The Effect of Immigration in the Retirement Age Reforms: learning from a numerical example.

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Abstract

This paper examines the role played by the low-skilled immigrant labor force in countries aiming to reform their public pensions systems by postponing the pensionable age. With an overlapping-generations model in continuous time and a fully redistributive pension system, the results of this paper suggest that immigration could imply a delay in the retirement age of the pension system. Even more, we find that the preferences for a delay in the retirement age increases with the labor productivity of both immigrants and native population.

Keywords: Immigration, welfare, pension benefits

JEL category: F22, H55, J61
Introduction

Social security reform is currently one of the top issues on the economic policy agendas of most industrialized countries. It is widely held that unless serious changes come about, the rise in the number of retirees relative to workers will threaten the viability of pay-as-you-go (PAYG) public pension systems in the long-run. With the aim of eliminating this future financial burden, important reforms are being proposed such as raising taxes, cutting pension benefits and/or delaying the retirement age (see Blondal and Scarpetta (1998) or Gruber and Wise (1997)).

In order to achieve this last reform, the main economic policy measures have undertaken to either allow a greater flexibility in social security retirement schemes (e.g. Germany, Italy or Sweden), to reinforce the link between lifetime contributions and pension benefits or to postpone the pensionable age. Indeed, this last measure is one of the policy conclusions of *Maintaining Prosperity in an Ageing Society*, OECD (1998): "...a direct way to encourage people to work longer would be to raise the pensionable age".

But delaying the retirement age may not be very popular among people. According to recent surveys, most of workers tend to manifest that they are happy with the current retirement age (see Cremer and Pestieau 2003) which suggests that reforms on the legal retirement age have currently become a very delicate matter for governments.\(^1\)

Besides, it has been demonstrated that pension systems in virtually all OECD countries in the mid-1990s made financially unattractive to work af-
ter the age of 55. In this sense, the general consensus is that social security systems provide enormous incentives to leave the labor force early. Clearly this makes even more difficult the retirement age reform.

Therefore, the increasing of the retirement age as a tool to improve the financial problems of public pensions systems faces two sensitive problems: the opposition of the people; and the disincentives to continuous work embedded in the pension system.

On the other hand, the current flow of immigrants towards developed countries with generous welfare systems constitutes another key economic issue. In most of these host countries, immigration is frequently viewed as a means to overcoming the financial challenges facing public pension schemes. In this sense, the host population may welcome a large number of immigrants and prefer a policy of open borders. At the same time, it is argued that immigrants are net beneficiaries of the welfare state (see Sinn (2002) and Chand and Paldam (2004) among others). For these reasons, the public choice approach towards immigration has gained increasing interest within the academic literature.

In line with Lagos and Lacomba (forthcoming), the present article explicitly examines the role that the low-skilled immigrant labor force plays in exerting potential pressure on the current legal retirement age. In a country with open borders and a PAYG, redistributive pension system, we abstract from the effect that the immigrant quota may have on very different social and economic issues and concentrate on the impact it has on the benefits of such a domestic pension scheme. As a time horizon is needed to assess the true impact of immigration,
this paper takes into account that at some point in the future immigrants will start collecting retirement benefits. Moreover, in order to avoid individuals who ignore the impact of current decisions on future retirement benefits, we assume fully rational individuals. That is, individuals who deem their future income benefits to be as quantitatively important as their present income benefits. Furthermore, our theoretical framework considers an overlapping-generations model in continuous time. Unlike Razin and Sadka (1999) and Krieger (2004), this allows us to specifically identify which groups of the native population are better or worse off with immigration.

The results of this paper suggest that in countries which have proposed reforms to solve the problem of the viability of public pension systems by postponing the pensionable age, the effect of immigration should be taken into account. Actually, most of the host-population’s optimal retirement ages increases with immigration. Concretely, we find that the impact of the immigration policy on the preferences of the optimal legal retirement age of the citizens depend on both the individual native’s income and the productivity of immigrants.

Previous literature dealing with retirement in a political and economic context has mainly focused on the effects of social security systems on the individual retirement decision. Our paper examines the legal retirement age, thus allowing us to emphasize the relevance of the indirect macro effects of changing the pensionable age, that is, the effects that altering the workers/retirees ratio, the well-known dependency ratio, has on pension benefits. The term ‘legal retirement age’ usually refers to the age at which workers are eligible for benefits.
However, since there are strong incentives to stop working after this standard entitlement age, in this model we consider the legal retirement age to be the age at which workers have to leave the labor force, that is, mandatory retirement.\textsuperscript{3} Indeed, the average retirement age in some OECD countries is very close to this standard retirement age (e.g. the United Kingdom, Portugal or Ireland).\textsuperscript{4}

This paper assumes that the increase in pension revenues caused by immigration is shifted entirely to the retirees. However, an equally plausible option would be to keep per capita pensions constant and reduce the tax rate. Lacomba and Lagos (forthcoming) show the relevance of correctly choosing the parameter affected by the dependency ratio, contribution rate or pension benefits, in the design of the Social Security programme.

