income household.
- b) “Elderly-PSC”: Age 65, with a self financed pension (the so-called base pension = BP) higher than cero and lower than or equal to a Maximum Pension (MP), and being a member of a low income household.

**Maximum pension:**
- US$133  from 07/2008 to 06/2009
- with solidarity contribution (MP) US$229  from 07/2009 to 06/2010
- US$286  from 07/2010 to 06/2011
- US$381  from 07/2011 to 06/2012
- US$486  from 07/2012

**Benefits:**
- b) “Elderly-PSC” = BSP - (BSP/MP)*BP  if MP ≥ BP ≥ BSP

All nominal variables are adjusted by the CPI.
### Colombia

#### Individual Account

*Source of funds:*

Insured person = 0.04 * ins_wage1 + 0.01 * ins_wage2 (if wage > 4* min_wage) + 0.002 * ins_wage3 + 0.004 * ins_wage4 + 0.006 * ins_wage5 + 0.008 * ins_wage6 + 0.01 * ins_wage7

Employer = 12%

where min_wage = floor = US$ 228  
ceiling=25*min_wage=US$9927.2

*Qualifying Conditions:*

a) “Ordinary” = individual account annuity must surpass the 110% of a min_wage.  
b) “Guaranteed minimum pension” = Age 62 with 23 years of service

*Benefits:*

a) “Ordinary” = individual account annuity.

b) “Guaranteed minimum pension” = If the pension is less than the minimum pension set by law, the government makes up the difference.  
Min: US$ 228

---

#### PAYG a/

*Source of funds:*

Insured person = 0.04 * ins_wage1 + 0.01 * ins_wage2 (if wage > 4* min_wage) + 0.002 * ins_wage3 + 0.004 * ins_wage4 + 0.006 * ins_wage5 + 0.008 * ins_wage6 + 0.01 * ins_wage7

Employer = 12%

The government also contributes to this pillar pensions (partial subsidy).

where min_wage = floor = US$ 228  
ceiling=25*min_wage=US$9927.2

*Qualifying Conditions:*

a) “Ordinary” = Age 62 with 26 years of service.  
b) “Guaranteed minimum pension” = Age 62 with 26.5 years of service

*Benefits:*

a) “Ordinary” = R * BMW + 0.015 * BMW * (years of service beyond the minimum) where:  
R = 0.655-0.05*(wage/minimum wage)

b) “Guaranteed minimum pension” = If the pension is less than the minimum pension set by law, the government makes up the difference.  
Min: US$ 228  
Max: 0.8 * BMW

a/ Parameters programmed to be operational from 2015 onwards, when our simulated workers will retire.

ins_wage1= wage   if wage <  4*min_wage

ins_wage2= wage-(4*min_wage) if 4*min_wage ≤ wage < 16*min_wage

ins_wage3= wage-(16*min_wage) if 16*min_wage ≤ wage < 17*min_wage

ins_wage4= wage-(17*min_wage) if 17*min_wage ≤ wage < 18*min_wage

ins_wage5= wage-(18*min_wage) if 18*min_wage ≤ wage < 19*min_wage

ins_wage6= wage-(19*min_wage) if 19*min_wage ≤ wage < 20*min_wage

ins_wage7= wage-(20*min_wage) if wage ≥ 20*min_wage

All nominal variables are adjusted by the CPI.  
BMW = The basic monthly wage is based on the insured’s average earnings in the last 10 years before receiving the pension.
Ecuador

PAYG

Source of funds:
Insured person: 6.64%
Employer: 3.10%
Government: Finances 40% of the cost of social insurance pensions; the total cost of social assistance pensions; contributes as an employer.

Floor=min_wage=US$240
There is no ceiling.

Qualifying Conditions:
“Ordinary” = Paid at any age with at least 40 years of contributions; age 60 with at least 30 years of contributions; age 65 with at least 15 years of contributions; or age 70 with at least 10 years of contributions.

\[
\text{Benefits} = \begin{cases} 
(0.5 + (x - 10) \times (1/60)) \times \text{avg}_\text{wage} & \text{if } 10 \leq x < 40 \\
(1 + (x - 40) \times 0.0125) \times \text{avg}_\text{wage} & \text{if } x \geq 40 
\end{cases}
\]

where \(x\) = contributing years; and \(\text{avg}_\text{wage}\) = average monthly earnings in the best 5 years

Max: US$ 9720

All nominal variables are adjusted by the CPI.
Mexico

**Individual Account**

*Source of funds:* 1.75% of covered earnings (Insured Person). 5.15% (Employer). The government contributes with 6.9% of the minimum wage to all accounts.

