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Social Security and Migration with Endogenous Skill Upgrading*

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Abstract: The aim of the paper is to investigate the joint redistributive effects of migration and social security and to reassess the sustainability issue raised in the existing economic literature. The paper first develops a theoretical framework to analyze the impact of international migration on the labor market. The model allows for heterogeneity across native-born individuals and for migrants to affect both the wages and the education decision in the recipient country. It then explicitly focuses on the impact of social security under alternative migration scenarios. The analysis shows that migration causes redistributive effects that increase across-group wage inequality. However, the endogenous educational response by residents partially offsets the redistributive impact of migration while creating additional interest groups. Migration helps the financial sustainability of the social security scheme but the interaction between migration and social security causes complex inter- and intragenerational redistributive conflicts, which are analyzed in the paper.

Keywords: Pensions, Human Capital, International Migration.

JEL Classification: H55, J24, O15

1 Introduction

All major industrial countries are facing economic problems related to population aging. Declining birth rates and rising longevity have increased the elderly dependency ratio: according to OECD (1998b), 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 stabilize only in 2050 (Lutz 1996). The increase could be even faster if recent (falling) labor market participation trends continued. Though this process occurs at different rates and with different timing across OECD countries, on average their populations are the oldest in the world.

As the share of the elderly in the population of rich countries increases, the cost of paying for pensions and health benefits rises. It is feared that aging can have dramatic effects on government finances, boosting taxes and placing the government's ability to finance other expenditures at risk. These demographic trends call for policy reforms, notably 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 developed countries have considered radical reforms undertaken by some developing countries, which replaced part or all of their public systems with private pensions based on individual accounts. In addition, international migration, that is migration from less-developed countries, has been argued to be a mitigating factor for a low birth rate.[1] It is held that migration may have a positive impact on the financial soundness of pension systems and therefore help in overcoming their shortfalls (OECD 1998a and 1998b; Razin and Sadka 1998, 1999a and 1999b).

The aim of this paper is to develop a model which describes the interaction between migration and social security as well as analyzing the sustainability issue and the joint

[1] Though the use of immigration policies for demographic purposes may raise several problems and objections, as discussed in OECD (1998a), the latter reports that some countries already adopt explicit age-related selection criteria for some categories of immigrants.

redistributive impact of migration and social security. 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 labor market and initiating inter- and intragenerational transfers. These transfers in turn must be understood to assess costs and benefits of alternative migration and pension policies.

We concentrate on the recipient country and first develop a theoretical framework to investigate the impact of migration on residents' economic decisions and welfare. We allow for heterogeneity across individuals and for migration to affect both the wages and the education decision in the recipient country. We next focus on how migration redistributes intragenerationally and derive implications for the residents' reactions to migration. We then explicitly focus on social security and analyze the effects of migration on its sustainability: we evaluate whether migration policies complement direct social security reforms. We finally study how migration affects the return generated by the social security scheme to each resident group.

The paper is organized as follows: Section 2 presents some facts on international migration and reports how the current literature depicts migration and social security issues; Section 3 introduces and develops the theoretical model, and Section 4 reports on conclusions.

2. Migration, labor market outcomes and social security

For the last decade, international migration has been an important source of population growth in most OECD countries and has been the major source in the European Union (OECD 1998a). The 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, labor-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) and 262.5 thousand Germany. The foreign and foreign-

born labor force is an important percentage of the total working population in most OECD countries.

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

- On average, the age structure of immigrants is younger than that of the native population. This suggests that immigration may help to alleviate aging in OECD countries (OECD 1998b) and to lessen the budgetary problems of public retirement schemes if migrants enter at working age.
- A large share of migrants are low skilled and therefore they alter the labor force composition increasing the number of unskilled workers in the total working population.[2] Lately, there has been a growing concern about the possibility that the inflow of less qualified workers depresses the relative wage and/or it increases the unemployment rate of unskilled labor. If this happens, the change in the skill composition can have labor market implications which are relevant for the analysis of the relationship between migration and social security.
- Migration flows do not seem to be influenced by business-cycle conditions of destination areas; rather, they are affected by long-run income and unemployment differentials between less-developed and destination countries.[3] These facts provide a justification for treating migration as exogenous and independent of changes into destination countries' wages.

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 does not play a crucial role either because *wages are fixed* by assumption or because wages are variable but the *wage premium is fixed*.

[2] Recent trends show an increase in migration of highly qualified temporary workers with respect to unskilled labor: for instance, in 1996 the 80% of US entries of temporary workers – a small fraction of total in movement – were qualified as skilled workers. However, these data need to be viewed with caution. Indeed, official statistics fail to report illegal immigration: this makes it difficult to quantify 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 favor 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).

[3] 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 France (OECD 1998a).

2.1 Fixed wages

If wages are fixed (Razin and Sadka 1998 and 1999b), the labor market implications of the arrival of unskilled migrants are assumed away and migrants only increase *the size of the population* in the recipient country. 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. If migrants only increase the size of the population, they are certainly a resource for strained public retirement systems. However, excluding the labor market impact of migration may be a serious limitation to the validity of the policy conclusions.

