WPS4355

POLICY RESEARCH WORKING PAPER 4355

Assessing the Distortions of Mandatory Pensions on Labor Supply Decisions and Human Capital Accumulation:

How to Bridge the Gap between Economic Theory and Policy Analysis

András Bodor
David Robalino
Michal Rutkowski

The World Bank
Middle East and North Africa Region
Human Development Group
September 2007

Policy Research Working Paper 4355

Abstract

Mandatory pension systems play a major role in individual savings and labor supply decisions. In particular, it is well known that defined benefit pension schemes, which are not actuarially fair, can create incentives for early retirement and therefore reduce labor supply and the stock of human capital in a given country. This is an important policy issue in middle-income countries, with still low participation rates in the labor force, where the "window" opened by the demographic transition is already closed or will close in the near future. In these countries, policies to stimulate private sector growth, competitiveness, and employment creation should be accompanied by policies that increase labor force participation, raising the ratio of active to inactive population and therefore the potential for higher income per capita growth.

Unfortunately, the analytical tools developed to assess pension reform options tend to focus on the financial sustainability of the schemes and the adequacy of benefits. Little attention is given in practice to the social costs imposed by distortions on the supply of labor. In part, this is given by the lack of analytical tools that, in the context of limited information regarding individual preferences and behavior, can be used to assess the magnitude of these distortions. This paper develops methodologies that can bridge the gap between economic theory and the practices of pension policy personnel under conditions of deep uncertainty regarding the variables driving individual behavioral responses to policy changes. First, the paper develops an indicator to predict the age-specific retirement probabilities induced by a particular pension system, given heterogeneous individual preferences over risk, consumption, and leisure. The paper then describes how this indicator can be used to project the size of the labor force by gender, age and skill level and therefore the dynamics of human capital accumulation. The integration of these two analytical tools allow us to show the impact of a particular pension reform proposals on the dynamics of labor supply, human capital and, given the dynamics of capital and total factor productivity, economic growth. Furthermore, the paper develops a set of life-cycle income measures for typical individual paths that allow us to measure the contribution of segmented pension schemes to the segmentation of the labor market. The methods are applied to the case of Morocco.

This paper—a product of the Human Development Group in the Middle East and North Africa Region (MNSHD)—is part of a larger effort in the department to better understand the labor market implications of pension reforms and amendments to the social insurance package in general. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at abodor@worldbank.org, drobalino@worldbank.org and mrutkowski@worldbank.org respectively.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

Produced by the Research Support Team

Assessing the Distortions of Mandatory Pensions on Labor Supply Decisions and Human Capital Accumulation: How to Bridge the Gap between Economic Theory and Policy Analysis

András Bodor, David Robalino and Michal Rutkowski[1]

[1] The authors are employees of the World Bank. The paper should not be considered as the official position of the World Bank in any regard.

1. Introduction

Defined benefit (DB) pension systems, usually financed on a pay-as-you-go basis, often embed bad microeconomic design features that create distortions in savings and labor demand/supply decisions. This paper focuses on two that are relevant from the point of view of labor markets: (i) incentives to retire early; and (ii) institutional fragmentation. None of these features is inherently built into a DB system, but the fact is that an overwhelming majority worldwide offer incentives to retire early and are split into separate subsystems for different professional groups, typically civil servants, military and private sector workers, and leaving behind uncovered workers. The contribution of this paper is to develop analytical tools that can be used to assess the magnitude of these distortions, particularly in the presence of limited data, and conduct ex-ante assessments of the impacts of alternative reforms.

Incentives to retire early take effect through various design features of DB systems, but the bottom line is the same in each of the distortionary DB design components: they do not allow for an actuarial relationship between social security contributions and pensions. In fact, an additional year of work typically does not yield corresponding growth in benefits, so workers have a tendency to retire at the earliest possible moment.

Most of the research on the impact of incentives for early retirement has been concentrating on OECD countries that have experienced steady drops in retirement ages despite substantial increases in longevity throughout the 20th century. Most recently, the international research project conducted in twelve OECD countries using the same methodology (Gruber and Wise, 1999, 2004 and forthcoming) found that the great majority of social security systems in these countries provide incentives to leave the labor force at early ages and that there is a strong relationship between these incentives and the withdrawal of older workers from the labor force. In addition, Hertbersson and Orszag (2003) have estimated that early retirement provisions in the OECD countries cost on average 7.5% of potential annual OECD output. They also showed that the distortions created by early retirement can be further accentuated by the aging of the population. For example, they estimated that male labor force participation in OECD countries would have to rise from 66% to 70% (from 2003 to 2010) to keep the costs of early retirement at the 2003 level in 2010. More generally, it has been suggested that eliminating incentives for early retirement is an important policy intervention to mitigate the macroeconomic impact of a shrinking labor force as the population ages (see Oliveira Martins et al., 2005). The evidence from OECD countries also shows that cutting down on early retirement incentives through reform of social security systems can have an important effect on labor force participation and positive fiscal implications from two sources: (1)

reduced required fiscal support from resulting increase in financial health of programs and (2) increased government tax revenues. Financial implications for program costs are very large (20 to 40% of current program costs) and countries can save as much as 1% of GDP in government revenues engendered by changes in the labor force participation of older workers.

The fragmentation of the pension system institutional organization is another source of labor market distortions. Fragmentation is explained by the emergence of occupational pension schemes that preceded the development of mandatory government pension schemes. The pension schemes that governments developed often deepened the fragmentation. Indeed, in certain societies the pension schemes of certain occupations (e.g. public servants) offer a significant portion of the total employee compensation package. This fragmentation is a significant source of economic inefficiency in several cases. Beyond the argument based on the economies of scale regarding the administration costs we see that the lack of (or limited) portability of pension rights across pension schemes effectively serves as a labor market friction. The labor market is the "place" where the dynamic matching process of physical capital and labor happens. Any administrative rule that prevents the occurrence of productive matches, or that does not allow the separation of matches that can be dominated in efficiency by another labor-capital match, ultimately causes economic inefficiency and does not allow the full utilization of the gains from trade. [2]

The lack of portability of pension rights makes the price of separation in potentially inefficient matches too high for the separation to happen. The different rates of returns the various pension schemes offer on contributions distort the role of the wages as the system informing about the price/value of labor effort. High indirect compensation through high internal rate of return (IRR) pension schemes create incentives for unemployed individuals to queue for jobs in the sector covered under the high IRR pension schemes. Fragmentation also creates incentives towards biased investment into human capital towards the skills applied in the sector covered by high IRR pension schemes. If the pension scheme with high IRR is offered towards government employees then the bias in skills development may undermine the skilled labor supply that the private sector needs for growth.

These supply-side distortions in the labor market imply an inefficient allocation of labor and therefore of other economic resources and may have a significant adverse impact on GDP growth. Thus the need to asses the magnitude of the distortions and motivate policy reform emerges.

The paper brings three specific methodological contributions to the analysis of supply side distortions. First we develop an indicator to measure incentives for early retirement, which takes into account the trade-off between consumption and leisure even when the distribution of individual preferences over this trade-off and the preferences over risk aversion are not known. We show that this indicator is superior to standard proxies used

[2] For an extensive review of the 'segmented labor markets (SLM)' literature please see Taubman and Wachter (1986).

to analyze incentives for early retirement, such as the slope of internal rates of return on contributions curve and the marginal change in pension wealth. Second, we develop a model that projects the skills composition of the labor force by age and gender and compute levels of human capital on the basis of standard wage equations. The model is used to assess how changes in retirement probabilities, by age and gender, affect the dynamics of human capital accumulation and, through this channel, economic growth. Finally, we develop a methodology to assess how fragmented pension systems affect incentives to move across sectors and decisions about investments in education. To illustrate the use of the tools we take the case of Morocco. Indeed, we consider Morocco a good representative of middle-income countries with badly designed and fragmented defined-benefit pay-as-you-go pension schemes. Hence, our conclusions can be applicable for other middle-income and, to some extent, high-income countries.

The structure of the paper is as follows. The next section (section 2) develops an indicator to measure incentives for early retirement. The methodology to assess the economic costs of early retirement is presented and illustrated in Section 3. Section 4 is concerned with the analysis of distortions related to investments in education and the mobility of the labor force. Finally, Section 5 concludes.

