Social Security and Migration with Endogenous Skill Composition

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Abstract

The paper investigates the impact of international migration on public pay-as-you-go pension systems. It first develops a theoretical framework to analyse the effects of migration on the labour market. The model allows for heterogeneity across individuals and for migration to affect both the wages and the educational choice in the recipient country. It then explicitly focuses on social security, under alternative migration scenarios. The analysis shows that migration helps the financial sustainability of the social security scheme, by reducing the elderly dependency ratio. However, it also highlights the complex inter and intragenerational redistributive conflicts caused by the interaction between migration and pension schemes. Migration influences the preferences of residents on social security: it is shown that migration polarises the preferences over the social security scheme and it can undermine the support to it. Social security affects the attitudes of residents towards migration: namely, it decreases the opposition to migration, by working as an insurance device for the unskilled workers.

1 Introduction

All major industrial countries are facing problems related to population ageing. The declining birth rates and the rising longevity have increased the elderly dependency ratio: according to OECD (1998a), there are currently about two people aged 65 and older for every ten people aged 15-64 in the OECD countries. By 2030, this ratio is expected to
reach three and a half to ten and to stabilise only in 2050 [Lutz (1996)]. The increase could be even faster if recent (falling) labour market participation trends continued. This process occurs at different rates and with different timing across countries: though ageing is likely to be quicker and sooner in Japan and Italy, on average populations of OECD countries are the oldest in the world.

As the share of the elderly in the population of rich countries goes up, the cost of paying for pensions and health benefits rises: it is feared that ageing can have dramatic effects on government finances, boosting taxes and putting the government's ability to finance other expenditure at risk. The negative demographic trends call for policy reforms especially in those areas where per capita expenditure for the elderly is particularly high: public retirement schemes are the natural candidates for reform, especially because their pay-as-you-go financing makes them very sensitive to demographic shocks.

Policy makers in rich countries show interest not only in following the radical reforms undertaken by some developing countries, which replaced part or all of their public systems with private pensions based on individual accounts. They are also considering the possibility of contrasting the adverse demographic trends to alleviate pay-as-you-go pension systems' problems: international migration is a clear candidate for this aim. It is held that migration may have a positive impact on the financial soundness of pension systems and therefore help overcoming their imbalances [OECD (1998 and 1998a) and Razin and Sadka (1998, 1999a and 1999b)]. Migration from less developed countries can help counterbalance the negative demographic trends and the declining fertility rate of industrialised economies.

The aim of this paper is to assess and qualify these arguments in the light of economic theory. To this end we concentrate on the recipient country and develop a theoretical framework to investigate the impact of migration on the residents' choices and welfare. We allow for heterogeneity across individuals and derive implications for the residents' reactions to migration. We then explicitly focus on social security and analyse the effects of migration on its sustainability: we evaluate if and how migration policies can represent a complement to direct social security reforms. We also study how migration influences the preferences of residents on the social security scheme and how, vice versa, the latter affects the attitudes of residents towards migration: migration might ease the financial problems of pension arrangements but it might polarise the preferences of agents over the social security scheme and sharpen the opposition to it. A policy which apparently makes

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1 Though the use of immigration policies for demographic purposes may raise several problems and objections, as discussed in OECD (1998), the latter reports that some countries already adopt explicit age-related selection criteria for some categories of immigrants.
the system more sustainable may actually destroy the consensus on it. On the other side, social security schemes can operate as an insurance device and thus contrast the negative effects of migration, were they to appear. Social security can therefore decrease the opposition to migration and make it more acceptable to residents.

The analysis developed in this paper differs from the existing related literature in that it describes migration not only as a demographic phenomenon increasing the number of contributors to the social security scheme but also as an economic shock perturbing the labour market and starting inter and intragenerational redistributive processes which one needs to take into account in order to understand the costs and benefits of alternative migration and pension policies.

The paper is organised as follows: Section 2 presents some facts about international migration; it discusses how they are captured by the current literature on migration and social security and it outlines our approach; Section 3 introduces and develops the theoretical model and Section 4 concludes.

2 Migration and social security

2.1 Some facts on international migration

For the last decade, the relative contribution of net migration has been an important source of population growth in most OECD countries and it has been the major source in the European Union [OECD (1998)]. ILO (1999) estimates that in 1995 over 90 million people were residing, legally or illegally, in a country other than their own.

The proportion of family immigration on total migration flows is increasing; yet, labour related migration is still extremely relevant. In 1996, the most recent year for which information is available, 129.2 thousand legal foreign workers entered Italy; 24.5 thousand the UK (more than 50% of total inflows), 262.5 thousand Germany. Foreign and foreign-born labour force is an important percentage of total working population in most OECD countries.

A few facts on international migration to OECD countries are relevant for our analysis.

² On average, the age structure of immigrants is younger than the age structure of the native population.

² Migration flows do not seem to be influenced by business cycle conditions of destination areas. They are rather affected by long run income and unemployment differentials between less developed and destination countries. Also political instability plays an important role: although asylum claims show a declining trend, they are
still an important component of migration flows; in 1996 there were 104.4 thousand asylum seekers in Germany and 21.4 thousand in France².

² A large share of migrants are low-skilled. Though recent trends show an increase in migration of highly-qualified temporary workers with respect to unskilled labour³, these data need to be taken with caution. Indeed, official statistics fail to report illegal immigration. This is one of the main difficulties which arises when quantifying the dimension and the characteristics of migration flows. Stalker (1994) estimates that there are 30 million irregular migrants worldwide (1/3 of total migrants). Many traditionally migrant-receiving countries are developing preferential immigration policies which favour immigration of high-skill workers with respect to low-skill workers. At the same time, legal migration flows are declining. Indeed, the majority of migrant workers occupy semi-skilled or unskilled positions, often under illegal conditions (ILO [1999]).