2.2 Variable wages and fixed wage premium

Although the assumption of variable wages and fixed wage premium introduces a link between migration and labor market outcomes (Razin and Sadka 1999a; Storesletten 2000), it has an undesirable implication: migration has the same effect both on skilled and unskilled agents and it never causes intragenerational redistribution.[4] However, unskilled workers are more subjected to competition and it is therefore highly likely that their attitude towards migration differs from that of the skilled agents.[5] If one believes that intragenerational conflicts related to changes in across-group inequality are an important effect of migration, variable wages and fixed wage premium are not the appropriate assumptions.

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

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

(1.)
$$\frac{\Delta z}{z} = \frac{1}{\sigma}\left[\frac{\Delta A}{A} - \frac{\Delta \frac{H}{L}}{\frac{H}{L}}\right]$$

[4] In a model where intragenerational redistribution is excluded by assumption, Razin and Sadka (1999a) show via simulations that migration can still be Pareto-improving depending upon the value of the elasticity of substitution between capital and labor in the production function.

[5] Eurobarometer (1997) reports that the degree of declared racism differs across educational groups and that the highest degree of racism is observed at an intermediate level of education (end of studies between 16 and 19).

where z is the wage premium (the relative wage of skilled to unskilled workers), A is the relative demand of skilled to unskilled labor, $\frac{H}{L}$ is the relative supply of skilled to unskilled workers and σ is the elasticity of substitution between the two types of labor.

For the last two decades, Δz has been positive in most OECD countries and in particular in the US. In Continental Europe, changes in across-group inequality z have been lower, but changes in relative demand and supply of skills seem 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 rates differentials, if the labor market is not competitive). Due to the arrival of relatively more unskilled migrants $\Delta\frac{H}{L}\Big/\frac{H}{L} < 0$ and, *ceteris paribus*, $\frac{\Delta z}{z} > 0$ - i.e. for given relative demand of workers (A constant) the wage premium z increases. LaLonde and Topel (1997) survey the existing evidence on the impact of migrants on the receiving country's labor market. They find a relatively small impact on the wages of unskilled workers in the US where higher immigration modestly lowers the wages of more recent immigration cohorts, but it has little effect on other groups, including young natives.[6] A number of European country studies confirms this result (Winter-Ebmer and Zweimuller 1999; 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 labor market. Topel (1997) presents some empirical evidence showing that this mechanism has worked in the US. Other authors focus on the sectorial composition: immigrant and native workers tend to concentrate in

different industries (Winkelman and Zimmermann 1992), with immigrants more likely to be employed in the informal economy. Both explanations highlight that there is an endogenous reaction of the unskilled residents to migrant labor force competition.

In this paper we suggest a further endogenous reallocation process taking place via the education decision.[7] Migration affects the skill composition of the labor supply and it lowers $\frac{H}{L}$, but it also triggers a price effect which works in the opposite direction. Indeed, the skill supply is not independent of the relative wage, which in our formulation is not fixed. The increase in the skill premium ($\frac{\Delta z}{z} > 0$) induces more people to invest in education and it drives $\frac{H}{L}$ up. Topel (1997) reports evidence of a positive relation between returns to schooling and college enrollments. Looking at both Sweden and the US he finds a striking positive relationship between the returns to skills and the decision to invest in education. The endogenous response of the skill supply to movements in the relative wage reduces the effect of migration on *z*. To succinctly capture this reallocation process we assume that it is instantaneous and involves only two educational levels.[8]

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 endogenizes the labor force skill composition, making the education choice dependent on migration via the effect the latter has on the wage gap across skill categories.

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[6] See Borjas (1994) and Zimmermann (1995).

[7] To the best of our knowledge, the decision to invest in education is independent of migration in all the existing literature on migration and social security. Canova and Ravn (1997) focus on questions close to ours and use a calibrated real business-cycle model to analyze 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.

[8] We are, however, aware that this skill upgrading process may take time, i.e. generations, to show up and it may be obscured by the existence of an array of (formal and informal) educational attainments.

These extensions allow us to reconsider the results of the existing literature on the relationship between migration and social security when the labor market impact is explicitly taken into account and to combine the implications of the intragenerational redistribution generated by a pension system and that associated to migration.

We consider a two period overlapping generations model (OLG) of a small (developed) open economy. Capital is perfectly mobile within the industrialized world but it does not flow to less-developed countries.[9] The interest rate is given at the level *r*. The resident labor force is immobile whilst international workers migrate from less-developed countries, increasing the labor input in the recipient country. We assume a zero population growth rate so that population can only increase via immigration, which takes place *once* at time *t* and is unexpected.[10] Furthermore, the old residents at time *t* cannot change the choices made when young. The young residents at time *t* maximize their objective function taking migration into account. At time *t+1* we distinguish between two scenarios according to the migrants'/recipient country's behavior. In the first, we observe a complete assimilation of migrants who have the same rights as residents (*assimilation* scenario). In the second, migrants return to their country with their offspring upon retirement (*return migration* scenario).[11]

3.1 Consumers

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 $[0, c^{Max}]$ with density function $g(\cdot)$. 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

[9] The assumption that capital does not flow towards less-developed countries is essential when dealing with international migration: if capital markets of less-developed and industrialized countries were perfectly integrated, people would never move, since capital flows would fully remove productivity differentials between the two areas.