2. Measuring distortions in retirement decisions

The standard indicators used to assess incentives for early retirement are the internal rate of return (IRR) on contributions and the change in pension wealth at a given retirement age.[3] These indicators, however, have at least three major problems. First, they do not capture the trade-offs between consumption and leisure, which are at the core of the retirement decision. Second, they ignore the interplay between benefit formulas, eligibility conditions and individual attitudes towards risk. Third, they would suggest the same retirement behavior to people with identical or similar career path whereas we observe heterogeneous retirement ages even for individuals who are similar or identical in their observable characteristic from the perspective of the pension system. The implication is that any conclusion in terms of whether individuals have weak or strong incentives to delay retirement can be misleading. In this section we propose a complementary indicator that takes the trade-off between consumption and leisure into account as well as the level of risk aversion of individuals.

In the standard inter-temporal utility maximization problem individuals choose how much to save, how much to work, and when to retire. Formally we have:

[3] The internal rate of return on contributions is the rate that equates the present value of contributions with the present value of pensions. It can be interpreted as the implicit interest rate that the pension system pays to plans members on their contributions. The pension wealth, on the other hand, is the present value of expected future pensions.

$$
\begin{aligned}
&\underset{s^*,l^*,R^*}{Max}: \sum_{t=a}^{R^*} U\left(c_t, l_t^*\right) v_t \rho^t + \sum_{t=R^*+1}^{X} U\left(c_t, h\right) v_t \rho^t \\
&s.t. \quad c_t = y_t\left(1 - s_t^*\right) \\
&\qquad s_t^* \in [0,1] \ \ \forall t \\
&\qquad y_t = w_t\left(h - l_t^*\right) \ \ if \quad t \le R^* \\
&\qquad y_t = P\left(\{s\}_a^{t-1}, \{y\}_a^{t-1}, \{r_t\}_a^{t-1}, \theta\right) \ \ if \quad t > R^*
\end{aligned} \tag{1}
$$

where U(.) is the standard period utility function capturing the trade-off between consumption (c) and leisure (l), v_t is the probability of survival to age t, ρ is the rate of time preference, y is income, w labor productivity, h total available working time at time t, s the savings rate, R the retirement age, X is the maximum number of years an individual can live and 'a' is the entry age to the labor market. The function P(.) gives the value of retirement income, which depends on past savings, wages, interest rates, as well as policy parameters θ (i.e. the type of pension system).

Ideally, one would like to solve a system such as (1) for every member in a given pension plan and determine the distribution of optimal retirement ages, which would depend on individual characteristics that affect the shape of the utility function, their productivity, and their survival probabilities. One could then assess how changes in policy parameters would affect retirement patterns and assess the associated economic costs/benefits. This, of course, is not possible, mainly because usually there are no data that would allow an estimation of individual utility functions.[4] Some could also argue whether a model such as (1) really captures individual behaviors.

Nonetheless, we argue that from a normative point of view, a simplified version of system (1) estimated for a sample of *imaginary* plan members, can provide useful information about the level of distortions that the pension system creates and that affect retirement decisions. The simplified version that we propose only focuses on the retirement decisions, taking the savings rate and labor supply as given. It fixes the savings rate equal to the contribution rate (during retirement consumption is equal to the pension) and sets labor supply equal to 260/365 – 260 is the total number of working days in a year. So a retired individual would have leisure equal to 1 while a working individual would have leisure equal to (365-260)/365. It further assumes a period utility function of the form:

$$
U(c,l) = \frac{\left[c^{\alpha}(lw)^{1-\alpha}\right]^{1-\lambda}}{1-\lambda} \tag{2}
$$

[4] Notice that simply observing who retires and who does not is not sufficient to analyze the true incentive structure since one does not have a counterfactual. For the same reason statistical inference about behavioral responses to pension policy changes is extremely limited based on data on observed retirement patterns as typically no variation of the pension system policy parameters is associated with observed data.

where α captures trade-off between consumption and leisure and λ is the coefficient of risk aversion. This concept of utility seems abstract but in practice it is simply a way to introduce a non-linear link between changes in the levels of consumption and leisure and the value/happiness derived from them. The "curvature" of the utility function with respect to the combined consumption-leisure argument is affected by the coefficient of risk aversion. The higher this coefficient the higher the curvature. The essence of risk aversion is that risk averse individuals value a level of consumption c_1 with 100% probability more than a level of consumption c_2 that is realized with a probability $p \in [0,1]$ if $c_1=c_2*p+0*(1-p)$, i.e. the expected value of consumption is identical in both cases.

Given the utility function, a given assumption for the path of wages, and the parameters of the pension system, it is possible to calculate the optimal retirement age as a function of the parameters α and λ.[5] The optimal retirement age would be the age where the marginal benefit of delaying retirement to one year later falls below the marginal costs -- all measured in utility terms. The benefits are, presumably, a higher pension, a higher consumption path, and consequently a higher consumption component of the expected utility calculation. The cost is delaying the increase in the level of leisure.

Formally, the net gain at age R of delaying retirement by one year is as follows:

$$ngu(R->R+1) = u(c_R,0.28) + \rho \sum_{t=R+1}^{X} u(p(R+1,t),1) v_t \rho^{t-(R+1)} - \sum_{t=R}^{X} u(p(R,t),1) v_t \rho^{t-R} \quad (3)$$

$$s.t.: \quad c_R = w_R(1-\tau); \quad p(X,t)_t = P\left(\{w\}_a^{X-1}, \theta\right)$$

where w_i is the wage received by the individual at age 'i' and τ is the contribution rate. So individuals will delay retirement as long as ngu(R) >0.[6]

Clearly, one does not know the joint distributions of the parameters α and λ within the population of plan members. This is a case of decision-making under conditions of deep uncertainty. One solution is to explore a large number of combinations assuming that the parameters are uniformly distributed within their supports. By doing so it is possible to derive a map of functions ngu(R; α,λ) that, we argue, provides a unique characterization of the pension system and informs about the magnitude of possible incentive problems. In addition, one can compute a summary indicator that gives the percentage of cases where the optimal retirement age is below a given threshold. In fact, as this indicator could be calculated at all possible retirement ages, the entire age profile of retirement can be generated in association with the given pension system rules and parameters.

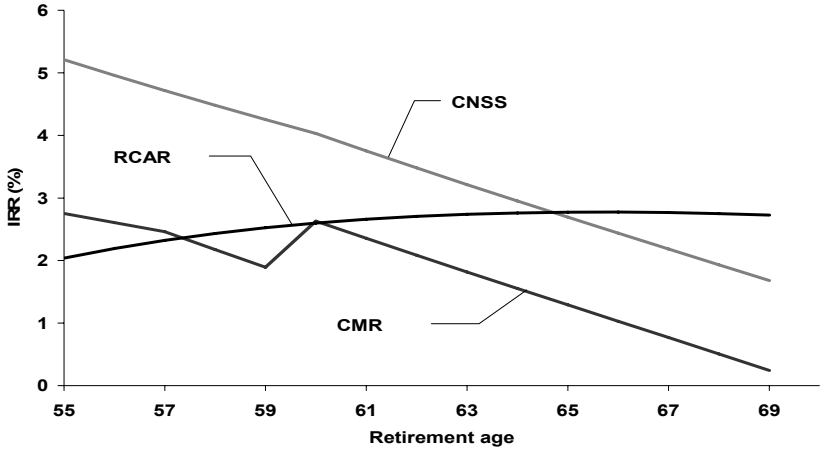
[5] The implicit assumption here is that the distribution of individual retirement ages can be generated using a sample of imaginary individuals who are heterogeneous in their preference parameters, but they all earn the same representative income. Admittedly, this is a strong assumption. In following stages of this research project an additional dimension, income heterogeneity, will be added to the model to eliminate this assumption.

[6] The decision rule that relies on the sign change of ngu(.) assumes that ngu() is monotonically decreasing.

We next apply these indicators to the three mandatory pension schemes in Morocco. The CNSS (Conseil National de S'ecurit'e Social) is the scheme for private sector workers. The CMR (Caisse Marocaine de Retraites) is the acronym for the civil servant pension scheme. Other public sector workers enroll in the RCAR (Régime Collectif d´Assurance et de Retraites). We compare our indicator to the standard measures the IRR and the pension wealth.