The first fact suggests that net immigration may help to balance the ageing in OECD countries (OECD [1998b]) and to lessen the budgetary problems of public retirement schemes: if migrants enter the recipient country when they are in working age and if they supply labour in the formal market, they increase the contributory base and reduce the elderly dependency ratio. However, migrants are not only young but also unskilled: they alter the labour force composition increasing the share of unskilled workers in the total working population. Lately, there has been a growing concern on the possibility that the inflow of low qualified workers depresses the relative wage and/or it increases the unemployment rate of unskilled labour. If this happens, the change in the skill composition can have labour market implications which make the relationship between migration and social security less clear-cut.

2.2 Migration as a demographic phenomenon

All the existing literature on the relationship between migration and social security accounts for the fact that migrants are young and add to the resident workforce. It also takes into account that migrants are mainly unskilled. However, in most of the (few) existing models the change in the skill composition bears no consequence because wages are fixed by assumption⁴. The labour market implications of the arrival of unskilled migrants are

²These facts provide a justification for treating migration as exogenous and independent of changes in destination countries' wages.
³In 1996 the 80% of entries of temporary workers in the US were qualified as skilled workers.
⁴Razin and Sadka (1998 and 1999b) and Storesletten (1999) share this assumption. Razin and Sadka model a two-period OLG economy with linear technology in order to address the effect of migration on
Therefore assumed away: migrants only increase the size of the population in the recipient country\(^5\). In Razin and Sadka (1998 and 1999b) for instance, a one-period migration increases the number of contributors to the pay-as-you-go scheme: the old residents at the time of migration are better off because the pie to be divided among them is larger if more agents contribute to the system, disregarding their ability level. The young residents at the time of migration are unaffected because their wages and their contribution rates do not change. The possibility of further migration is excluded and therefore future generations are not affected, because the effects of migration are over in one period. In this framework migration is always Pareto-improving and therefore the inflow, even of unskilled workers, should not be opposed, at least on economic grounds.

As long as we only consider the demographic impact of migration, the latter is certainly a resource for strained public retirement systems. However, excluding the labour market impact of migration may be a serious limitation to the validity of the policy conclusions.

### 2.3 Unskilled migration and labour market outcomes

The standard relation used to analyse the impact of the inflow of low-qualified workers on relative wages is the following (Johnson [1997]):

\[
\frac{\xi}{z} = \frac{1}{\eta A} i \frac{H}{L} \eta
\]

where \(z\) is the wage premium (the relative wage of skilled to unskilled workers), \(A\) is the relative demand of skilled to unskilled labour, \(H/L\) is the relative supply of skilled to unskilled workers and \(\eta\) is the elasticity of substitution between the two types of labour.

For the last two decades, \(\xi/z\) has been positive in most OECD countries and in particular in the US. In Continental Europe, across group inequality \(z\) has been lower, but the changes in relative demand and supply of skills seems to have affected relative employment (Gottschalk [1997]).

International immigration of unskilled workers is a natural candidate to explain increasing across group wage inequality (or employment rate differentials, if the labour market is not competitive): international immigration from less developed to developed countries corresponds to a decrease in \(\frac{H}{L}\). Due to the arrival of relatively more unskilled migrants \(\frac{\xi}{z} \frac{H}{L} < 0\) and, coeteris paribus, \(\frac{\xi}{z} > 0\) - i.e. for given relative demand of workers the sustainability of social security. Storesletten studies how immigration can help solving scalar problems associated with population ageing using a calibrated general equilibrium OLG model where migration does not affect the wage premium.

\(^5\) This is what we mean by describing migration as a demographic phenomenon.
(A constant) the wage premium $z$ increases. If migration has an impact on the wage premium, the conclusions of the models describing migration essentially as a demographic phenomenon with no influence on wages need to be reconsidered.

2.3.1 Variable wages and fixed wage premium

Razin and Sadka (1999a) partly meet the "fixed wage" objection investigating the case of variable factor prices: the arrival of migrants not only increases the active population but it also lowers workers' marginal productivity via a decrease in $k$. If capital movements are not enough to offset the change in $k$, wages before and after migration are different and the spread between the two depends on how big the labour inflow is and how costly the capital movements are. Via simulations they show that migration can still be Pareto improving depending upon the value of the elasticity of substitution in the production function between capital and labour.

Though this extension introduces a link between migration and labour market outcomes, their assumption that unskilled wages are a fixed and exogenous fraction of skilled wages has some undesirable implications:rst, it does not allow to account for the observed changes in the wage premium mentioned above. Second, skilled and unskilled agents have the same preferences over migration and the latter never generates intragenerational redistribution. Both implications seem rather implausible. Unskilled workers are believed to be more subject to migrants' competition and it is therefore highly likely that their attitude towards migration differs from the skilled agents' one. If wages are fixed and there is a social security system, we have seen that unexpected one period migration causes intergenerational redistribution from migrants to the old residents. If wages are flexible and the wage premium is fixed, we also observe redistribution between migrants and young residents. Migration does not give rise to any intragenerational conflict related to a change in across group inequality. If one believes that the latter is an important effect of migration, variable prices and a fixed wage premium are not the appropriate assumptions. We need to go a step further and reconsider equation (1).

2.3.2 Variable wages and variable wage premium: the role of education

LaLond and Topel (1997) survey the existing evidence on the impact of migrants on the receiving country's labour market. They find a relatively small impact on unskilled wages: higher immigration modestly lowers the wages of more recent immigration cohorts, but it

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6 Barriers to capital movements are not explicitly modelled.