[10] It will be clear as we proceed that none of the conclusions of the paper would change if migration were perfectly anticipated.

[11] In the last section we analyze further migration scenarios.

their second period income.[12] 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 labor.[13] When old, agents retire and finance their second period consumption out of their savings and pensions.

The recipient country operates a balanced pay-as-you-go pension scheme: it collects contributions proportional to income at a constant rate τ and it pays per capita lump-sum benefits p_t, so that the amount of the pension does not depend on the agents' skill level.[14] 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 maximization problem:

$$\begin{aligned} &\max U\left(x_t^j, x_{t+1}^j\right) \\ &s.t. \\ &x_t^j + \frac{x_{t+1}^j}{1+r} = \omega_t^j + \frac{p_{t+1}}{1+r} \end{aligned} \qquad (2.)$$

x_t^j represents consumption at time t of agent j; ω^j is the net wage earned at time t and it is equal to:

$$\omega^j = \begin{cases} \hat{\pi} - c^j & if \quad j \in H \\ \hat{w} & if \quad j \in L \end{cases}$$

[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 labor supply. We here take a different approach and assume that the investment cost is indeed a measure of an agent's ability, which does not affect the effective labor supply but it only reduces the amount of resources available for consumption to each agent.

[14] This assumption is made by Razin and Sadka in all the versions of their model. In general, real world pension systems are only partially redistributive. The pension benefit they pay can always be represented as a linear combination of a purely redistributive and a contribution-related component. Given the objectives of the paper, we focus only on the former and, as we go along, we highlight how the results of the model are affected if we explicitly take into account the contributory component.

where $\hat{\pi} = \pi(1-\tau)$ is the net of payroll tax wage of a skilled worker[15] and $\hat{w} = w(1-\tau)$ is the net of payroll tax wage of an unskilled worker.

From the solution to the above problem we can derive the indirect utility functions $V^j(\omega^j, p, r)$ whose maximization determines the decision to invest in human capital: notice that ω^j 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 human capital investment decision. It is convenient to invest in human capital if $\omega^H \geq \omega^L$. The last agent who finds profitable to invest is characterized by an education cost c^* satisfying the following condition:[16]

(3.) $$c^* = \hat{\pi} - \hat{w}$$

Using c^*, the equilibrium share of the resident population investing in education is:

(4.) $$e^* = \left[\int_0^{c^*} g(c)dc\right] = G(c^*)$$

In order to determine π and w we introduce production.

3.2 Production

The production function is Cobb-Douglas:

(5.) $$Y = H^{(1-\beta)}L^{\beta}$$

[15] Here we assume that the cost of education is non-deductible. The absence of deductibility is compatible with our formulation of the education costs. Agents receive their wage net of payroll contributions and use it to repay the loan. Had we assumed that the investment in human capital required time and therefore reduced the amount of time spent working, the assumption of full deductibility would have been more appropriate because education implies foregone earnings.

[16] If the pension system is partially redistributive, it is possible to show that the cut off level of costs is $\tilde{c} = (\pi - w)(1-\alpha\tau)$, where α is the weight attached to the redistributive component. The smaller the α, the higher the cut off level of cost and the larger the number of people investing in education.

where Y is the production in the representative firm; H and L are respectively the skilled and the unskilled labor inputs[17] and $0<\beta<1$. The skilled labor input is given by $H=eN$, where e is the share of the resident population N investing in education, still to be determined.

The representative firm acts competitively. Given the unskilled wage w, the aggregate demand for unskilled labor is:

(6.) $$L^D = \left(\frac{\beta}{w}\right)^{\frac{1}{1-\beta}} eN$$

Given e, the unskilled labor supply is:

(7.) $$L^S = (1-e)N + M$$

i.e. the number of unskilled residents plus the M immigrants, who, by assumption, have no access to the educational system. This could be justified assuming 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 recognized in the recipient country.[18]

Given w and substituting (6) in the expression for the marginal productivity of skilled labor, the competitive wage π of skilled agents and the skill premium z are:

(8.) $$\pi = aw^{-\frac{\beta}{1-\beta}}$$

[17] The idea here is that the two different types of workers do not simply differ in their relative productivity parameter but they have different jobs. 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. Topel (1999) lists a number of studies which reject the assumption of perfect substitutability of (adjusted for productivity differentials) workers with different skill levels.

[18] If migrants arrived at an age when they can still invest in education in the recipient country or if they had the same skill composition as residents, migration would only be a demographic phenomenon and its impact would be equivalent to an increase in the population size. The assumption that migrants have no access to the educational system allows us to explore the specificity of migration with respect to an increase in the population growth rate.

(9.) $$z = \frac{\pi}{w} = aw^{-\frac{1}{1-\beta}}$$

where a is a positive constant. Both π and z are negative functions of w.