In Morocco the standard measures, the IRR and the pension wealth, indicate the existence of incentives problems. The IRR is downward slopping for the CNSS and the CMR, suggesting that individuals "receive less" on their contributions if they delay retirement (see Figure 1). For example, an individual retiring at age 55 from the CNSS would receive an implicit real rate of return on contributions of 5% while an individual retiring at age 60 would receive only 4%. This occurs because the accrual rate is not adjusted as a function of the retirement age to correctly take into account that individuals retiring earlier, and therefore contributing for shorter and receiving pensions for longer periods, should also get lower pensions. The RCAR in Morocco does adjust the accrual rate approximately this way. In fact, the adjustments are such that the IRR increases when individuals delay retirement. Hence, one would like to conclude that in the case of the RCAR there are positive incentives to delay retirement. How strong are they?

Figure 1: Internal Rates of Return on Contributions



The IRRs are for men with a salary equal to average earnings, who join the system at age 25 and contribute continuously until retirement. Real wages are assumed to grow at 3%.
Source: Authors' calculations.

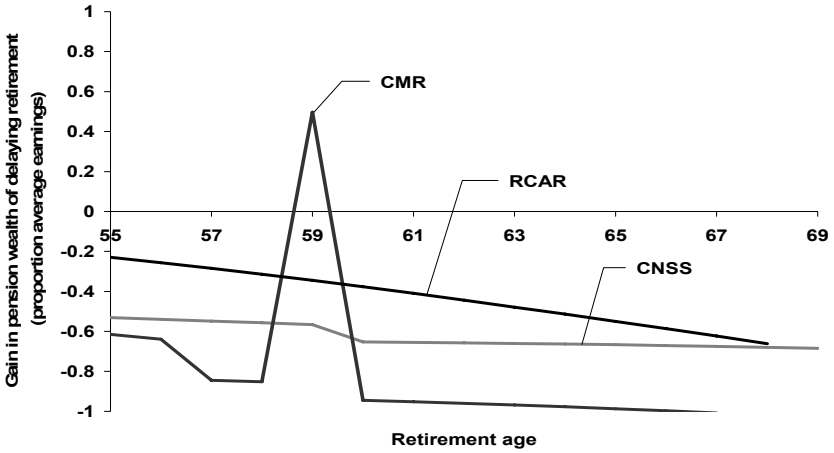
A more accurate picture of the situation is given by the change in the net pension wealth occurring as a result of a delay in the retirement decision. Similarly to the gain in utility defined in equation (3), the change in net pension wealth resulting from delaying retirement from age j to age j+1 is given by:

$$gpw(j->j+1) = (1-\tau)w_j + PW_{j+1}\rho - PW_j \qquad (4)$$

where PW_i is the value of the pension wealth retiring at age i.

According to this measure, in the case of Morocco, none of the pension funds provide true incentives for delayed retirement. Changes in pension wealth are negative for all retirement ages (see Figure 2). Even for the RCAR, the results suggest that current adjustments to the accrual rate would not be sufficient to motivate individuals to delay retirement. The CMR is a peculiar case. The system provides strong incentives to individuals who are 59 years old to delay retirement by one year. This is because at age 60 the accrual rate increases to 2.5% from 2% for all previous years of service.

Figure 2: Changes in Net Pension Wealth by Retirement Age



Same assumptions as for Figure 1. In addition, the discount rate used for present value calculations is set at 2%.
Source: Authors' calculations.

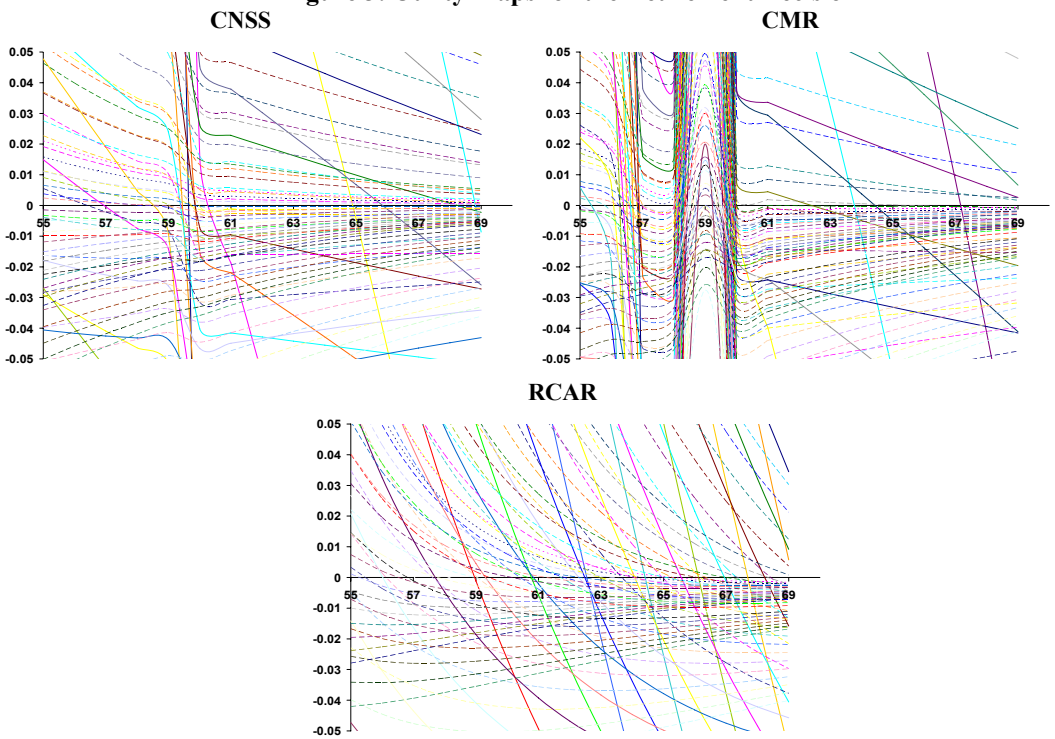
In practice, however, we do observe that in all pension funds individuals retire at various retirement ages. The question is really in which pension fund the incentives for early retirement are stronger. It is here where the maps ngu(R,α,λ) of each of the pension funds become helpful. These maps were calculated under the assumption that wages grow in real terms at 3% per year and the rate of time preference ρ is 0.98 annually. One hundred combinations of the parameters α and λ were used: $\alpha \in [0.2,0.7]$ and $\lambda \in [0.5,5]$. The results are presented in Figure 3.

The map for each fund is very different and characterizes the benefit formulas and eligibility conditions in a unique way. Each "line" within the map is associated with a given combination of the parameters α and λ. In all funds, the lines can be grouped into three categories. First, lines which are always below the horizontal axis. These are associated with utility functions that never generate incentives to delay retirement. The gain in expected utility from delaying retirement is always negative and individuals retire as soon as possible – in our example at age 55. The second type of lines involves lines that are always above the horizontal axis indicating that the gains from delaying retirement are always positive. These lines correspond to individuals who never have incentives to retire in the period of analysis (they could retire afterwards). Finally, there are lines which cross the horizontal axis. The more relevant are the ones that cross the

axis from above. In this case, the point of crossing gives the optimal retirement age.[7]

In the case of the CNSS the majority of lines are either above or below the horizontal axis. So in the CNSS individuals with a certain propensity for retirement will most likely retire as soon as possible. In the CMR the majority of lines start below the horizontal axis, cross the line from below and then cross the axis again from above. Hence for individuals it is optimal to retire as soon as possible up to age 58. At age 59 it is better to wait one more year. The distorted map that emerges reflects the peculiarity of the benefit formula based on final wages where the accrual rate increases from 2% to 2.5% at age 60. The map of the RCAR corresponds to a system that is more actuarially fair. A majority of individuals will not retire immediately regardless of their propensity to do so. This is because of the upward slopping IRR function.