7 In the models surveyed, if wages are fixed and there is no social security, migration does not generate any redistributive flows.
has little effect on other groups, including young natives. A number of country studies confirm this result and extend it to the skill composition of unemployment: among others, Winter-Ebmer and Zweimuller (1999) and Venturini (1999).

Though the impact of immigration on the unskilled wage is not large, the assumption that wages do not respond at all to migration is still not appropriate. Rather, the low effect of immigration on unskilled workers' wages seems to be the result of a reallocation process started by migration itself. Some authors explain it by means of the geographical mobility of natives: native unskilled workers move away from areas of more intense immigration, spreading the effects on wages across the nationwide labour market. Topel (1997) presents some empirical evidence showing that this mechanism has worked for instance in the US.

In this paper we suggest an alternative reallocation process. The idea is that while immigration affects the skill composition of labour supply and lowers $H_L$, a price effect works in the opposite direction. Indeed, the skill supply is not independent of the relative wage which in our formulation will not be fixed. The increase in the skill premium $\frac{\partial \pi_z}{\partial z} > 0$ induces more people to invest in education and $H_L$ increases. The endogenous response of the skill supply to movements in the relative wage reduces the effect of migration on $z$.

This explanation is supported by empirical studies: Topel (1997) reports evidence of a positive relation between returns to schooling and college enrollments. Looking at both Sweden and the US one finds a striking positive relationship between the returns to skills and the decision to invest in education.

The focus on the skill composition should not obscure the importance of the sectorial composition of migration flows. Immigrant workers and native workers tend to concentrate in different industries (Winkelmann and Zimmermann (1992)). The former are also more likely to be employed in the informal economy. The asymmetric distribution of migrant and native workers across sectors affects their relative wages and may have implications similar to the ones determined by the differences in the skill composition we are going to study in this paper.

3 The model

Our theoretical model has the following main features:

- it allows for the presence of skilled and unskilled workers and for the relative wage to change in response to migration;
it endogenises the labour force skill composition, making the education choice dependent on migration via the effect the latter has on the wage gap across skill categories. The decision to invest in education is independent of migration in Razin and Sadka and - to the best of our knowledge - in any other existing model.\(^{10}\)

These extensions allow us:

\(^2\) to reconsider the results of the existing literature on the relationship between migration and social security when the labour market impact is explicitly taken into account.

\(^2\) to combine the implications of the intragenerational redistribution generated by a social security system operating as a demogrant programme and the intragenerational redistribution associated to migration.

Both social security and migration have a redistributive impact. They divide the population in groups of contributors and beneficiaries. In a steady state situation, if social security operates as a demogrant system\(^{11}\), it redistributes resources within a generation from skilled to unskilled workers, granting the former a higher return on contributions. Migration, on the contrary, increases the wage premium in our model, redistributing resources from unskilled to skilled agents. These divergent effects suggest that the relationship between migration and pension policies goes beyond the financial sustainability issue and it involves intragenerational conflicts which need to be analysed carefully.

3.1 The analytical framework

We consider a two period OLG model of a small open economy. Capital is perfectly mobile so that the interest rate is given at the world level \(r\). The resident labour force is immobile whilst international workers migrate, increasing the labour input in the recipient country. Migration takes place once at time \(t\) and it is unexpected. The old residents at time \(t\) cannot change the choices made when young. The young residents at time \(t\) maximise their objective function taking migration into account. At time \(t + 1\) we distinguish between two scenarios according to the migrants’/recipient country’s behaviour: in the first one we observe a complete assimilation of migrants who have the same rights as residents (assimilation scenario). In the second one, migrants return to their country when old together with their offspring (return migration scenario).

\(^{10}\) Canova and Ravn (1997) focus on questions close to ours and use a calibrated real business cycle model to analyse the macroeconomic effects of an unexpected migration when alternative redistributive schemes operate in the economy. In their model wages and the wage premium can vary but the number of skilled workers is exogenous to the model.

\(^{11}\) This is the assumption made by Razin and Sadka in all the versions of their model.
3.2 Education

When young, residents can either invest in education and work as skilled workers (type H agents) or they can work as unskilled workers (type L agents). Investing in education requires the payment of an idiosyncratic cost $c_j$, distributed on the interval $0; c_{\text{Max}}$ with density function $g(\phi)$. We assume that capital markets are perfect: agents who invest in education at the beginning of their youth borrow at the market interest rate $r$ and repay their debt out of their second period income. If the agents decide to bear the investment cost, they all acquire the same level of human capital and supply inelastically one unit of skilled labour. When old, agents retire and finance their second period consumption with their savings and pensions.

The recipient country operates a balanced pay-as-you-go pension scheme: it collects contributions proportional to income at a rate $\zeta$ and it pays benefits $p$ in the form of a demogrant, i.e. the amount of the pension does not depend on the agents' skill level. Both residents and migrants have access to the social security scheme. They may differ in the degree of appropriability of benefits.

Residents decide how much to consume and save solving the following maximisation problem:

$$\max U(x^j_t; x^j_{t+1}) $$
$$s.t.$$  
$$x^j_t + \frac{x^j_{t+1}}{1+r} = !^j_t + \frac{p^{t+1}}{1+r} \tag{2}$$

$x^j_t$ represents consumption at time $t$ of agent $j$; $!^j_t$ is the net income earned at time $t$ and it is equal to:

$$!^j_t = \begin{cases} 
    b_j \cdot (1 - \zeta) & \text{if } j \in H \\
    0 & \text{if } j \in L
\end{cases}$$

12 Given the assumption of perfect capital markets, the timing of the debt repayment does not affect the agent's lifetime resources.