**The model**

Following Lagos and Lacomba (forthcoming), we consider an overlapping-generations model in continuous time.\textsuperscript{5} At each point of time $t$ a new cohort of individuals is born. We assume a constant birth rate which is normalized to the unity. In this model we have a continuous and uniform distribution of agents on age, with no uncertainty on the length of their lives, going from zero to a fixed age, $T$. Furthermore, a continuous distribution of agents on labor productivity between a minimum and a maximum level $[l_-, l_+]$ is assumed.

The government levies an income labor tax, $\tau$, for a redistributive social security program. The social security program is a balanced budget ”pay as you go” system (PAYG), in which current workers are net contributors while the retired are net beneficiaries.
The utility function of individuals throughout their lifetimes is similar to Crawford and Lilien, (1981). These individuals have a stationary and temporally independent utility function, which is separable and strictly increasing in terms of consumption and leisure. We assume that leisure yields utility to the individual only when this individual is retired. The pension or retirement benefits are received only after they stop working. The instantaneous utility function is therefore as follows:

\[ U(c^t_i, \theta^t) = u(c^t_i) + v(\theta^t) \tag{1} \]

where \(c^t_i\) is the consumption at period \(t\) of individual \(i\). The consumption utility is twice differentiable with \(u' > 0, u'' < 0\). Let \(\theta^t\) be the leisure per unit of time \(t\), equal for all individuals, with a leisure utility of \(v(\theta^w_t) = 0\), in their working years and \(v(\theta^R_t) = v\), in their retirement years.

Let \(\delta, r\) be the subjective rate of time preference and the market rate of interest, respectively. Let \(p\) be the annual pension benefits that workers receive when they retire. Let \(\hat{R}\) be the current legal retirement age at which pension benefits are available. Hence the lifetime utility that an individual \(i\) must maximize over his lifetime can be written as

\[
\int_0^T U(c^t_i, \theta^t) e^{-\delta t} dt = \int_0^{\hat{R}} u(c^t_i) e^{-\delta t} dt + \int_{\hat{R}}^T [u(c^t_i) + v(\theta^t)] e^{-\delta t} dt \tag{2}
\]

subject to
\[
\int_0^\tau c_i e^{-rt} dt = \int_0^\tau (1 - \tau) l_i e^{-rt} dt + \int_{\hat{R}}^\tau pe^{-rt} dt
\]

where \( l_i \) is the labor productivity for an individual \( i \).

As regards individual pension benefits, the pension system is assumed to be unfunded and fully redistributive so that the discounted value of the total pensions received by any individual is as follows

\[
P = \int_{\hat{R}}^T \frac{\tau \hat{R} L}{T - \hat{R}} e^{-rt} dt
\]

where \( L \) is the average labor productivity of the working population.

For the sake of simplicity, we assume that there are no returns on savings and that individuals do not discount the future, so both discount rates are zero (\( \delta = r = 0 \)). This assumption implies that each individual will set a constant consumption per period. That is, individuals are fully rational and hence their future income benefits become quantitatively as important as their present income benefits. Thus the indirect remaining lifetime utility function of an individual \( i \) can be reduced to

\[
U(c_i, \theta) \equiv (T - a) u(c_i) + \left( T - \hat{R} \right) v
\]

and the optimal consumption is given by

\[
c_i = \frac{1}{T} \left( \hat{R} (1 - \tau) l + \left( T - \hat{R} \right) p \right)
\]
where \( a \) is the age of the individual, \( \hat{R} \) is the retirement age, \( \tau \) the tax rate on wages and \( p \) the annual pension benefits.

At period \( t \), a quota of \( m \in (0,1) \) immigrants are allowed in. Following Razin and Sadka (1999), it is assumed that these immigrants are all young \((a = 0)\) and unskilled workers \((\text{low } l)\). They have the same preferences and the same fertility rate as the native population. Hence, in the host country a cohort of \( 1 + m \) individuals is born at each point of time from period \( t \) on.