Figure 3: Utility Maps for the Retirement Decision



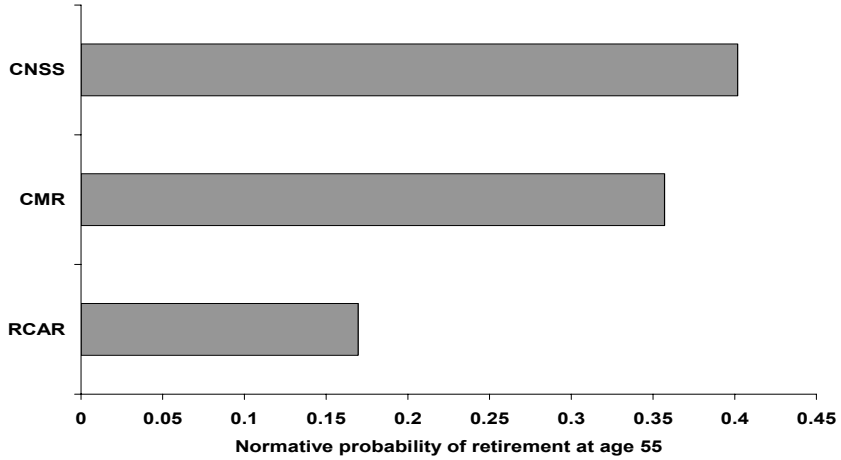
Source: Authors' calculations.

The information captured in the maps can be summarized by the probability of early retirement, defined here as the probability of retiring at age 55. As suggested by the charts, the probability of early retirement is highest in the CNSS. In that case, for 40% of the individual preference parameter pairs the optimal retirement age is age 55. For the CMR the probability of early retirement is somewhat lower (36%). As previously indicated, the lowest probability of early retirement corresponds to the RCAR (17%). So

[7] The discussion here is simplified so not all the special cases of the nonmonotone ngu(.) lines with multiple intersections with the horizontal axis are not discussed here; however, the behavioral consequences can be easily determined using the same framework for these individuals as well.

even if the pension wealth indicator suggested a lack of incentives for delayed retirement, in reality, most probable, the RCAR does encourage retirement at higher ages – which is also consistent with the slope of the IRR function.

Figure 4: Normative Probability of Early Retirement



Source: Authors' calculations.

In conclusion, the utility maps and the normative estimator of the probability of early retirement provide more precise information about the incentives to retire early, given individuals with heterogeneous preferences. The slope of the IRR function and the change in pension wealth are useful to flag distortions, but one needs to be careful when deriving conclusions on actual retirement behavior based on these overly simplified measures. This is because these two indicators do not take into account the trade-off between consumption and leisure and the level of risk aversion of individuals. Another attractive feature of the proposed indicator is that the calculations are simple. Therefore, future assessments of pension institutions and international comparisons of the effects of benefit formulas and eligibility conditions on retirement decisions could benefit from the proposed calculations. Finally, the indicator is useful to assess, ex-ante, the potential impact that policy changes can have on retirement decisions. As discussed in the next section, these decisions affect the level of human capital of a given country and therefore its growth potential.

3. Estimating the cost of early retirement in terms of the loss of productive capacities of the economy

As discussed in the previous section, from the individual's point of view the decision to retire is a choice that reflects preferences between leisure and consumption. From the point of view of the country, however, retirement represents a loss of human capital, particularly when it occurs at early ages. Standard analyses in pension policy focus on the fiscal costs of early retirement. Here we argue that the economic cost of early retirement should be also taken into account. Hence, this section develops a methodology to assess the impact that a pension system can have on human capital

accumulation and economic growth, by influencing retirement decisions[8] and therefore labor force participation rates for individuals with different skill levels. [9]

The model – from skill formation to human capital

The model developed here projects the labor force by gender, age and education level. Assuming a competitive environment we characterize the human capital of individuals with the marginal product of their labor, an equivalent value to their wages if they are employed. These are approximated by standard wage functions which we describe in the next section.[10] Clearly this definition of human capital may be counterintuitive to some as total human capital, a stock accumulated through a long period, is practically represented by the total wage bill under full employment of the labor force, i.e. the share of economic output attributable to labor effort during a year, a short period compared to the overall timeframe of human capital accumulation.

The fist step is to project the total population by age and gender on the basis of expectations about future fertility and mortality rates. Hence a vector Pop(g,a,t) is computed where g=1 if male and g=2 if female, 'a' refers to age and 't' refers to the time period.

The next step is to project the supply of skills by the education sector. This supply is characterized by the vector Skill(s,g,a,e,t) where s=1 refers to "enrolled in an institution of the education system", s=2 refers to those who are "not enrolled in the system of education", while e∈{no education, 1st year of primary education, 2nd year of primary education, …} is an element of the complete set of educational attainment categories. A particular type of school constitutes as many distinct educational attainment categories as many years are necessary to successfully complete its curriculum.

Entry to primary education is projected as follows:

$$\begin{aligned} Skill(s=1,g,a=6,e=P1,t) &= Pop(g,a=6,t)*SR(g,a=6,t) \\ Skill(s=2,g,a=6,e=NoEd,t) &= Pop(g,a=6,t)*\left[1-SR(g,a=6,t)\right], \end{aligned} \tag{5}$$

where SR(g, a=6, t) is the scholarization rate at the mandatory primary education entry age. (P1 refers to "1st year of primary education", NoEd refers to "no education".) Those who do not enter primary education are registered as "out of school" population without education.

[8] The model could be used as well to assess the economic impact of the effect of the pension system on the age of entrance to the formal labor market.

[9] In this paper the term human capital is used for the human capital actually offered for work, i.e. the human capital stock does not include the potentially highly productive, but inactive population.

[10] The empirical analysis of the household survey presented in the following section includes the economic sector in the set of explanatory variables in determining wages. Since the labor force projection does not have a sector dimension the specification of the wage equation is somewhat simplified here, i.e. it omits economic sector from the set of right hand side variables.

Based on the time series on education enrollment stocks, advancement rates, repetition rates and drop-out rates an E x (E+1) skills development transition matrix (TR) is generated, where E is the number of distinct educational attainment categories. TR(e1, e2) is the probability of "advancing" from education category e1 to education category e2. In the special case when e1= e2 TR(e1, e2) refers to repetition probability.[11] TR(e1, E+1) is defined as the probability of successfully completing educational level e1 and leaving the education system after the successful completion. So how does the model follow educational attainment in the society? A particular education level 'e' can be reached in one of the following ways. First we cover the case of advancement (and repetition) within the education system.

$$\Delta Skill(s=1,g,a,e,t] = \left[1 - Mort(g,a-1,t-1)\right] * \sum_{i=1}^{E} Skill(s=1,g,a-1,i,t-1) * TR(i,e) \quad (6)$$

where Mort(g,a,t) is the gender and time specific mortality probability of dying in the period when reaching age 'a' conditional on surviving through the previous period. Note that the model is only concerned about net flows. Beyond the age of entering primary education the net flows are always within and from (never to) the education system.

Those who finish successfully their intended level of education are transitioned out the school system according to the following equation:

$$\Delta Skill(s=2,g,a,e,t) = \left[1 - Mort(g,a-1,t-1)\right] * Skill(s=1,g,a-1,e,t-1) * TR(e,E+1) \quad (7)$$

The probability of dropping is the difference between 1 and the sum of the elements in a given row of the transition matrix. We have:

$$\Delta Skill(s=2,g,a,e,t) = \left[1 - Mort(g,a-1,t-1)\right] * Skill(s=1,g,a-1,e,t-1) * \left(1 - \sum_{i=1}^{E+1} TR(e,i)\right) \quad (8)$$

The evolution of those who already left the education system is according to the following equation:

$$\Delta Skill(s=2,g,a,e,t) = \left[1 - Mort(g,a-1,t-1)\right] * Skill(s=2,g,a-1,e,t-1) \quad (9)$$

The potential labor supply is given by those who are out of the education system, however, only the applicable labor force participation rates allow us to calculate the portion of the potential labor force that actually contributes to the human capital stock:

[11] Note that this formulation assumes that the transition probabilities only depend on the "to" and "from" education categories, and independent of gender, age and time. The reason why we do not present a more general formulation is that we assumed an only 2 dimensional transition array in the quantitative example we present in this paper.

$$LF(g,a,e,t) = LFPR(g,a,e,t) * \sum_{i=1}^{2} Skill(i,g,a,e,t) \tag{10}$$

where LF is the labor force array and LFPR is the labor force participation array.[12]

Now, we are ready to turn the LF array into a measure of human capital. Recall that we can predict the individual human capital value for all combinations of gender, age and educational attainment categories HCCat(g,a,e). Then the evolution of human capital is given by

$$SumHumCap(t) = \sum_{g=1}^{2} \sum_{a=1}^{A} \sum_{e=}^{E} LF(g,a,e,t) * HCCat(g,a,e) \tag{11}$$

In this paper we infer changes in retirement probabilities by age, by looking at changes in participation rates.[13] Hence, we can compare the dynamics of human capital under the status-quo with the dynamics of human capital in the case where participation rates change as a result of changes in pension benefit formulas and eligibility conditions.