13 It is common to interpret the idiosyncratic cost $c_j$ as a measure of an agent's ability affecting his effective labour supply. We here take a different approach and assume that the investment cost does not affect the effective labour supply but it only reduces the amount of resources available for consumption to each agent. Though people may be characterised by different costs of investing in human capital, once they have made the investment, the "quality" of the investment itself is no longer affected by the initial investment cost characterising the agent. If an agent invests in human capital, he acquires a skill to perform a task he would not be able to perform without investing in education.
where $b = \frac{1}{2} (1 - \xi)$ is the net of payroll tax income of a skilled worker and $w = w(1 - \xi)$ is the net of payroll tax wage of an unskilled worker. $\theta$ $2 [0; 1]$ denotes the degree of deductibility of the cost of education.

From the solution to the above problem we can derive the indirect utility functions $V (i; p; r)$ whose maximisation determines the decision to invest in human capital: notice that $i$ is the only variable relevant for this choice because the pension received does not depend on the skill level and therefore it does not enter the investment in human capital decision$^{14}$. It is convenient to invest in human capital if $\theta > i$. The last agent who finds protable to invest is characterised by an education cost $e$ satisfying the following condition:

\[ b \equiv w (1 - \theta) \]  

Rearranging terms, the cut off level of costs is:

\[ e = \frac{b \equiv w}{1 - \theta} \]  

If there is no deductibility ($\theta = 0$), the cut off level of costs reduces to:

\[ c^0 = b \equiv w \]  

If there is full deductibility ($\theta = 1$); equation (4) becomes:

\[ c^0 = \frac{1}{2} w \]  

We focus here on the most unfavourable case in terms of incentives to invest in human capital, namely the case of no deductibility$^{15}$. Using $c^0$, the equilibrium share of the total population investing in education is$^{16}$:

\[ \text{...} \]
\[ e^a = 4 \int_0^\infty g(c) dc^5 \] (7)

In order to determine \( \lambda \) and \( w \) we introduce production.

### 3.3 Production

Production in a firm requires unskilled labour and one skilled worker, an entrepreneur who runs his own firm and earns gross profits \( \lambda \). The production function is:

\[ Y_j = H_j L_j \] (8)

where \( Y_j \) is production in the firm run by agent \( j \); \( H_j \) is the level of human capital of the skilled agent \( j \) and \( H_j = H \); \( L_j \) is the unskilled labour input and \( \bar{e} < 1 \). Firms/entrepreneurs act competitively. Given the wage \( w \) of an unskilled worker employed in firm \( j \), firm \( j \)'s (unskilled) labour demand is:

\[ L_j^D = \frac{\mu - H_j}{w} \] (9)

We sum \( L_j^D \) over the number of firms and get the aggregate demand for unskilled labour:

\[ L^D = \frac{\mu - H}{w} \bar{e} N \] (10)

where \( \bar{e} = \int_0^\infty g(c) dc \) is the share of the total resident population \( N \) investing in education, still to be determined. Given \( \bar{e} \), the unskilled labour supply is:

\[ L^S = (1 - \bar{e}) N + M \] (11)

i.e. the number of unskilled residents plus the \( M \) immigrants, who, by assumption, have no access to the educational system\(^{18}\).

\(^{17}\)In (8) we are assuming: i) that each firm needs only one skilled worker to be run; ii) that the skilled worker is the owner of the firm. Neither of the assumptions is essential for the results of the paper. In particular, nothing would change if we had one representative competitive firm, hiring labour services and combining skilled labour and unskilled labour through a Cobb-Douglas technology.

\(^{18}\)This could be justifiably assumed that migrants arrive at an age when they can no longer invest in education in the recipient country and at the same time the investment in education they may have made in their home country is not recognised in the recipient country. If migrants can invest in education once they enter the recipient country, their impact should be analysed as an increase in the population size.
By the zero profit condition, the reward $\frac{1}{2}$ for the skilled agent running $..r_m \ j$ exhausts $..r_m \ j$’s product:

$$\frac{1}{2} = Y_j \ wL_j = aw^i \ \bar{w}$$  \hspace{1cm} (12)

where $a$ is a constant. Given the exhaustion of product holds for every $j$, we have $\frac{1}{2} = \frac{1}{4}$.

We define the skill premium $z$ as the ratio between the skilled and the unskilled wage:

$$z = \frac{1}{4} w = aw^i \ \bar{w}$$  \hspace{1cm} (13)

From (13) we know that an increase in the wage of unskilled workers reduces the skill premium. From (5) the cut off level of the education cost must decrease when the unskilled wage increases given that $\frac{dc_n}{dw} < 0$. Hence the higher $w$, the smaller the share $e$ of the total resident population investing in education.

### 3.4 Equilibrium

Consider the equilibrium in the labour market at time $t$.

Substituting (7) into (10) and (11) and imposing the equilibrium in the unskilled labour market the competitive wage $w$ is determined:

$$\frac{\mu - H}{w} \frac{\bar{w}}{1} = \frac{2Z}{4} g(c,c_5) N = \frac{2Z}{4} g(c,c_5) N + M$$  \hspace{1cm} (14)

Equation (5) and (14) jointly determine the equilibrium wage and the equilibrium share of skilled population $e^\mu$.

Dividing both sides by $N$ and indicating by $m = \frac{M}{N}$ the share of migrants on the total resident population we get:

$$1 + \frac{\mu - H}{w} \frac{\bar{w}}{1} \ # \ G(c^\mu) = 1 + m$$  \hspace{1cm} (15)

Consider now the equilibrium condition at time $t + 1$. In the assimilation scenario we have:

$$1 + \frac{\mu - H}{w} \frac{\bar{w}}{1} \ # \ G(c^\mu) = 1$$  \hspace{1cm} (16)

Assimilation implies that the immigrants’ offspring have the same preferences, distribution of costs and fertility behaviour of the offspring of those who were native born at
time $t$. When migrants are assimilated to residents, migration increases the size of the native born population at time $t+1$ from $N$ to $N+M$. Equation (16) holds also for the return migration case. The size of the total resident population at time $t+1$ is in this case $N$, as it was before migration took place.