3.3 Equilibrium

Consider the equilibrium in the labor market at time t. Substituting (4) into (6) and (7) and imposing the equilibrium in the unskilled labor market we obtain:

(10.) $$\left(\frac{\beta}{w}\right)^{\frac{1}{1-\beta}}\left[\int_0^{c^*} g(c)dc\right]N = \left[1-\int_0^{c^*} g(c)dc\right]N + M$$

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

(11.) $$\left[1+\left(\frac{\beta}{w}\right)^{\frac{1}{1-\beta}}\right]G(c^*) = 1+m$$

Equation (3) and (11) jointly determine the equilibrium wage and the equilibrium share of skilled population e^*. From (3), (8) and (11), the cut off level of the education cost must decrease when the unskilled wage increases given that $\frac{dc_j^*}{dw} < 0$. Hence the higher w, the smaller the share e of the total resident population investing in education.

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

(12.) $$\left[1+\left(\frac{\beta}{w}\right)^{\frac{1}{1-\beta}}\right]G(c^*) = 1$$

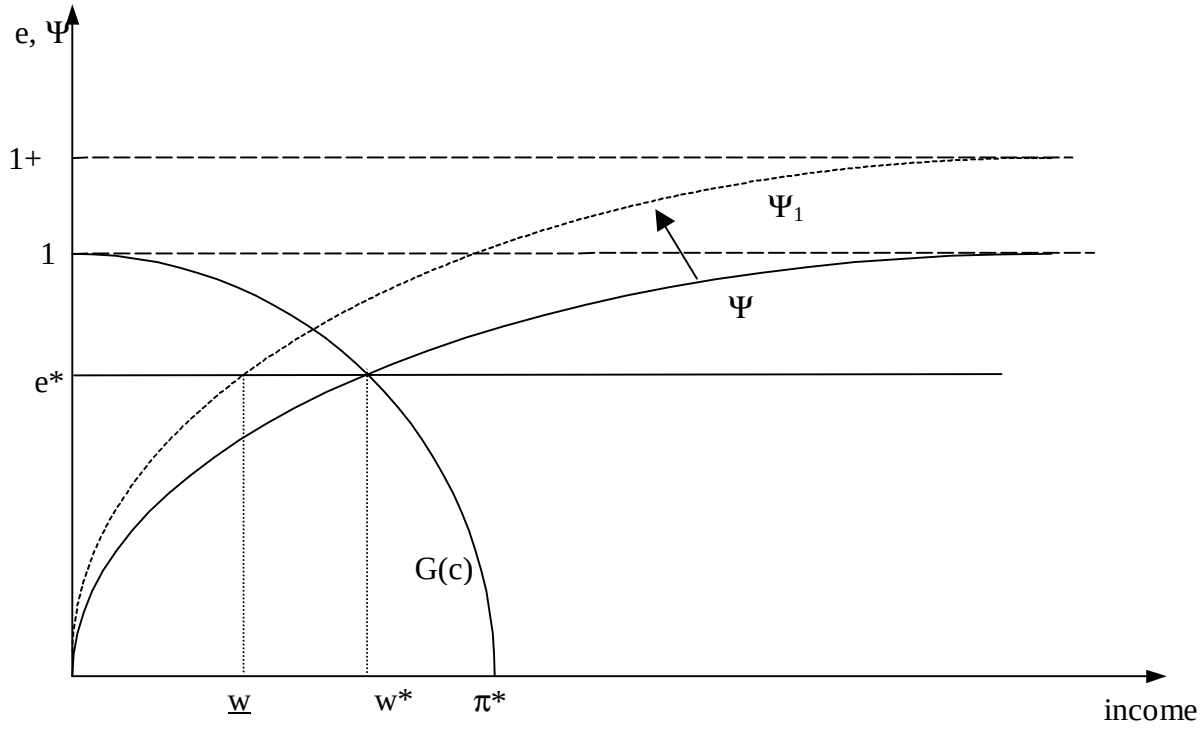
Assimilation implies that the immigrants' offspring have the same preferences, distribution of costs and fertility behavior as the offspring of the native born in time *t*. When migrants are assimilated to residents, migration increases the size of the native born population at time *t+1* from *N* to *N+M*. Equation (12) holds also for the *return migration* case. The size of the total resident population at time *t+1* is in this case just *N*, as it was before migration took place.

3.4 Results

3.4.1 Migration and intragenerational redistribution

Rearranging (11), the equilibrium condition is represented in Figure 1. The $G(c^*)$ curve is equal to 1 when w is equal to *0* and then falls, reaching *0* when $w=\pi$. When the education choice does not depend on migration, $G(c^*)$ reduces to a horizontal line passing through e^*. The $(1+m)\Big/\left[1+(\beta/w)^{\frac{1}{1-\beta}}\right]$ curve -we indicate it by Ψ- starts at the origin and then rises to approach $(1+m)$ asymptotically. When there is no migration, $m=0$ and Ψ approaches 1 asymptotically. There is clearly a single intersection between Ψ and $G(c^*)$ at w^* and e^*, which represent, respectively, the equilibrium unskilled wage and the equilibrium share of skilled population before migration occurs, as Figure 1 shows.