Admittedly, there are limitations in the proposed analysis. First, the choice of the measure of human capital only considers the supply side of the labor market, i.e. implicitly assumes that those who enter the labor force will actually get a job and thus become a part of the (productive) human capital stock. Hence, our projections really constitute an analysis of potential human capital. In addition, the individual productivity values that we derive are associated with the interaction of labor supply and demand at a given point in time, and then we assume that this interaction is applicable to the future. Note that the productivity of a given unit of human capital can change as a result of technological progress. Our estimates of human capital should therefore be considered as a lower bound.

Quantitative example: the case of Morocco

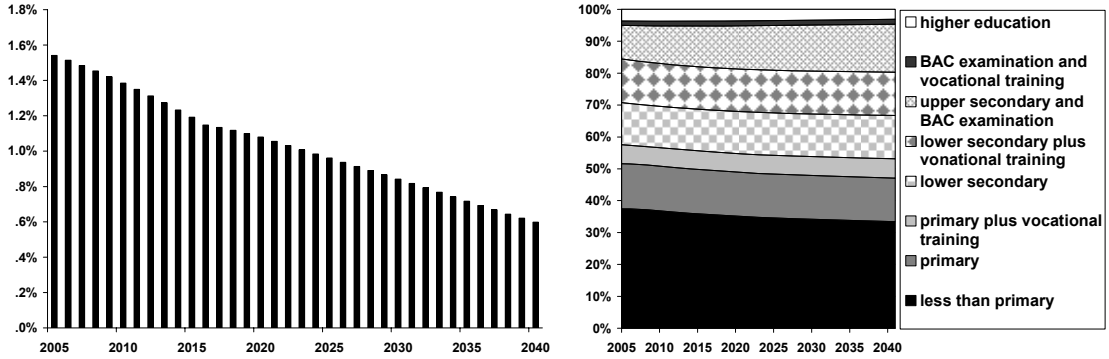
We illustrate the use of the model in the case of Morocco. Figure 5 illustrates the dynamics of population growth and the skills composition of the labor force as projected

[12] In practice we had to make certain homogeneity assumption in the case of the labor force participation rate array since the level of the disaggregation of the available data along the educational attainment dimension was insufficient. The ILO publishes age and gender specific labor force participation rate projections for the various countries in the LABORSTA database.

[13] The model could be easily extended to projecting the age and gender distribution of the population divided into 3 categories: "in school", "retired", "potential labor force". This formulation would allow that the changes in labor force participation induced by changes in the pension system enter the model through the changes in the gender and age specific retirement probabilities. The choice of formulation depends on the application, in particular, whether it is easier to assess the impact of the changes induced by the pension system in terms of retirement probabilities or labor force participation rates.

in the baseline scenario for Morocco. The question that we ask is how changes in participation rates – induced by changes in retirement probabilities – would affect these baseline dynamics.

Figure 5: Population Growth and Skills Composition of the Labor Force in Morocco



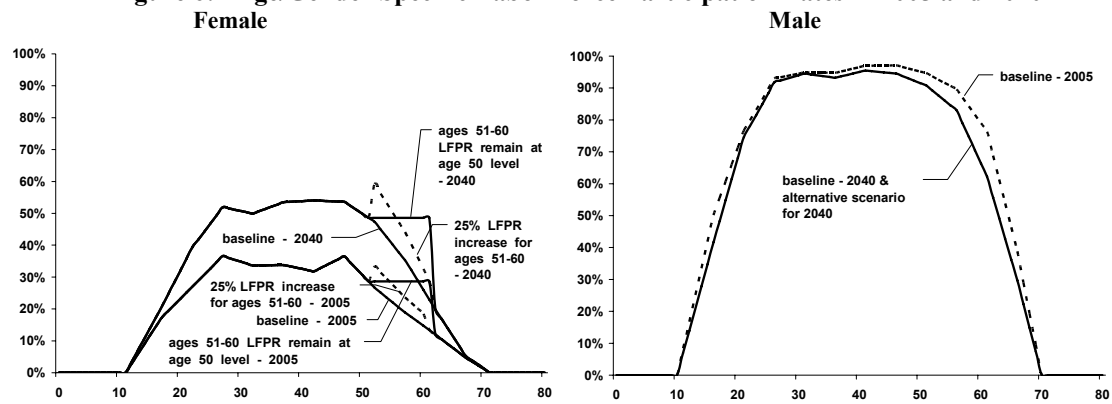
Source: ILO Authors' calculation.

The right panel of Figure 6 illustrates that male labor force participation rates are high across the board including ages potentially affected by early retirement (that is prior to age 60, which is the "standard" retirement age). The male labor force participation rate for the 59 year-old age cohort is 84.3 percent suggesting that the role of men in income generation for the family dominates the incentives exerted by the early retirement rules of the pension system, i.e. there does not seem to be room for further increasing male activity rates through changing early retirement rules.[14] In fact, projected male activity is expected to shrink. The range of labor force participation rates of 51-59 year-old men is expected to move from 84.3%-95.7% to 74.7%-94.3% by 2040. In contrast, female labor force participation rates are low across the board and steeply decreasing during ages 51 to 59 from 28.7% to 16.1%. While female activity is expected to increase, the steeply decreasing activity prior to age 60 is expected to persist (e.g. in 2040 48.8% of 51 year old women are expected to be employed or seeking employment, while only 35.3% of the 59 year-old women is expected to belong to the labor force).[15] In general, it appears that the preference maps shown in the previous section are consistent with the observed labor force participation of women.

[14] Note that the age specific labor force participation rates of the total population of Morocco are not identical to that of the consolidated membership of the 3 pension schemes introduced earlier. Those working in the informal sector are not covered under any of the schemes. In fact, it is possible that some people take advantage of the generous early retirement rules in one of the formal systems they belong to, and then offer labor services in the informal sector. These people are pensioners from the point of view of the pension scheme, and they are active in the view of national labor force participation estimates.

[15] We do not address labor force participation patterns beyond age 60 for two reasons: 1) early retirement rules are not applicable to this age group and only delayed retirement bonuses could affect the activity of these generations; 2) the dispersions of the state of individual health conditions are so large beyond 60 that retirement incentives cannot be effectively assessed without considering this constraint.

Figure 6: Age/Gender Specific Labor Force Participation Rates in 2005 and 2040



For females participation rates are assumed to deviate from the baseline due to changes in early retirement provisions (see main text).
Source: ILO Laborsta Economically Active Population Estimates and Projections and authors' calculations.[16]

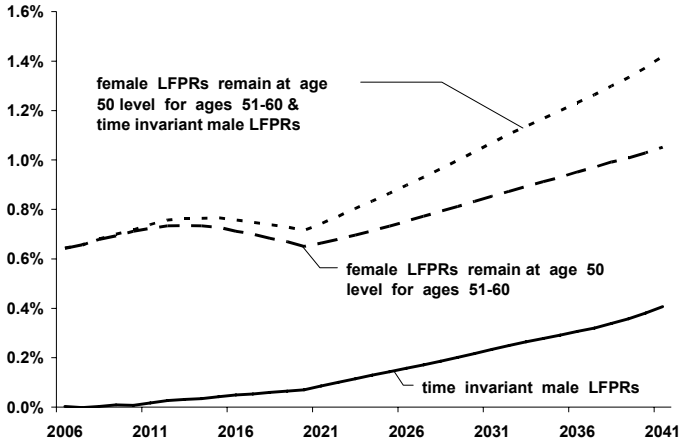
We assess 5 possible scenarios for changing early retirement behavior and associated labor force participation as shown in Figure 6. Note that the labor force participation patterns here are selected for illustrative purposes, they do not reflect a particular expected behavioral response to a particular pension reform although the magnitude of the changes represented by the various scenarios are feasible if a high consolidated coverage of the pension schemes is assumed. Recall that actual labor force participation behavioral responses associated with a particular pension reform can be estimated in a data rich environment using econometric methods or the tools described in the previous section of this paper could be applied in cases of data constraints. The first scenario assumes that female labor participation patterns change immediately and the new labor force participation rates of women aged 51 to 60 are identical to that of the 50 year-old cohort. The second scenario is the same for women, but we also fix the male labor force participation rates at 2005 levels, and consequently we do not allow male participation rates to fall in this scenario. The third scenario assumes the same time invariant male activity rates at the 2005 level, but in this case female activity patterns do not change. Scenarios 4 and 5 increase the labor force participation rates of women aged 51 to 60 by 25% immediately without and with imposing time invariant male labor force participation rates respectively.