3.5 Results

3.5.1 The effects of migration

Rearranging (15); the equilibrium condition is represented in Figure 1. The $G(c^\alpha)$ curve is equal to 1 when $w$ is equal to 0 and then falls, reaching 0 when $w = \frac{1}{\alpha}$. When the education choice does not depend on migration, $G(c^\alpha)$ reduces to an horizontal line going through $e^\alpha$. The curve -we indicate it by $\hat{\alpha}$ - starts at the origin and then rises to approach $(1 + m)$ asymptotically. There is clearly a single intersection at $w^\alpha$ and $e^\alpha$; which represent, respectively, the equilibrium wage and the equilibrium share of skilled population before migration occurs, as Figure 1 shows.

[Figure 1 here]

If the number of skilled workers is independent of immigration, i.e. if $e^\alpha$ is constant, the immigration of unskilled workers shifts the $\hat{\alpha}$ curve upwards to $\hat{\alpha} 1$ but it does not affect $e^\alpha$: the equilibrium unskilled wage decreases to $w$. Indeed, for fixed $e^\alpha$:

$$\frac{dw}{dm}_{e=e^\alpha} = \frac{1}{\alpha w}\left[\frac{1}{\bar{H}w} - e^\alpha\right] < 0$$

(17)

where $\alpha$ is a constant. Given that the skilled wage is a decreasing function of the unskilled wage, skilled agents are positively affected by migration while unskilled agents are worse off. Focusing on the resident population, migration causes redistributive effects which increase across-group inequality.

We have already noticed that empirical work finds surprisingly small effects of immigration on wages (and employment), lower than those implied by (17). We suggest the following explanation for these empirical findings: the arrival of new unskilled workers lowers $w$ and, at the same time, it induces a shift of native workers from the unskilled to the skilled labour sector. Migration has therefore two effects: it changes the skill premium and it increases the number of skilled agents in the economy. The former effect is present also if migration does not affect the education choice, but the size of the change in the skill premium is different; the latter strictly depends on the endogeneity of $e^\alpha$ with respect to $m$. Notice that the crucial feature is that migration gives the residents an incentive to move towards areas of the economy where migrants' competition is less strong. Here
we focus on the educational choice and on the unskilled/skilled occupational shift as an onsetting force to the competition of unskilled immigrants. Mobility across sectors or across regions can work in the same direction and therefore deliver similar results. We now analyse these two effects in more detail.

The decrease in the unskilled wage caused by immigration implies an increase in the wage premium and it induces more people to invest in education. The increase in $e$ in turns pushes the wage of unskilled workers up, partially onsetting the reduction of $w$. Indeed, substituting $c^i$ in (15) we have:

$$1 + \frac{\mu - H}{w} G(1_i) \frac{aw}{1} w = 1 + m$$

By implicitly differentiating (18), we find that

$$\frac{dw}{dm} = i \frac{1}{w^{i - e^i} + [f(w)] G^0(c^i)}$$

where $[f(w)]$ is a non-negative function of $w$. Immigration lowers unskilled workers' wage $\frac{dw}{dm} < 0$ but the change in educational choices induced by migration partially counter-balances this effect. Indeed, for $G^0(c^i)$ different from zero:

$$\frac{dw}{dm} \bigg|_{e^i = e^i} > \frac{dw}{dm}$$

In Figure 2, we represent the impact of immigration both on $\bar{e}$ and on $G(c^i)$: $G(c^i)$ shifts to the right and the new equilibrium $(w_1; e_1)$ is characterised by a lower wage and a higher share of skilled population. As in the case where $e^i$ is fixed, migration increases the skilled wage and it decreases the unskilled wage. However, the reduction in the unskilled wage generated by migration is less strong than the one we observe when the decision to invest in human capital is independent of migration - i.e. $w_1 > w^2$; $w^2$, therefore the redistribution of resources and the change in the across-group inequality is lower when $e$ adjusts to migration.

[Figure 2 here]

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Figure 2 also allows to analyse the impact of changing the payroll tax rate, i.e. the size of the pay-as-you-go program. Since we are assuming no deductibility, (5) holds and a rise in $\bar{e}$ shifts the $G(c^i)$ curve to the left. This causes both the equilibrium unskilled wage and the equilibrium share of skilled population to fall.
3.5.2 The preferences over migration

Based on the results established so far, migration is a positive shock for skilled workers whilst it is a burden for unskilled workers: the first would be in favour of migration whilst the latter would oppose it. In order to analyse the preferences of residents over migration it is not enough to focus on the agents who are skilled (unskilled) both before and after migration. When \( e^\phi \) is a function of \( m \) we observe an additional effect of migration: increasing the number of skilled workers in the economy, it creates additional interest groups. The total resident population can in fact be divided in three groups: the skilled agents \( H \), the unskilled agents \( L \) and the "otherwise unskilled" skilled agents \( H^M \); this last group identifies those agents who invest in human capital only under migration. We focus on the impact that migration has on them in order to have a complete picture of the preferences of residents over migration.