Figure 1: The impact of migration on wages/profits when the education choice does not depend on migration.



If the number of skilled workers is independent of migration, i.e. if e^* is constant, the arrival of unskilled workers shifts the Ψ curve upwards to Ψ_1 but it does not affect e^*: the equilibrium unskilled wage decreases to $\underline{w}$. Indeed, for fixed e^*:

(13.) $$\left.\frac{dw}{dm}\right|_{e^*=\bar{e}} = -\frac{1}{\Lambda w^{-\frac{2-\beta}{1-\beta}} e^*} < 0$$

where Λ 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 existing empirical work finds small effects of immigration on wages (and employment), lower than those implied by (13). 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 labor 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^* 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 offsetting force to the initial competition generated by unskilled immigrants. Mobility across sectors or across regions can work in the same direction and therefore deliver similar results. We now analyze these two effects in more detail.

The decrease in the unskilled wage caused by immigration implies an increase in the wage differential and it induces more people to invest in education. The increase in e^* in turns

pushes the wage of unskilled workers up, partially offsetting the reduction of *w*. Indeed, substituting c^* in (11) we have:

(14.) $$\left[1+\left(\frac{\beta}{w}\right)^{\frac{1}{1-\beta}}\right]G\left((1-\tau)\left(aw^{-\frac{\beta}{1-\beta}}-w\right)\right)=1+m$$

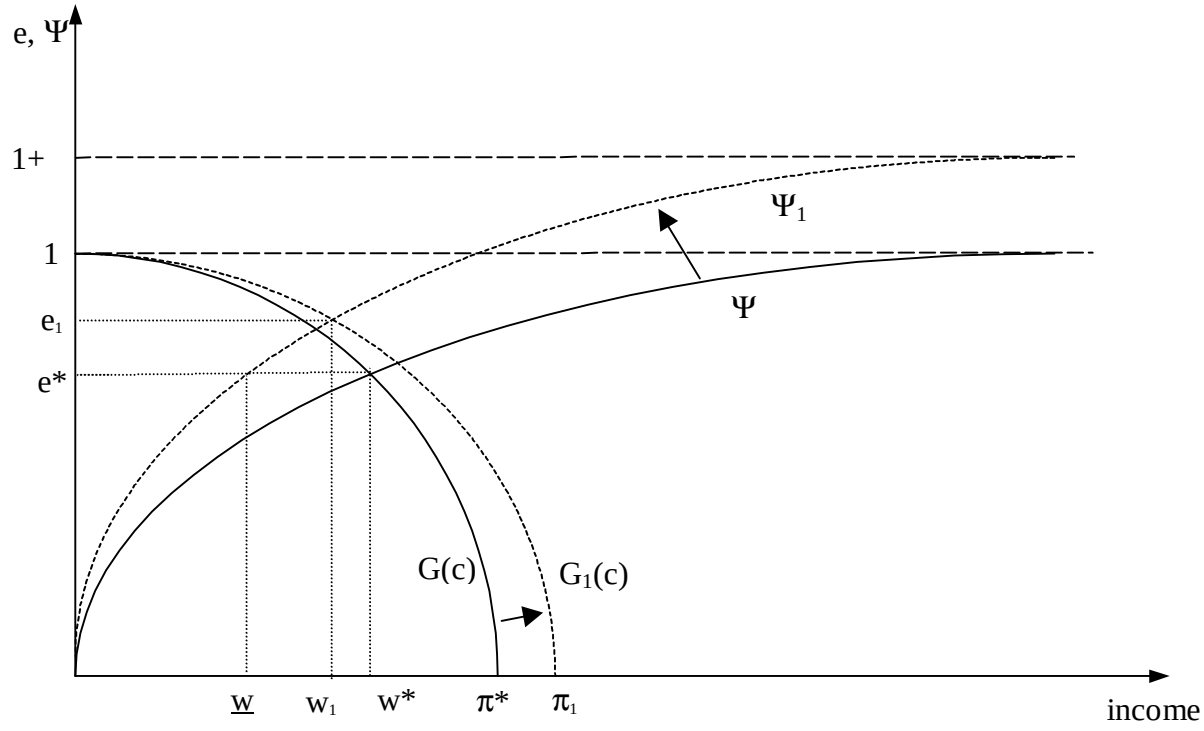
By implicitly differentiating (14), we find that:

$$\frac{dw}{dm}=-\frac{1}{\left[\Lambda w^{-\frac{2-\beta}{1-\beta}}e^*\right]+[f(w)]G'(c^*)}$$

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

$$\left|\frac{dw}{dm}\right|_{e^*=\bar{e}} > \left|\frac{dw}{dm}\right|$$

Figure 2: The impact of migration on wages/profits and the share of skilled resident when the education choice depends on migration.



In Figure 2, we represent the impact of immigration both on Ψ and on $G(c^*)$: $G(c^*)$ shifts to the right and the new equilibrium (w_1, e_1) is characterized by a lower wage and a higher share of skilled population.[19] As in the case where e^* 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. $w_1 \in \left[\underline{w}, w^*\right]$. Therefore the

redistribution of resources and the change in the across-group inequality is lower when e adjusts to migration.