Floor = minimum wage; where minimum wage = US$4.70*25 (we accounted 25 labor days per month)
Ceiling = 25* minimum wage

**Qualifying Conditions:**

a) “Ordinary”= Age 65 with 25 years of service
b) “Early Retirement”= if the annuity surpasses by at least 30% the guaranteed minimum pension.
c) “Guaranteed Minimum Pension”= Age 65 with 25 years of service and the annuity is less than a minimum pension.

**Benefits:**
a) “Ordinary”= individual account annuity.
b) “Early Retirement” = individual account annuity.
c) “Guaranteed minimum pension”= US$163

**PAYG**

We haven’t analyzed this pillar because it is being phased out since 1997.

All nominal variables are adjusted by the CPI.
Paraguay

PAYG

Source of funds:
Insured person: 9%
Employer: 14%
Government: 1.5%

Floor=min_wage=US$ 242.5
There is no ceiling.

Qualifying Conditions:
a) “Ordinary” = Age 60 and 25 years of service.
b) “Early pension” = Age 55 and 30 years of service.

Benefits:
a) “Ordinary” = avg_wage
where avg_wage=average earnings in the last 3 years
b) “Early pension” = 0.8* avg_wage + 0.04* avg_wage*(min(59, age-55))

Max: US$ 2425
Min: US$ 60

All nominal variables are adjusted by the CPI.
Peru

<table>
<thead>
<tr>
<th>Individual Account</th>
<th>PAYG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Source of funds:</strong> 12.72% of covered earnings (Insured Person). floor = US$ 157.7, and there is no ceiling</td>
<td><strong>Source of funds:</strong> 13% of covered earnings (Insured Person). floor = US$ 157.7, and there is no ceiling</td>
</tr>
</tbody>
</table>
| **Qualifying Conditions:** Age 65; a pension is paid at any age if the individual account has accumulated assets that will replace at least 50% of average indexed earnings in the last 120 months. | **Qualifying Conditions:**
| a) “Ordinary” = Age 60 with 20 years of service. |
| b) “Early pension” = Age 55 and 30 years of service. |
| **Benefits:** | **Benefits:**
| a) “Ordinary” = 0.3*avg_pen_wage + 0.02*avg_pen_wage*(contributing years exceeding 20, max 100%) where avg_pen_wage= average earnings in the last 60 months |
| b) “Early pension” = The pension is reduced by 4% for each year that the pension is taken before the normal pensionable age. Minimum: $ 130 Maximum: $ 270 |
| Constant-attendance supplement: A monthly amount is paid equal to the minimum wage (US$ 157.7). |

All nominal variables are adjusted by the CPI.
Uruguay

Law 16713 (passed in 1995)

**Individual Account**

<table>
<thead>
<tr>
<th>Source of funds:</th>
</tr>
</thead>
</table>
| 0.15 * AC; where AC = \[
\begin{cases}
\text{wage - US$ 724; if US$ 724} & \leq \text{wage} \leq \text{US$ 1,449} \\
\text{US$ 1,449 - US$ 724; if wage > US$ 1,449}
\end{cases}
\]

**Qualifying Conditions:**

a) “Ordinary”: Age 60 with 35 years of service  
b) “Advanced Age”: Age 70 with 15 years of service, and the individual doesn’t have any pension.

**Benefits:**

a) “Ordinary” = individual account annuity.  
b) “Advanced Age” = individual account annuity.