Assuming that migration takes place at time \( t \), consider the agent whose cost of education corresponds to the cut off under migration \( c^*_{i,1} \). We want to see whether he is better off having migration and becoming skilled rather than not having migration and remaining unskilled. We find the following:

\[
\frac{b_{t,1} - c^*_{i,1}}{b_{t+1} - c^*_{i,1}} > \frac{b_{t+1} - c^*_{i,1}}{b_{t+1} - c^*_{i,1}}
\]

(19)

Given that migration decreases the unskilled wage \( b_{t+1} < b_{t} \), the last agent who is able to invest in education at \( t \) when migration takes place is worse off under migration: his unskilled wage \( b_{t+1} \) would have been higher than the skilled wage he now earns, once the costs of education are paid. His lifetime income is higher being an unskilled agent and having no migration rather than being a skilled agent under migration.

Consider now the agent whose cost of education corresponds to the cut off \( c^*_{i,1} \) when no migration takes place. We have:

\[
b_{t+1} + c^*_{i,1} = b_{t,1} < b_{t+1} = b_{t+1} + c^*_{i,1}
\]

(20)

which can be rewritten as:

\[
b_{t,1} < b_{t+1} - c^*_{i,1}
\]

(21)

\(^{20}\)Equation (19) and (20) hold only in the assimilation scenario: in this case the comparison between lifetime incomes at different times is independent of pensions and therefore it reduces to a comparison between first period wages. In the return migration scenario the pension benefit plays a role. We go back to this point at the end of Section 3.6.2.
This agent is therefore better off having migration and becoming skilled rather than remaining unskilled and having no migrants in the country. Given that all the functions are continuous, we can identify the level of the cost of investing in human capital $\beta$, which makes an agent indifferent between having migration and becoming skilled or not having migration and remaining unskilled:

$$b_i \beta = w_{1i}$$  \hspace{1cm} (22)$$

[Figure 3 here]

Define now $\gamma$ as the fraction of "otherwise unskilled" skilled agents who are better off under migration:

$$\gamma = \frac{R_{\beta}}{R_{c_{1t}}} \frac{g(c)dc}{R_{c_{1t}} \frac{g(c)dc}{}}$$

For the remaining $(1 - \gamma)$, though they become skilled, migration is a burden. Within this group there are therefore two types of agents having conflicting interests and therefore different attitudes towards migration. A share $\gamma H^M$ benefits from migration and forms a coalition with $H$ to sustain migration while the remaining share $(1 - \gamma)H^M$ is worse off under migration and forms a coalition with $L$ to oppose it.

The results obtained in this section show that migration not only redistributes resources from residents to migrants, as the existing literature shows. It also gives rise to redistributive flows among different groups in the young resident population. Migration makes a share of the young population richer and the other share poorer. Preferences over migration are differentiated according not only to the skill level (skilled versus unskilled) but also to the cost of education: high cost skilled agents have the same preferences on migration as unskilled agents. The distribution of education costs is therefore a crucial determinant of the interest groups dimension.

The young are not the only ones whose preferences are relevant for the decision to open the country to international migration. Also the preferences of the old at time $t$ need to be taken into account. Notice that their wages are fixed at the time of migration. To determine their attitude towards migration we have to analyse explicitly the impact of migration on pensions. This is pursued in Section 3.6.1.
3.5.3 The time path of wages and investment in human capital

At time $t$ migration decreases unskilled wages and it increases skilled wages and the fraction of the native population investing in human capital. Equation (16) tells us the behaviour of the same variables at time $t+1$. Given that $w$ is independent of the population size, it follows that at time $t+1$ all the variables go back to their pre-migration levels. This conclusion holds both in the assimilation and in the return migration scenario. Looking at the time paths of the main variables, we therefore observe:

\[
\begin{align*}
\epsilon_{it+1} & = \epsilon_{it} < \epsilon_{it} \\
w_{it+1} & = w_{t+1} > w_t \\
\gamma_{it+1} & = \gamma_{it+1} < \gamma_{it}
\end{align*}
\]  

The impact of migration on the relevant variables lasts only for one period.

3.6 Social security

In this section we first discuss the effects of migration on the social security budget constraint. We then analyse how the attitudes towards migration are affected by the explicit consideration of the redistributive role of the pension scheme and how the desirability of a redistributive social security system is weakened or strengthened by migration.

3.6.1 The sustainability analysis

We have to distinguish between the social security budget constraint holding at the time of migration and the social security budget constraint holding a period after migration (and for all the following periods).

Assuming that the population growth rate is zero, so that the population size can increase only as a consequence of unexpected migration, at time $t$ when migration flows enter the country we have:

\[
\begin{align*}
\int_0^{\frac{1}{4}} \epsilon_{it}^2 N \frac{6}{5} \gamma_{it}^3 & = c \epsilon_{it}(c) dc \frac{7}{9} + \epsilon_{it}^2 N w_t + M \gamma_{it} = p_t N
\end{align*}
\]  

The first term represents contributions paid by the skilled workers. The second and third terms represent respectively the unskilled and migrant workers' total contributions.
These are used to pay pensions to the resident old. Dividing by the total resident population size $N$ and reminding the assumption that $\epsilon = 0^{21}$, the social security budget constraint becomes:

$$
\epsilon \epsilon^t + \epsilon (1 - \epsilon^t) w_t + m \epsilon w_t = p_t
$$

(25)

Consider the budget constraint (25): a change in $m$ has a direct effect via the migrants' contributions and an indirect effect via $\epsilon^t$, $\frac{1}{2}$ and $w$. Assuming constant contributions, the impact of migration flows on the sustainability of social security can be analysed looking at what happens to per capita pensions $p$ at the time of migration. By totally differentiating equation (25) we find:

$$
\epsilon^t + \epsilon \frac{d\epsilon^t}{dm} [1/2 + w_t] + \epsilon \frac{dw_t}{dm} [m \epsilon^t] + \epsilon \frac{d\epsilon^t}{dm} w_t + \frac{d\epsilon^t}{dm} = \frac{dp_t}{dm}
$$

(26)

By inspection of (26) we can conclude that per capita pensions of the old at the time of migration increase - i.e. $\frac{dp_t}{dm} > 0$. This can also be interpreted as saying that migration increases the resources available in the social security scheme, i.e. it relaxes the budget constraint. Moreover, introducing endogenous skill composition makes the impact of migration on the social security budget constraint even more favourable. Indeed, the term $\frac{d\epsilon^t}{dm} [1/2 + w_t]$ in (26) is always non negative. Given these results, we can observe that the old at time $t$ will be in favour of migration.