We start by looking at the impact of the reforms on the contribution of each age group to the total level of human capital with and without changes in participation rates. The human capital share of the 51-60 age group is expected to increase even without changes in the pension system rules. Not surprisingly, the share of human capital of the pre-retirement age groups further increases with additional surges in their labor force participation. Figure 7 illustrates that the human capital share of the age group is 0.6-1.2 percentage point larger over the already steady increase of the baseline represented by the horizontal axis in this view. Later we will see that keeping the activity of men high at current levels has a larger impact on the growth of the total human capital stock as this represents a labor force participation increase compared to the baseline in all the age

[16] Gender and age group specific activity rate projections are available from the ILO until 2020, beyond that linear convergence assumed to the activity rates of the ILO aggregate category "more developed regions" reaching its level in 2075.

cohorts of the gender that is currently dominant in the labor force. However, the deviation from the baseline with respect to the 51-60 aged population is driven by the increase in female labor force participation as the deviation of male labor force participation from the baseline is much smaller.[17]

Figure 7: Additional Share of the 51-60 Age Group in Total Human Capital over the Baseline



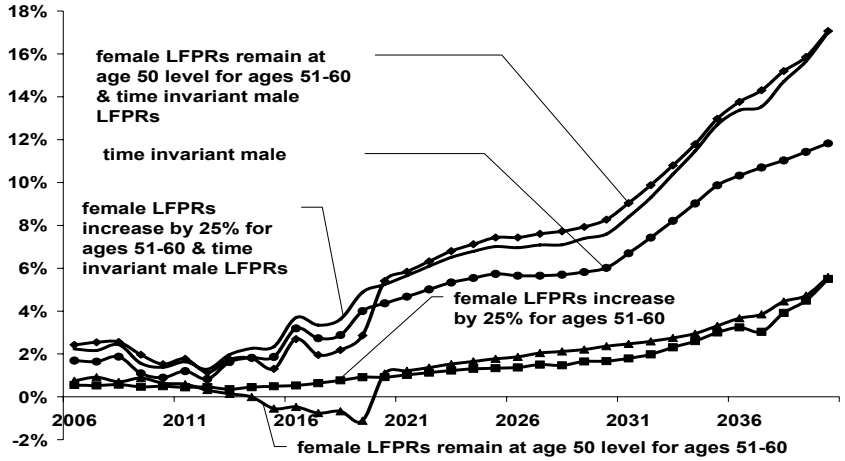
Source: ILO Authors' calculation.

Figure 8 summarizes the ultimate results of this quantitative exercise. Recall that the major determinants of the evolution of human capital, i.e. population growth, skills development through education and the baseline labor force participation path determine a baseline increasing path of human capital. In the case of Morocco the annual rate of human capital growth stands at 3.56% in 2006 and this rate is expected to decrease to 1.1% by 2040.

The human capital growth rate would be higher than the baseline if corrected early retirement incentives convince a significantly higher ratio of those who are close to the standard retirement age to remain in the labor force.

[17] Note that the human capital calculations underlying the results shown in this paper assume that the productivity of a man and a woman with identical age and educational attainment are identical. This seems to contradict the fact that the wage regression equation identifies gender as significant explanatory variable suggesting higher ceteris paribus human capital for men. Two possible explanations for the significance of the gender dummy is wage discrimination or that men are truly more productive than women after controlling for education and age. Our calculations assume that the wage differential is due to wage discrimination and consequently we associate identical human capital values for women and men with identical age and education.

Figure 8: Changes in the Growth Rate of Human Capital Due to Changes in Labor Force Participation Rates



Source: Authors' calculation based on ILO labor force participation projections.

The message of this analysis is that increased labor force participation rates among women induced by corrected early retirement rules in the pension system can have a significant and measurable impact on the rate of accumulation of productive capacities of the economy. Because of low initial female labor force participation and contrasting high activity of men in Morocco, the increased participation of the pre-retirement age women has a limited impact on the total growth rate of human capital. The additional human capital growth that could be achieved through maintained labor force participation of men is approximately 2.5 times larger than the expected behavioral response of women to changing early retirement rules. On average, during the period 2006-2040, corrected early retirement incentives could increase the human capital growth rate by approximately 2 percent. This is a remarkable portion, $1/50^{th}$ of the total human capital accumulation growth rate, considering that this impact is typically disregarded in the policy analysis of the impact of pension reform.

4. Pension system fragmentation and labor mobility

This section illustrates the effects that a fragmented pension system can have on incentives to supply labor in a given sector as well the mobility of labor across sectors. The analysis is based on micro simulations of career paths for individuals with different levels of education working in different economic sectors – and therefore belonging to different pension plans. In these simulations, wages are projected using a function similar to the one that was applied to compute human capital and estimated using household survey data.

Formally, at time t, the wage of an individual of gender 's', age 'i', education category 'e', working in sector 'j' , expressed as a share of average earnings is given by:

$$w_t(s,i,e,j) = \exp\left(\beta_0 - \ln\left(\overline{w}_0\right) + \beta_{1sej} i + \beta_{2sej} i^2\right) \qquad (12)$$

where ‘s’, ‘i', ‘e’ are respectively the gender, age, and level of education of the individual and ‘j’ is the economic sector where he or she operates. Hence the marginal effect that age (experience) has on wages depends on the characteristics of the individual and the economic sector.

Given equation (12), for any given individual we can compute net income flows across life. These are given by:

$$nif(s,i,e,j) = E(e,i)(1-R)w_t(s,i,e,j)\overline{w}_i(1-\tau_j) + (R)P\left(\left\{w(s,i,e,j)_a^t\,\overline{w}_i,\theta_e\right\}\right) \tag{13}$$

where R=1 if the individual is retired or R=0 otherwise, P(.) is the function returning the pension of the individual as a function of policy parameters of the relevant pension system in the sector, and E(e,i) is a function that is equal to one if an individual that will achieve education level ‘e’ is out of school at age ‘i' or zero otherwise. Also for simplicity we set the initial age and the initial time at 1 so ‘t’ and ‘i' are substitutes.

Using (13) we can compute internal rates of return to marginal investments in education. The internal rate of return $r^*(s,i,e,j)$ of moving from education level ‘e’ to education level e+1 is characterized by:

$$\sum_{i=1}^{X}\left(nif(s,i,e+1,j)-nif(s,i,e,j)\right)\left(1+r^*(s,e,e+1,j)\right)^{-t}v_i = 0 \tag{14}$$

Finally, we can compute the expected net gain of taking a job in sector ‘j’ at time ‘t’, or waiting to take a job in sector j′ at time t+1 with probability p(j’). This is given by:

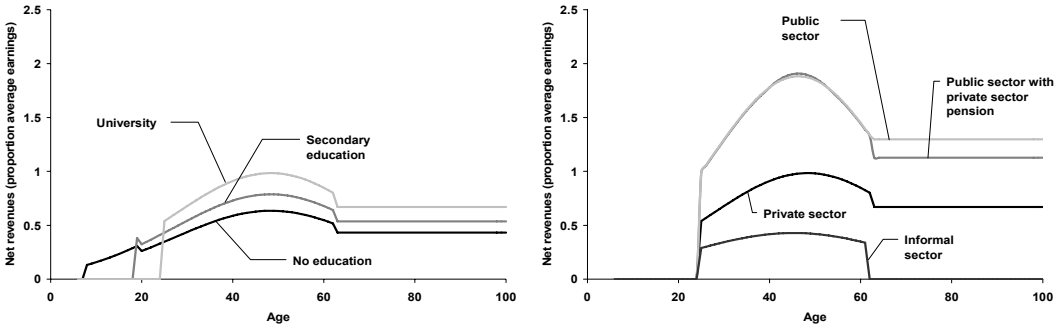
$$ngw_t(s,i,e,j,j') = \left(p(j')PV_{t=i+1}^{X}[nif(s,t,e,j')] + (1-p(j'))PV_{t=i+1}^{X}[nif(s,t,e,j)]\right) - PV_{t=i}^{X}[nif(s,t,e,j)] - \sum_{k=a}^{i} nif(s,k,e,j)b(1+r)^{(i-k)} \tag{15}$$

where PV[] is the present value function. The last term in equation (15) is used to take into account that an individual who continually delays taking the job in sector ‘j’ might have to accumulate some level of debt to finance its consumption (the parameter ‘a’ gives the age when the individual is first offered the job in sector j′). Here the assumption is that the individual borrows a fraction ‘b’ of the net income flow that he or she would have achieved by taking the job in sector ‘j’.