3.4.2 Interest groups

Based on the results established so far, we know that migration redistributes intragenerationally, increasing the skilled wage and reducing the unskilled wage. However, when e^* is a function of migration, migration increases the number of skilled agents. By so doing, it creates additional *interest groups*. The total resident population can in fact be divided in three interest groups: the skilled agents H, who are positively affected by migration; the unskilled agents L, who are negatively affected by migration and the "otherwise unskilled" skilled agents H^M; this last group identifies those agents who invest in human capital only after migration pressure. We focus on the impact that migration has on them in order to have a complete picture of the effects of the arrival of young migrants from less-developed countries.

Consider the agent whose cost of education corresponds to the cut off under migration c_t^*. Our aim is to assess if the native-born agent is better off having migration and becoming skilled rather than not experiencing migration and remaining unskilled. We look at this comparison also to determine what the preferences over migration of the H^M group are.[20] We find the following:[21]

(15.) $$\hat{w}_{t,nm} > \hat{w}_t = \hat{\pi}_t - c_t^*$$

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[19] Figure 2 also allows to analyse the impact of changing the payroll tax rate: a decrease in τ shifts the $G(c^*)$ curve to the right. This causes both the equilibrium unskilled wage and the equilibrium share of skilled population to rise.

[20] As a point of clarification, notice that when we talk about preferences over migration, we refer to the attitudes of agents towards it. The latter are determined by the comparison of the indirect utility function in the absence of and under migration. Given that r is fixed, the indirect utility function only depends on net wages. By directly comparing them, we can establish whether lifetime resources go up or down when migrants enter the country. If they increase, we say that agents are in favor of migration; if they decrease we say that agents are against it.

[21] Equation (15) and (16) hold only in the assimilation scenario. In this case the comparison between lifetime incomes with/without migration is independent of pensions and therefore reduces to a comparison between first period wages. In the return migration scenario the pension benefit plays a role. We return to this point at the end of Section 3.5.2.

where the subscript *nm* denotes the value of a given variable if there were no migration. Given that migration decreases the unskilled wage ($\hat{w}_t < \hat{w}_{t,nm}$), the last agent who profitable invests in education at *t* when migration takes place is worse off under migration. This is true since his unskilled wage $\hat{w}_{t,nm}$ would have been higher than the skilled wage he now earns, once the costs of education are paid for. 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 $c^*_{t,nm}$ when no migration takes place. He is indifferent between investing/not investing in education. Given that migration increases the skilled wage, we have:

(16.) $$\hat{w}_{t,nm} + c^*_{t,nm} = \hat{\pi}_{t,nm} < \hat{\pi}_t$$

which can be rewritten as:

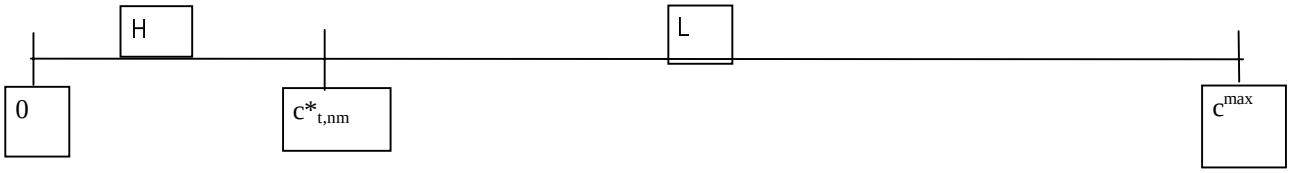
(17.) $$\hat{w}_{t,nm} < \hat{\pi}_t - c^*_{t,nm}$$

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 $\hat{c}_t$ which makes an agent indifferent between having migration and becoming skilled or not having migration and remaining unskilled:

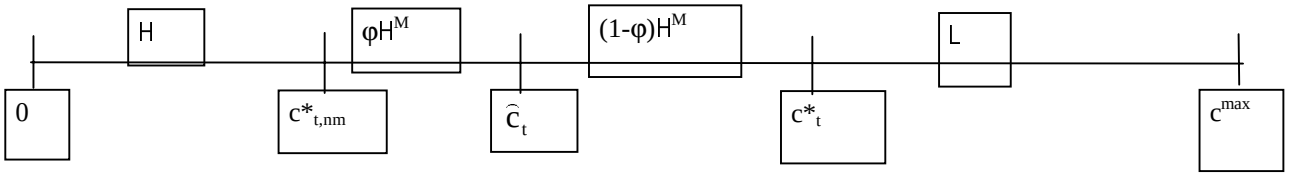
(18.) $$\hat{\pi}_t - \hat{c}_t = \hat{w}_{t,nm}$$

Figure 3: Interest groups.

Without migration



With migration



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

$$\varphi = \frac{\int_{c^*_{t,nm}}^{\hat{c}_t} g(c)dc}{\int_{c^*_{t,nm}}^{c^*_t} g(c)dc}$$

For the remaining *(1-φ)*, 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.