**PAYG**

<table>
<thead>
<tr>
<th>Source of funds:</th>
</tr>
</thead>
</table>
| (0.075 + 0.15) * AC; where AC = \[
\begin{cases}
\text{wage; if wage} & \leq \text{US$ 724} \\
\text{US$ 724; if wage > US$ 724}
\end{cases}
\]

**Qualifying Conditions:**

a) “Ordinary”: Age 60 with 35 years of service  
b) “Advanced Age”: Age 70 with 15 years of service

**Benefits:**

a) “Ordinary” = average wages * rr,  
Where: rr = 0.5 + 0.005*(contributing years exceeding 35, max 2.5%) + 0.02*(years of postponing retirement after 60 if pension right wasn’t configured yet, max 20%) + 0.03*(years of postponing retirement after 60, max 30%); and average wages = average of the best 20*12 wages or average of the last 10*12 wages, whichever is greater.  
b) “Advanced Age” = average wages * rr; where rr = 0.5 + 0.01* (contributing years exceeding 15, max 14%)  

Minimum: US$ 80  
Maximum: US$ 598

Workers whose first wages lie below the US$ 724 threshold may opt to split their insured contributions by halves between the individual account and the PAYG pillars. Opting workers receive a special bonus of 50% of their PAYG pension. The nominal amounts are updated using the average wage index.
### Individual Account

**Source of funds:**

\[
0.15 \times AC; \text{ where } AC = \begin{cases} 
\text{wage - US$ 724;} & \text{if US$ 724} \leq \text{wage} \leq \text{US$ 1,449} \\
\text{US$ 1,449} - \text{US$ 724;} & \text{if wage} > \text{US$ 1,449}
\end{cases}
\]

**Qualifying Conditions:**

a) “Ordinary”: Age 60 with 30 years of service  
b) “Advanced Age”: Age 65, and the individual doesn’t have any pension.

**Benefits:**

a) “Ordinary” = individual account annuity.  
b) “Advanced Age” = individual account annuity

### PAYG

**Source of funds:**

\[
(0.075 + 0.15) \times AC; \text{ where } AC = \begin{cases} 
\text{wage;} & \text{if wage} \leq \text{US$ 724} \\
\text{US$ 724;} & \text{if wage} > \text{US$ 724}
\end{cases}
\]

**Qualifying Conditions:**

a) “Ordinary”: Age 60 with 30 years of service  
b) “Advanced Age”: Age 70 with 15 years of service, or 69 and 17, or 68 and 19, or 67 and 21, or 66 and 23, or 65 and 25, and the individual doesn’t have any pension.

**Benefits:**

a) “Ordinary” = average wages \( \times r \);  
Where:  
\[
r = 0.45 + 0.01 \times \text{(contributing years exceeding 30, max 5%)} + 0.005 \times \text{(contributing years exceeding 35, max 2.5%)} + 0.02 \times (\text{years of postponing retirement after 60 if pension right wasn’t configured yet, max 20%}) + 0.03 \times (\text{years of postponing retirement after 60, max 30%}); \text{ and}
\]

average wages = average of the best 20*12 wages or average of the last 10*12 wages, whichever is greater.  
b) “Advanced Age” = average wages \( \times r \);  
Where:  
\[
r = 0.5 + 0.01 \times \text{(contributing years exceeding X, max 14%)}, \text{ and X=years of service required according to age.}
\]

**Minimum:** US$ 80  
**Maximum:** US$ 598

Workers whose first wages lie below the US$ 724 threshold may opt to split their insured contributions by halves between the individual account and the PAYG pillars. Opting workers receive a special bonus of 50% of their PAYG pension.  
The nominal amounts are updated using the average wage index.
Venezuela

PAYG

Source of funds:
Insured person: 1.93% of gross earnings
Employer: 4.82% of payroll
Government: 1.5%

Ceiling= five times the minimum urban wage
There is no floor

Qualifying Conditions:
a) “Ordinary” = Age 60 with 15 years of service
b) “Old-age grant”= 2 whole years of contribution in the last 4 years

Benefits:
a) “Ordinary” = US$ 138 + 0.3*avg_pen_wage + 0.01* avg_pen_wage* (years of contribution exceeding 15).
Where: avg_pen_wage= average earnings in the last 5 years or the average in the best 5 of the last 10 years, whichever is greater.
An additional 5% of the pension is paid for each year the pension is deferred after the pensionable age.
b) “Old-age grant” = 10% of the insured’s total covered earning.

Min: 40% of avg_pen_wage

All nominal variables are adjusted by the CPI.