We apply this framework to the case of Morocco. Equation (12) was estimated by simple OLS using the 1998 household survey for Morocco. We defined 10 levels of education for the purposes of the analysis. In addition we consider four economic sectors: private, formal non-agricultural sector, the public sector, and the agricultural/informal sectors. In the analysis we constructed 120 career paths. These paths cross 10 levels of education, with four economic sectors, and with three types of pension funds. As before, in all cases, the growth rate of real average earnings is set at 3% per year and the discount rate is 4%.

The results show marked differences in the dynamics of wages across education levels. The left panel of Figure 9 shows the career path of three individuals who work in the private sector. One has no education, the other has only secondary education and the third one has higher education. Not surprisingly, for the individual with no education the wage curve starts at a lower level and is also flatter. The various career paths also show that individuals working in the public sector, regardless of the level of education, enjoy a better situation both in terms of wages and pensions (see right panel in Figure 9). On the contrary, individuals working in the agricultural sector and/or the urban informal sector receive lower wages than in the private sector – and they do not have pensions.

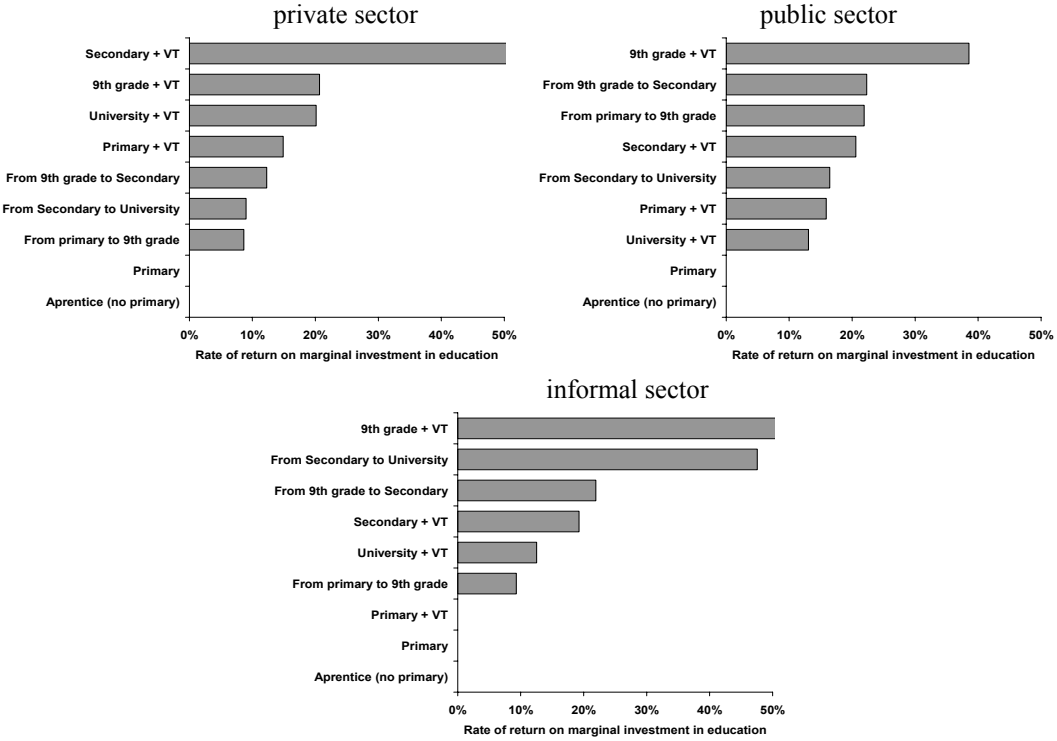
Figure 9: Selected Career Paths by Level of Education and Economic Sector



Source: Authors' calculations.

There are also important variations across sectors in terms of the internal rates of return on investments on different levels of education. Higher education for instance, is better valued in the public sector (Figure 10). Secondary education with a technical diploma from a vocational training institution is highly valued in the private sector. In the informal sector, on the other hand, the highest rates of return are for investments in 9 years of basic education plus a technical diploma from a vocational training institution. In all sectors, investments in only primary education or primary education plus a technical diploma are not worth much. These investments are important, only as that they allow individuals to access higher educational levels.

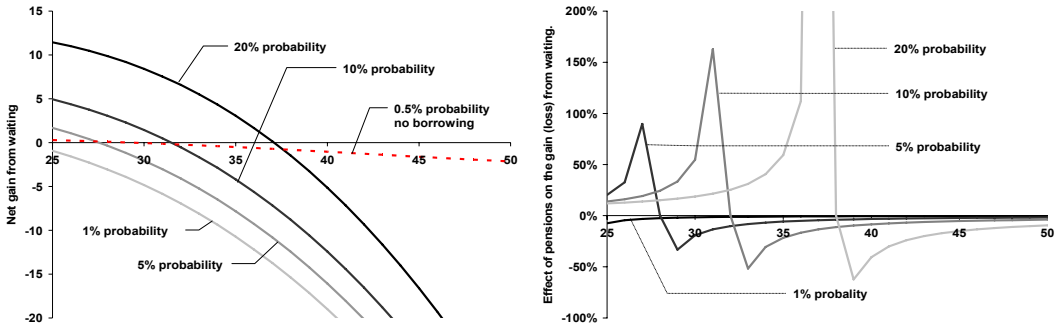
Figure 10: Internal Rates of Return on Investment in Education by Economic Sector



Source: Authors' calculations

What are the incentives for individuals to queue for jobs in the civil service? To answer this question we compute equation (15) for a 25 year old-individual having to decide whether to take a job in the private sector at time 't', or wait for a job in the public sector that can occur with probability 'p'. We simulate four values for p: 1%, 5%, 10% and 20%. We also assume that if the individual does not work he/she has to borrow an amount equivalent to 50% of the salary paid by the private sector job. The net gains from waiting for the public sector job are graphed in the left panel of Figure 11. Each line corresponds to one value of 'p'. We observe that even in the case of a very low probability of finding a public sector job, the individual has an incentive to wait for one year. If the probability of finding a job is 10% then the individual would have incentives to wait for 8 years. If the probability is 20% then the individual would have incentives to wait for 12 years. With no borrowing needs (b=0) even with a 2% probability of finding a job in the public sector the individual would have incentives to wait for 10 years (see dotted line).

Figure 11: Incentives to Queue for Jobs in the Public Sector



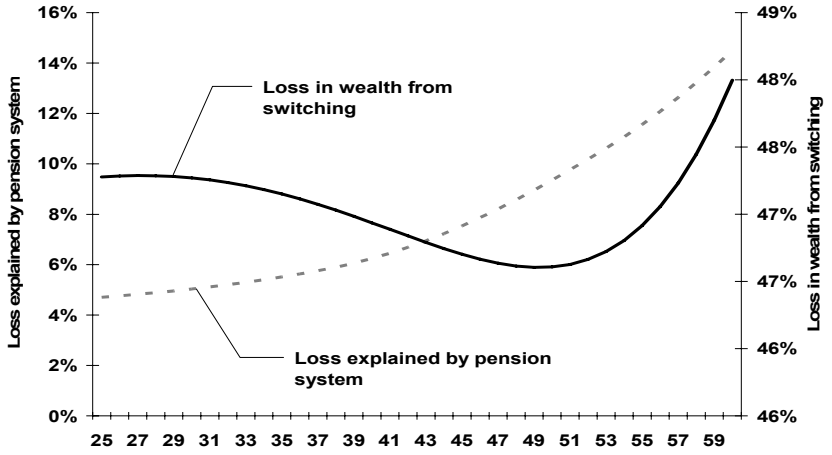
Source: Authors' calculations

How much of the incentive to delay taking the job in the private sector is explained by the pension system? To answer this question we calculate equation (15) assuming that pensions in the civil service respond to the same rules as pensions in the private sector. We then compare the resulting ngw(.) functions. The percentage differences between the net gains of waiting at different ages are graphed in the right panel of Figure 11. The results show that differences in the pension system have strong effects around the age where waiting is no longer optimal. Depending on the probability of finding a job in the public sector, differences in pensions can increase by 10 to 40% of the net gain of waiting and therefore provide strong incentives to let the job in the private sector pass. Similarly, pensions can reduce by 10 to 30% the loss from waiting and also contribute to queuing.