The results obtained in this section show that migration gives rise to redistributive flows among different groups in the young resident population: a share of it becomes richer and the other share poorer. Preferences over migration are differentiated according to skill level (skilled versus unskilled) and cost of education, with high cost skilled agents having the same preferences on migration as unskilled agents. The distribution of education costs is therefore a crucial determinant of the interest groups' dimension.

3.4.3 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 (12) illustrates the behavior 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 return to their pre-migration levels. This conclusion holds both in the *assimilation* and in the *return migration* cases. Looking at the time paths of the main variables, we therefore observe:

$$\begin{aligned} e^*_{t-1} &= e^*_{t+1} < e^*_t \\ w_{t-1} &= w_{t+1} > w_t \\ \pi_{t-1} &= \pi_{t+1} < \pi_t \end{aligned} \tag{19.}$$

and note that the impact of migration on the relevant variables lasts only for one period.

3.5 Social security

In this section we first discuss the effects of migration on the social security budget constraint. We then analyze 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.

3.5.1 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 all subsequent periods).

At time *t* when migration flows enter the country we have:

$$\tau e^*_t N \pi_t + \tau\left(1 - e^*_t\right) N w_t + M \tau w_t = p_t N \tag{20.}$$

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 resident population size *N*, we obtain the social security budget constraint in per capita terms:

$$\tau e_t^* \pi_t + \tau\left(1 - e_t^*\right) w_t + m\tau w_t = p_t \tag{21.}$$

A change in m has a direct effect on p_t via the migrants' pension contributions and an indirect effect via e_t^*, π_t and w_t. The impact of migration flows on the sustainability of social security can be analyzed looking at what happens to per capita pensions p_t at the time of migration. In our model, total contributions are proportional to output; therefore immigration, by increasing productive inputs, rises total contributions. Since the number of old people at the time of migration is fixed, we can conclude that per capita pensions for the old increase - i.e. $\frac{dp_t}{dm} > 0$. This effect can also be interpreted as saying that migration increases the resources available in the social security scheme, i.e. it relaxes the budget constraint. Given these results, the old at time t will favor immigration.[22]

Notice also that the increase in per capita pensions when the skill composition is endogenous is larger than the one observed when e is independent of m. This can be seen by totally differentiating equation (21):

$$\tau \frac{de_t^*}{dm}\left[\pi_t - w_t\right] + \tau \frac{dw_t}{dm}\left[m - e_t^*\right] + \tau\left[w_t + \frac{d\pi_t}{dm} e_t^*\right] = \frac{dp_t}{dm} \tag{22.}$$

and observing that the term $\frac{de_t^*}{dm}\left[\pi_t - w_t\right]$ in (22) is always non negative.

[22] For the purpose of the sustainability analysis, nothing would change if we assumed a variable contribution rate and constant benefits. If per capita pensions are kept constant, the increase in the contributory base allows a reduction of the payroll tax rate. This, too, represents a softened budget constraint. In this case, however, the old at time t are not affected by migration while the young benefit from the lower τ.

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 older migrants return to their origin country with their offspring and they receive only a fraction ζ of the pension that residents receive: the lower ζ, the higher the exploitation is. These two frameworks allow a public finance assessment in the recipient country of either an assimilation or an exploitation policy.

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

$$\tau e^{*}_{t+1}(N+M)\pi_{t+1} + \tau\left(1-e^{*}_{t+1}\right)(N+M)w_{t+1} = p_{t+1}(N+M) \tag{23.}$$

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

$$\tau e^{*}_{t+1}\pi_{t+1} + \tau\left(1-e^{*}_{t+1}\right)w_{t+1} = p_{t+1} \tag{24.}$$

Looking at (24) 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.[23]

If there is return migration, (24) reads:

$$\tau e^{*}_{t+1}\pi_{t+1} + \tau\left(1-e^{*}_{t+1}\right)w_{t+1} = p^{RM}_{t+1}(1+\zeta m) \tag{25.}$$

Migration affects the social security budget constraint also at time *t+1*. Given (19), the amount of resources collected at time *t+1* coincides with that collected at time *t-1* but, as long as $\zeta \neq 0$ the total benefits to be paid are higher. Therefore, individual benefits must decrease if

[23] This holds when the payroll tax rate is fixed at time *t*. If not, the young would be affected by migration also via the pension system.

the system is to be balanced. The following relationship between the pension benefits under assimilation and return migration holds:

$$p_{t+1}^{RM} = \frac{p_{t+1}}{(1+\zeta m)}$$

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 the migrants' contributions are totally expropriated, i.e. $\zeta = 0$. As long as the migrants' benefits cannot be totally expropriated, *an assimilation policy guarantees young residents at the time of migration higher pensions than an exploitation policy would*. 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. Thus, unless the benefits to be paid to migrants revert to zero, no exploitation policy can compensate for the loss of future contributions.