At that period \( t \) the agents will be characterized both by age and labor productivity. They will also have a different amount of accumulated wealth, \( \pi(a, l) \) which is given by the total income earned minus total consumption up to the instant at which the immigrants arrive

\[
\pi(a, l) = \begin{cases} 
  a \left( 1 - \frac{\hat{R}}{T} \right) ((1 - \tau)l - p) & a \leq \hat{R}; \\
  \hat{R} \left( 1 - \frac{\tau}{T} \right) ((1 - \tau)l - p) & a \geq \hat{R}.
\end{cases}
\]  

This expression describes the pattern of wealth accumulation.

There exists a threshold labor productivity \( \bar{l} \) such that \( \bar{l}(1 - \tau) = p \). In particular

\[
\bar{l} = \frac{\hat{R}\tau L}{(1 - \tau)(T - \hat{R})}.
\]  

We consider a contribution rate, \( \tau \), such that \( \bar{l} > \bar{l} \), therefore, the accumulated wealth increases linearly with age up to the point in which \( a = \hat{R} \) for any labor
productivity. In other words, they save money for retirement. Beyond that point they start to spend their accumulated wealth until \( a = T \), where \( \pi(T, l) = 0 \).

Besides, with the arrival of immigrants at period \( t \), the retirement benefits of each native individual are affected in a different way according to age, \( p(a) \). Three benchmark cases can be defined.

In the first benchmark, we consider native individuals whose age at period \( t \) is higher than mandatory retirement age, \( a \geq \hat{R} \). These individuals are net beneficiaries of the pension system and pass away before the first immigrants start collecting benefits. Thus, the discounted value of the total pension benefits received by an retired individual aged \( a \) is as follows

\[
P(a) = \int_{a}^{T} \frac{\tau \hat{R}L + \tau tmI}{T - R} dt
\]

where \( I \) denotes the average labor productivity of immigrants. It is assumed that \( I < L \). The component on the right hand side (RHS) of (9) represents the total tax contribution of native working population and immigrants to individual pension benefits of currently retired people.

In the second benchmark, we consider native individuals whose age at period \( t \) is higher than the mandatory retirement period, \( T - \hat{R} \leq a \leq \hat{R} \). These native individuals are presently working but pass away before the first immigrants start collecting benefits. Thus, the discounted value of the total pension benefits received by an individual aged \( a \) is as follows
\[ P(a) = \tau \hat{R}L + \int_{T-a}^{T} \frac{\tau tmI}{T-R} dt \]  
(10)

where the first component on the right hand side (RHS) of (10) represents the total tax contributions of the native population to the pension benefits of the native individual. The second term reflects the additional tax contribution of immigrants.\(^7\)

In the third benchmark, we consider the case in which the age of native individuals at period \( t \) is lower than the mandatory retirement period, \( a \leq T - \hat{R} \). These native individuals coincide with immigrants in the retirement period and, thus, for at least some years, they share pension benefits with them. The discounted value of the total pension benefits received by an individual aged \( a \) changes significantly

\[ P(a) = \frac{a}{T-R} \tau \hat{R}L + \int_{T-a}^{R} \frac{\tau tmI}{T-R} dt + \int_{R-a}^{T-a} \frac{\tau \hat{R}(L + ml)}{T-R + (t-R)m} dt \]  
(11)

The first two components on the RHS of (11) represent the total tax contribution of the native population and immigrants (respectively) to the pension benefits of the native individual when the first generation of immigrants has not yet reached the retirement period. However, the third term reflects the tax contribution of the native population and immigrants to the pension benefits
when the first generation of immigrants is already in the retirement period, that is, when there are at least $\hat{R}$ generations of immigrants in the host country.

Finally, as a special case within this cohort, it is worth examining the case of native individuals who are born at period $t$, that is, individuals who are aged $a = 0$. These native individuals coincide with immigrants throughout the entire retirement period and therefore share pension benefits from beginning to end. The discounted value of the total pension benefits can be expressed as

$$P(0) = \int_{\hat{R}}^{T} \frac{\tau \hat{R} (L + mI)}{T - \hat{R} + (t - \hat{R})m} dt$$

(12)

The component on the RHS of (12) represents the total tax contribution of the native population and immigrants to the individual pension when the first generation of both immigrants and native individuals aged 0 at period $t$ reaches the mandatory retirement age.\(^8\)

Consequently, with the arrival of immigrants, the retirement benefits of the host population are affected in a different way according to whether they share or not pension benefits. In the first two benchmarks, for native individuals who do not coincide (and thus do not share) with immigrants in the retirement period, immigrants are net contributors to the social security system. In the third case, for native individuals who coincide (and thus share) with immigrants in the retirement period, immigrants are also beneficiaries of pension benefits.