The final question that we address is what are the incentives to switch from a public sector to a private sector job? We do this analysis for an individual with higher education considering the possibility of switching at various ages. The relevant measure in this case is the change in the financial wealth, which is the present value of future wages and pensions. The results are presented in Figure 12. Not surprisingly our calculations show that individuals switching would face important losses; the financial wealth would be reduced by 46% to 48%.

Most of the losses in financial wealth are of course attributable to lower salaries in the private sector. A sizable part of the losses, however, is also explained by the move to a less generous pension system. Hence, the change in pension system reduces the financial wealth by between 5% and 15% depending on the age of the switching. The longer the individual waits, and therefore the higher the expected pensions are, the higher the loss (see dotted line in Figure 12).

Figure 12: Incentives to Switch Jobs between the Public and Private Sectors



Source: Authors' calculations

This section has analyzed incentives for labor mobility across main economic sectors. The analysis is based on the analysis of career paths and the calculation of three indicators: internal rates of return on education, net gains from queuing for jobs in the public sector, and the change in wealth resulting from switching jobs across sectors. These indicators can be easily computed on the basis of labor force or household survey data. When applied to Morocco the indicators show that a fragmented pension system distorts rates of return on education, reduces incentives to supply labor in the private sector, and discourages mobility between the public and private sectors. The corollary is that pension reforms that unify the pension system can contribute to facilitating labor mobility across sectors and therefore to facilitating economic restructuring and improved efficiency.

5. Conclusions

There is ample evidence of distortions that pension systems can impose on labor markets by influencing the decision of whether to retire and become inactive; and whether to supply labor in the public, formal private, or informal sectors. Typical defined benefit pension system designs (lacking actuarial connection between contributions and benefits) constitute an especially high risk for labor market distortions since they tend to offer variable internal rates of return at various ages, and if the pension system is fragmented, they tend to offer different returns across sectors as well.

The standard indicators used to assess incentive problems are the internal rate of return (IRR) on contributions as a function of the retirement age and the change in pension wealth at a given retirement age. These indicators, however, do not capture the tradeoffs between consumption and leisure, which are at the core of the retirement decision, and they also ignore the interplay between benefit formulas, eligibility conditions and the individuals' attitude towards risk. This is why we proposed a complementary indicator -

the normative estimator of the probability of early retirement based on utility maps. This indicator takes into account the tradeoff between consumption and leisure as well as the heterogeneity of preferences of individuals. We then used the indicator to assess the incentives problems in Morocco, a fairly representative country for the middle-income group. We showed that incentives for early retirement are important, particularly in the national scheme. Using a model that projects the labor force by age, gender, and skills level we also showed that changes in labor force participation rates resulting from pension policies that affect retirement decisions can have important effects on human capital accumulation. Potentially, *on average, in the period 2006-2040, corrected early retirement incentives could increase the human capital growth rate by approximately 2 percent under conceivable stylized scenarios.* We find this impact quite significant in light of current pension reform discussion/decision-making practices that fail to quantify this broader economic implication.

Subsequently, we conducted an analysis based on micro simulations of career paths for individuals with different levels of education working in different economic sectors – and therefore belonging to different pension plans. We focused on three indicators: internal rates of return on education, net gains from queuing for jobs in the public sector, and the change in wealth resulting from switching jobs across sectors. When applied to Morocco the indicators showed that *a fragmented pension system distorts rates of return on education, reduces incentives to supply labor in the private sector, and discourages mobility between the public and private sectors.* The corollary is that pension reforms that unify the pension system can contribute to facilitating labor mobility across sectors and therefore to facilitating economic restructuring and improved efficiency.

There are both methodological and policy conclusions from our paper. Regarding the methodology, we believe that future assessments of pension institutions and international comparisons of the effects of benefit formulas and eligibility conditions on retirement decisions could benefit from the calculation of the normative estimator of the probability of early retirement based on the utility maps. The indicator is useful to assess, ex-ante, the potential impact that policy changes can have on retirement decisions. In addition, we believe that a complex analysis of the consequences of early retirement go beyond the narrow assessment of the impact on the financial sustainability of the pension scheme, it should even go beyond assessing the consolidated fiscal impact and it should address the impact of early retirement on the evolution of human capital. The methodology described in this paper using the gender, age and educational attainment specific projection of the labor force and the associated measure of human capital is a suitable framework for the analysis of how early retirement affects the evolution of productive capacities in the economy.

Regarding policies, the paper strengthens the argument for the existence of significant economic benefits of reforms that reduce incentives for early retirement, and eliminate differences in benefit formulas and eligibility conditions for different segments of the labor force. While those benefits have been pointed out in the literature, there are still a significant number of policy-makers in high- and middle-income countries that consider them exaggerated, especially when compared to the political costs of introducing pension

reforms. Our paper will hopefully contribute to some reassessment of the cost-benefit analysis of pension reforms, by showing that the benefits may have been so far underestimated.

References

Becker, Gary S. 1993. "Human Capital – A Theoretical and Empirical Analysis with Special Reference to Education." 3rd Edition. University of Chicago Press.

Blondal, S., and S. Scarpetta. 1998. The Retirement Decisions in the OECD Countries. OECD Economics Department Working Paper no. 202, July.

Borsch-Supan, A., and R. Schnabel. 1998. Social Security and Declining Labor Force Participation in Germany. American Economic Review 88 (2): 173-178

Cörvers, Frank Andries de Grip and Hans Heijke. 2002. "Beyond Manpower Planning: A Labour Market Model for the Netherlands and its Forecast to 2006." In: Michael Neugart and Klaus Schömann (eds.) 'Forecasting Labours Market in OECD Countries – Measuring and Tackling Mismatches.' Edward Elgar, Cheltenham, UK.

Doeringer, P. B. and Piore, M. 1971.International Labour Market and Manpower Analysis: Lexington, MA: D.C. Heath

Gruber, J., and D.A. Wise, eds. 1999. *Social Security and Retirement Around the World*. Chicago: University of Chicago Press

Gruber, J., and D.A. Wise, eds. 2004. *Social Security and Retirement Around the World: Micro Estimation*. Chicago: University of Chicago Press

Gruber, J., and D.A. Wise, eds. (forthcoming). *Social Security and Retirement Around the World: Fiscal Implications of Reform*. Chicago: University of Chicago Press

Heijke, Hans (ed.). 1994. "Forecasting the Labour Market by Occupation and Education – The Forecasting Activities of Three European Labour Market Research Institutes." Kluwer Academic Publishers.

Herbertsson, T. T. and Orszag M. 2003. "The Early Retirement Burden – Assessing the Cost of the Continued Prevalence of Early Retirement In OECD Countries." Watson Wyatt Technical Reports Report 2003-LS04.

Leontieff, Wassily. 1966. "Input-Output Economics." Oxford University Press.

Oliveira Martins, Joaquim, Frédéric Gonand, Pablo Antolin, Christine de la Maisonneuve and Kwang-Yeol Yoo. 2005. "The Impact of Aging on Demand, Factor Markets and Growth." OECD Economics Working Papers No. 420.

Queisser M. and Whitehouse E. 2006. Neutral Or Fair –Actuarial Concepts and Pension System Design. OECD Social, Employment and Migration Working Papers No. 40

Sousa-Poza, A. 2003. Labour Market Segmentation in Switzerland, mimeo.

Taubman, Paul and Michael L. Wachter. 1986. “Segmented Labor Markets.” In: Handbook of Labor Economics, Vol. II., Elsevier Science Publishers BV.