3.5.2 The redistribution analysis

Migration triggers complex redistributive flows. It gives rise to intergenerational redistribution as 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 also yields an intragenerational redistributive impact. The impact of this redistribution is from the unskilled and a fraction of the "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 initiates further intragenerational redistributive effects. Define g_t^j the return earned on the contributions paid into the social security scheme by a young agent belonging to group *j* at any time *t*.

(26.) $$g_t^j = \frac{p_{t+1}}{\tau \pi_t} - 1, \; j \in H$$

(27.) $$g_t^j = \frac{p_{t+1}}{\tau w_t} - 1, \; j \in L$$

First, we consider the no migration case. Using equation (24) to substitute for p_{t+1} in (26) and (27), it is easy to see that $g^H_{nm}<0$ and $g^L_{nm}>0$. Unskilled workers are net beneficiaries of the pension scheme and earn a positive return on their contributions equal to $e\left(\frac{\pi}{w}-1\right)$; skilled workers are net contributors and earn a negative return on their payroll tax equal to $-(1-e)\left(1-\frac{w}{\pi}\right)$. The difference between the two returns measures the degree of solidarity built in the system. The redistributive pay-as-you-go scheme places a cost on skilled agents to the benefit of unskilled agents.

Complete assimilation. 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 find that $g^H_m<0$ and $g^L_m>0$. Moreover $|g^H_m|>|g^H_{nm}|$ and $g^L_m> g^L_{nm}$. The redistribution of the pension scheme increases: skilled (unskilled) agents pay more (less) owing to the increase (decrease) in their wage but they receive the same pension. The degree of solidarity built in the system increases: migration affects the preferences of skilled workers on the pension scheme and it might give rise to an opposition to the pension scheme itself. As long as migrants are assimilated, social security does not affect the preferences of skilled agents over migration: they are in favor of it because of migration's positive effect on wages. However, the skilled agents' preference towards the adoption of a different pension scheme which rewards the education effort more becomes stronger. On the other hand, migration represents a burden on unskilled agents because it decreases their wage. However, the pension scheme operates here as a *risk sharing* device and it partly offsets the loss imposed on the unskilled by migration. The decline in unskilled wages, which decreases the contributions of the unskilled, does not reduce their pensions. Thus, the redistributive social security scheme partly compensates the unskilled for the loss in wages owing to 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 divergent preferences on migration but also on pension schemes; migration polarizes their differences 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 systems would require. In the absence of a redistributive pension scheme the impact of migration on unskilled agents would be more dramatic.

Return migration. We now study the redistributive pattern in the return migration case. One can easily show that $|g^H_{nm}|<|g^H_m|<|g^H_{rm}|$. This scenario yields the most redistributive pension scheme for skilled agents, i.e. the one granting the lowest (highest negative) return on contributions. The opposition of skilled agents to the pay-as-you-go pension scheme peaks in this framework. If we look at unskilled residents, we find $g^L_m > g^L_{nm} > g^L_{rm}$: unskilled agents prefer a redistributive system only if there is assimilation. If there is return migration, not only the gain they obtain is the lowest but it may also become negative. In fact, nothing guarantees that $g^L_{rm} > 0$. If this is true, unskilled agents may even become net contributors and experience a negative return. In this case, the unskilled would join the skilled group and put pressure on abandoning the pay-as-you-go pension system. The return migration scenario is the most unfavourable both for skilled and unskilled agents. 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 a no migration regime, they support a redistributive pension scheme; under a migration regime, they oppose it. Notice that, if there is assimilation, for the $(1-\varphi)H^M$ agents whose lifetime income is reduced by migration, the redistributive pension scheme amplifies the loss and it therefore strengthens their opposition to migration. These conclusions hold also under the return migration case.[24]

[24] However, φ 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 in the return migration case φ goes down, increasing the number of those who are worse off when migrants enter the country.

3.6 Altering the migration model

One might wonder whether our modeling of migration captures the behavior of international migration; or, if we look from the policy angle, whether there are no other migration policies a country could adopt which could eliminate or remarkably reduce the intragenerational conflicts described above. There exist at least two alternative migration models to consider. First, a policy of *continuous migration*, i.e. every period a share *m* of migrants over the total resident population arrives and remains in the country with their offspring. Secondly, one could postulate a policy of return migration of the old *and* assimilation of the young. How are the results of the previous sections affected by these changes? In the case of continuous migration, equation (11) for the labor market equilibrium and equation (21) for the social security scheme hold not only at time *t* but for all the following periods. Looking at the time path of the relevant variables we find:

$$
\begin{aligned}
& e^*_{t-1} < e^*_t = e^*_{t+1} = e^*_{t+i} \\
& w_{t-1} > w_t = w_{t+1} = w_{t+i} \\
& \pi_{t-1} < \pi_t = \pi_{t+1} = \pi_{t+i}
\end{aligned}
\tag{28.}
$$

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 favorable 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, although this

is the best scenario for residents, it does not make every resident better off and across group conflicts still persist.

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 privatization 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 labor 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. For example, if migrants work in the informal sector, we may still observe the labor market impact of migration. However, the implications on the social security system sustainability would change. For instance, 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 stylized model highlights that, to answer pension issues, education and integration policies cannot be left out of the picture.

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