**Optimal retirement age**

Once the setting each native individual faces has been determined, the fo-
cus will be on how the arrival of immigrants affects the optimal mandatory retirement age of each native individual and, as consequence, what kind of role immigration could play in solving the current social security problems. Through a numerical example, we study how an increase in the immigrant quota modifies (delaying or advancing) the optimal legal retirement age of each native individual.

For the sake of simplicity, we just consider two levels of labor productivity \( (l_- \text{ and } l_+) \) for native individuals. The indirect utility function for a native individual of age \( a \) and labor productivity \( l_i \) used in this numerical example is given by

\[
U(R, a, c_i) = \begin{cases} 
(T - a)(u(c) + v) & R < a; \\
(T - a)u(c) + (T - R)v & R \geq a.
\end{cases} 
\]  

(13)

and the optimal consumption is given by

\[
c = \begin{cases} 
\frac{1}{T-a} ((T - a)p + \pi(a, l_i)) & R < a; \\
\frac{1}{T-a} [(R - a)(1 - \tau) l_i + (T - R)p + \pi(a, l_i)] & R \geq a.
\end{cases} 
\]  

(14)

where \( R \) is the new retirement age, \( p \) the annual pension benefits (as previously defined, see (9), (10), (11) and (12)) and \( \pi \) the accumulated wealth up to period \( t \) (see (7)). The basic issue in deriving these expressions is that the optimal
consumption adjusts to an income change only in the remaining periods of life.

The parameter values introduced in (13) and (14) are the following ones: life length \( T = 57 \); status quo retirement age \( \hat{R} = 48 \); new retirement age \( R \in [T/2, T] \); income labor tax \( \tau = 0.25 \); labor productivity \( l_i = \{4, 8\} \); average labor productivity of host-population \( L = 6 \); quota of immigrants \( m = \{0.1, 0.2\} \); age of native worker \( a \in [0, 48) \); age of native retiree \( a \in (48, 57] \); and value of leisure \( v = 1.4 \).

Next, we consider two levels of average labor productivity for immigrants: low and high, \( I = \{0.1, 5.9\} \). For each level, we make an exercise of comparative statics. We compare the retirement age that maximizes the utility function of the native individuals for two different quotas of immigrants. If, for instance, the retirement age that maximizes the utility function is larger (lower) with the highest quota of immigrants, then it can be deduced that the entrance of immigrants delays (advances) the optimal retirement age of this native individual.

The results are presented in the following table.

<table>
<thead>
<tr>
<th></th>
<th>High I</th>
<th></th>
<th>Low I</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rich</td>
<td>Poor</td>
<td>Rich</td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Advance R</strong></td>
<td>3.5%</td>
<td>36.84%</td>
<td>19.29%</td>
<td>45.6%</td>
</tr>
<tr>
<td><strong>Delay R</strong></td>
<td>96.5%</td>
<td>63.16%</td>
<td>81.71%</td>
<td>54.4%</td>
</tr>
</tbody>
</table>

The row **Advance R** denotes the percentages of native population with a lower retirement age maximizing their utility function when the immigrant quota
increases. Similarly, the row *Delay R* denotes the percentages of native population with a higher retirement age maximizing their utility function when the quota of immigrants increases. The columns denote, for a level of labor productivity of immigrants (high or low), the percentages of rich and poor native individuals with a lower (*Advance R*) and higher (*Delay R*) retirement age maximizing their utility function respectively when the immigrant quota increases.

As it can be observed, the majority of the native population prefers to delay the retirement age of the pension system. That is, an increase in the immigrant quota rises their optimal retirement ages. Besides, the percentages vary significantly for different levels of labor productivity. The richer native population and the more skilled immigrants are, the larger the percentages (always above fifty per cent) of host-population are to support a delay on the retirement age. The following figure illustrates this reasoning.
The impact of immigration on retirement age preferences can be explained by the income effect, the substitution effect and the labor productivity of immigrants.

If immigrants have a high labor productivity, the income effect tends to advance retirement. An increase in the immigrant quota raises the native individual’s income by increasing pension benefits. This gain of income implies a higher demand for leisure, that is, they retire at an earlier age. With respect to the substitution effect, the arrival of immigrants raises the relative price of leisure and, thus, the native individual substitutes leisure for consumption. Consumption becomes cheaper in terms of leisure. Hence, this means that the substitution effect generates incentives to delay retirement.
Mostly, the total effect increases the optimal retirement ages of native individuals. Thus it can be concluded that the substitution effect outweighs the income effect. That is, the native individual prefers to delay the age of retirement in order to attain both a greater level of consumption through higher pension benefits and a lower retirement period sharing pension benefits with immigrants.