Consider now the budget constraint at time $t+1$: In the assimilation scenario migrants have the same rights as residents and therefore they receive the same pension. In the return migration scenario migrants go back to their country when old together with their offspring and they receive only a fraction $\lambda$ of the pension the residents get. These two frameworks can be used to study the implications of the adoption of an assimilation or an exploitation policy by the recipient country: the lower $\lambda$, the higher the exploitation is.

Starting from the assimilation scenario, the social security budget constraint is:

$$
\epsilon \epsilon^t_{t+1} (N + M) \epsilon^{1/2}_{t+1} + \epsilon (1 - \epsilon^t_{t+1})(N + M) w_{t+1} = p_{t+1} (N + M)
$$

(27)

Dividing by the total number of residents $(N + M)$ (we include the migrants' offspring in the resident population) we have:

\[21\] This assumption is maintained throughout this and the following sections.
\[
\zeta e_{t+1} + (1 - \zeta e_{t+1})w_{t+1} = p_{t+1}
\] (28)

Looking at (28) we notice that, under the assimilation policy, migration no longer affects social security sustainability at time \( t + 1 \). The young at the time of migration are affected by it only via wage changes and not via social security benefits. They receive the same pensions they would receive if migration had not taken place.

If there is return migration, (28) reads:

\[
\zeta e_{t+1} + (1 - \zeta e_{t+1})w_{t+1} = p_{t+1}^{RM} (1 + \theta m)
\] (29)

Migration affects the social security budget constraint also at time \( t + 1 \). Given (23), the amount of resources collected at time \( t + 1 \) coincides with that collected at time \( t + 1 \) but, as long as \( \theta \neq 0 \); the total benefits to be paid are higher. Therefore individual benefits must decrease if the system must be balanced. The following relationship between the pension benefits under assimilation and return migration holds:

\[
p_{t+1}^{RM} = \frac{p_{t+1}}{1 + \theta m}
\]

If there is return migration, the increase in pensions at time \( t \) comes at a cost in terms of lower benefits at time \( t + 1 \); unless migrants are totally expropriated of their previous period contributions, i.e. \( \theta = 0 \). As long as migrants cannot be totally expropriated of their benefits, an assimilation policy guarantees young residents at the time of migration higher pensions than an exploitation policy. Though return migration allows the government to reduce the amount of benefits the migrants are entitled to, it also reduces the number of contributors to the scheme: unless the benefits to be paid to migrants go down to zero, no exploitation policy can compensate for the loss of future contributions.

3.6.2 The redistribution analysis

Migration triggers complex redistributive flows. It gives rise to intergenerational redistribution: the young finance higher pensions to those who are old at the time of migration. Ignoring the social security scheme, we have already shown that migration has also an intragenerational redistributive impact: from unskilled and a fraction of "otherwise unskilled" skilled workers to skilled workers, the remaining fraction of "otherwise unskilled" skilled workers and migrants. The social security scheme managed as a demogrant program starts further intragenerational redistributive effects. Despite the return earned

20
on the contributions paid into the social security scheme by a young agent belonging to
group \( j \) at time \( t \).

\[
q^j_{t+1} = \frac{p^j_{t+1}}{\bar{\gamma}^j_{t+1}} \quad 1; j \in H
\]

\[
q^j_{t+1} = \frac{p^j_{t+1}}{\bar{\gamma}^j_{t+1}} \quad 1; j \in L
\]

We consider the no migration case. Using equation (28) to substitute for \( p^j_{t+1} \) in (30) and (31), it is easy to see that
\( g^H_{nm} < 0 \) and \( g^L_{nm} > 0 \). Unskilled workers are net beneftiaries of the pension scheme and earn a positive return on their contributions equal
to \( \bar{e}^j(1; e^j) \); skilled workers are net contributors and earn a negative return on their payroll tax equal to \( j(1; e^j) \). Though the redistributive pay-as-you-go scheme
places a cost on skilled agents to the benefit of unskilled agents, we assume that the degree
of solidarity built in the pension scheme when there is no migration is accepted by the
skilled residents.

We turn now to the case where we have migration and complete assimilation: given
that the skilled (unskilled) wage increases (decreases) while pensions are constant for the
young at the time of migration we still nd \( g^H_{m} < 0 \) and \( g^L_{m} > 0 \). Moreover, \( g^H_{m} > g^H_{nm} \) and \( g^L_{m} > g^L_{nm} \): The redistribution operated by the pension scheme increases: skilled agents
pay more owing to the increase in their wage but they receive the same pension; unskilled
agents pay less and receive the same pension. If the degree of solidarity built in the
system under no migration represents the maximum amount of redistribution the skilled
agents are willing to accept, migration affects their preferences on the pension scheme and
might give rise to an opposition to it. As long as migrants are assimilated, social security
does not affect the preferences of skilled agents over migration: they are in favour of it
because of its positive affects on wages and lifetime income. However, their preference
towards the adoption of a dierent pension scheme which rewards the education eort
more becomes stronger. On the other side, migration represents a burden on unskilled
agents because it decreases their lifetime income; however, the pension scheme partly
offsets the loss imposed by migration, that is, it operates here as a risk sharing device.
The decrease in wages, which decreases contributions, does not reduce pensions. The
redistributive social security scheme partly compensates them for the impact of migration.
Unskilled agents oppose migration: if the latter takes place, then it is better for them to
have a redistributive pension scheme. Skilled and unskilled agents not only have dierent
preferences on migration but also on pension schemes; migration polarises their dierences.
even more. Notice here the trade off between providing insurance against unexpected events of an agent’s life and linking pension to past contributions like defined contribution fully funded systems would require. In the absence of a redistributive pension scheme the impact of migration on unskilled agents would be more dramatic.

We now study the redistributive pattern in the return migration case. One can easily show that \( \bar{g}_{nm} < \bar{g}_{Hm} < \bar{g}_{rm} \). To this scenario is therefore associated the most redistributive pension scheme for skilled agents, i.e. the one granting the lowest (highest negative) return on contributions. Their opposition to the pay-as-you-go pension scheme peaks in this framework. If we look at unskilled residents, we have \( g_m > g_{nm} > g_{rm} \); this ordering says that, in case of migration, unskilled agents prefer a redistributive system only if there is assimilation. If there is return migration, not only the return they obtain is the lowest but it may also become negative. In fact, nothing guarantees that \( g_{rm} > 0 \): unskilled agent may even become net contributors and start earning a negative return. In this case, they would join the skilled group and put pressure on abandoning the pay-as-you-go system. The return migration scenario is the most unfavourable both for skilled and unskilled agents. Further to the findings obtained in the previous section on the comparison between assimilation and exploitation policies, this result shows that, contrary to a common perception, a policy based on allowing migration in the first period with the expectation of granting migrants lower benefits in the second period does not pay. Moreover, it can increase the opposition to the system migration should have saved.

We look now at the \( H^M \) group: in the absence of migration, these agents would all be unskilled and net beneficiaries of the pension scheme. Under migration, they all become skilled and net contributors; the return on contributions becomes negative and migration can therefore completely change their preferences on the pension scheme. Under no migration they support a redistributive pension scheme; under migration they oppose it. Notice that, if there is assimilation, for the \((1 - \gamma) H^M\) agents whose lifetime income is reduced by migration, the redistributive pension scheme amplifies the loss and it therefore strengthens the opposition to migration. These conclusions hold also in the return migration case. However, \( \gamma \) changes in this case because pensions received in the return migration case differ from those received in the absence of migration and therefore benefits enter the comparison between welfare under return migration and under no migration. Namely, it is easy to show that \( \gamma \) decreases, increasing the number of those who are worse off when migrants enter the country.
3.7 Changing the modelling of migration

One might wonder whether our modelling of migration captures the behaviour of international migration; or, if we look from the policy angle, whether there are no other migration policies a country could adopt which eliminate or remarkably reduce the intragenerational conflicts described above. There are two additional alternative ways of modelling migration one might want to consider in this framework: continuous migration, i.e. every period $M$ unskilled migrants enter the country and remain in the country with their offspring; return migration of the old and assimilation of the young. How are the results of the previous sections affected by the change in the migration features? In the case of continuous migration, equation (15) for the labour market equilibrium and equation (25) for the social security scheme hold not only at time $t$ but for all the following periods\(^\text{22}\). Looking at the time path of the relevant variables we find:

\[
\begin{align*}
    e_{t-1} &< e_t = e_{t+1} = e_{t+i} \\
    w_{t-1} &> w_t = w_{t+1} = w_{t+i} \\
    \frac{1}{\sigma_t} &< \frac{1}{\sigma_t} = \frac{1}{\sigma_{t+1}} = \frac{1}{\sigma_{t+i}}
\end{align*}
\]

Though migrants enter the country in each period, only first period migration affects the equilibrium prices and skill share in the recipient country. The same thing can be said of pensions: $p_{t-1} < p_t$ because of the arrival of the first group of migrants but $p_t = p_{t+1} = p_{t+i}$. Focusing on the young at time $t$, continuous migration grants all the resident groups a higher pension than the one they would get under the migration scenarios already discussed. This might mitigate the opposition of skilled workers to the pay-as-you-go scheme and the opposition of unskilled workers to migration. However, continuous migration would not substantially change the results a government could achieve with the assimilation policies described before. Continuous migration is not a substantially more powerful policy instrument.

If we consider return migration of the old and assimilation of the young, it is clear this is the most favourable migration policy instrument for residents: it allows exploitation of the old without having to give up the contributions of the young. It is also clear that, though this is the best scenario for residents, it does not make every resident better off and across group conflicts still persist.

\(^{22}\)Provided $m$ is red..ned to take into account the change in the size of the resident population.
4 Conclusions

The analysis developed in this paper highlights that migration alleviates the financial problems public retirement systems are going through. However, it also shows that it gives rise to serious redistributive conflicts exactly as other pension reform proposals like funding or privatisation do. Moreover, instead of strengthening the support to the existing pension scheme via the reduction in its solvency problems, migration can undermine it.

Notice that these results are found under the assumption that all migrants enter the formal labour market and pay contributions to the public retirement scheme. The existence of an informal economy where workers do not pay contributions and are not entitled to receive pensions raises other important issues not discussed here: if migrants work in the informal sector, we may still observe the labour market impact of migration. However, the implications on the social security system sustainability would change. The first period transfer to the old generation would not take place; if a social safety net is present, migrants may benefit from it thus increasing the expenditure on welfare.

International migration raises complex social policy questions: our stylised model highlights that, to answer pension issues, education and integration policies cannot be left out of the picture. Analysing international migration as a baby boom certainly has serious limitations.
References