However, when immigrants have a low labor productivity, the income effect of an increase in the immigrant quota leads to a delay in the retirement age. The arrival of immigrants reduces the native individual’s income by decreasing their pension benefits. This loss of income implies a lower demand for leisure which means that native individuals opt for a delay in the retirement age. On the contrary, the substitution effect of an increase in the immigrant quota leads to an earlier retirement age. The arrival of immigrants reduces the relative price of leisure so that native individuals substitute consumption for leisure. Consumption becomes more expensive in terms of leisure. Therefore, the native individuals prefer to retire at an earlier age.

According the results, in this case in the majority the income effect outweighs the substitution effect. Leisure becomes more expensive in terms of consumption and thus the optimal retirement age increases. A delay in the retirement age not only increases the working period but also reduces the retirement period sharing pension benefits with low-skill immigrants.

Summing up, it can be concluded that most of the host-population’s optimal retirement ages are raised with immigration. Even more, the percentage of host-
population opting for a delay in the retirement age increases with the labor productivity of both immigrants and native population.

**Conclusions**

One of the main reforms undertaken to solve the viability of public pension systems is to delay the pensionable or the legal retirement age. In this sense, the results of this paper suggest that governments attempting to postpone the legal retirement age should take into account the effect of immigration. Actually, immigration could imply a delay in the optimal retirement age of the pension system.

Mainly, we find that if immigrants have a high labor productivity, the arrival of immigrants raises the relative price of leisure and this event generates incentives to delay retirement. However, if immigrants have a low labor productivity, the arrival of immigrants reduces the native individual’s income by decreasing their pension benefits and a delay in the retirement age not only increases the working period but also reduces the retirement period sharing pension benefits with low-skill immigrants. Even more, we find that the preferences for a delay in the retirement age rises with the labor productivity of both immigrants and native population.

In conclusion, immigration could play a prominent role in solving current social security problems, by either helping to stabilize pension system budgets or by modifying (delaying) the mandatory retirement age.

**Notes**

A survey of January 2005 for the insurance company AXA based on a sample of 9,300
people in 15 of the World’s major industrialized countries, finds a widespread opposition among workers to increasing the retirement age limit, notably when they are close to retirement: http://www.retirement-scope.axa.com.


3In some countries there are direct restrictions on working beyond the standard age (Portugal or Spain make entitlements to pension benefits beyond the standard age conditional on complete withdrawal from work) or frequently, individuals have to leave their current jobs to receive their pensions; see Blondal and Scarpetta (1998) or Gruber and Wise (1999).

4When individuals are allowed early access to pension benefits, albeit with some adjustment in the amount to which they are entitled, the average retirement age is usually found between the age at they are eligible to receive their pensions and the standard retirement age; see Blondal and Scarpetta (1998) or Samwick (1998).

5In Lagos and Lacomba (forthcoming) we analyze how the arrival of immigrants affects the optimal legal retirement age of each native individual and, as consequence, what kind of pressure this event could exert on the retirement age of the public pension system. In this paper we provide a numerical example in a similar context.

6Razin and Sadka (1999) suggest that the equal ability distribution assumption is a subject of open debate. Djajic (2003) argues that the assimilation of immigrants is a multidimensional process of enormous complexity. In each of these dimensions (earnings, human capital occupational status, consumption, fertility...) they assimilate at rates that may differ from those of their children. For these reasons, the assumption that the ability index of the immigrants’ offspring is distributed similarly to the native population is followed less strictly in this paper.

7In the second term on the RHS of (9) and (10), t denotes the number of immigrant generations living in the host-country ever since the first generation arrived.

8In the third term on the RHS of (11) and (12), \( t - \tilde{R} \) m denotes the number of immigrant generations collecting pension benefits ever since the first generation of immigrants arrived.

9These parameter values involve a labour life of 48 years and a percentage of retirees around
a 15.78% of the native population.

\[ \frac{\partial U}{\partial c} \frac{\partial c}{\partial c} \bigg|_{R=T} < v < \frac{\partial U}{\partial c} \bigg|_{R=T/2}. \]

In words, an interior optimal one is obtained when the leisure's marginal utility is larger (lower) than the consumption's marginal utility whether the individual decides to work full time (minimum time allowed). In our example this holds for different values of leisure.

References


