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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 pensions and to reassess the sustainability issue raised in the existing economic literature. The paper first develops a theoretical framework to analyse the impact of international migration on the labour 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 pensions under alternative migration scenarios. The analysis shows that migration causes redistributive effects which 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 pension scheme but the interaction between migration and pensions causes complex inter- and intragenerational redistributive conflicts, which are analysed in the paper.

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1. Introduction

All major industrial countries are facing economic problems related to popula-

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tion ageing. The declining birth rates and the 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 stabilise only in 2050 (Lutz, 1996). The increase could be even faster if recent (falling) labour 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 ageing can have dramatic effects on government finances, boosting taxes and placing the government's ability to finance other expenditure 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 overcoming their shortfalls (OECD, 1998a,b; Razin and Sadka, 1998, 1999a,b).

The aim of this paper is to investigate the joint redistributive effects of migration and pensions and to reassess the sustainability issue raised by the existing economic literature. The analysis developed in this paper differs from the related literature in that it describes migration not only as a demographic phenomenon increasing the number of contributors to the pension scheme but also as an economic shock perturbing the labour 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 the labour market. We allow for heterogeneity across individuals and for migration to affect both the wages and the education choice in the recipient country. We then explicitly focus on social security, which in this paper is synonymous with pension system, and analyse the effects of migration on its sustainability: we evaluate whether migration can complement direct pension reforms. We finally study the joint redistributive effects of migration and social security under alternative migration scenarios. We focus on

[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.

how migration changes the residents' lifetime income and social security returns to throw some light on the preferences of residents over migration and social security arrangements.

We show that migration causes redistributive effects which increase across-group wage inequality. However, the endogenous educational response by residents partially offsets the redistributive impact of migration, while creating additional interest groups. Agents are differentiated not only according to skill level but also to cost of education, with high cost skilled agents having the same attitude towards migration as unskilled agents. We also show that migration eases the financial problems of pension arrangements but, by increasing the redistribution operated by the social security scheme, it might polarise the preferences of agents and sharpen the opposition to it. A policy that apparently makes 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.

The paper is organised 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, labour 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, labour-related migration is still extremely relevant. In 1996 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 labour 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 ageing in OECD countries (OECD, 1998b; United Nations Population Division, 2000) 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 labour force composition increasing the number of unskilled workers in the total

working population[2]. Lately, there has been a growing concern on the possibility that the inflow of less 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 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] (OECD, 1998a). 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 international migration and social security accounts for the fact that migrants are young and add to the resident workforce and it treats migration as an exogenous phenomenon[4]. 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*.

2.1. Fixed wages

If wages are fixed (Razin and Sadka, 1998, 1999b), the labour market implications of the arrival of unskilled migrants are assumed away: migrants only increase the *size of the population* in the recipient country and therefore they are a resource for strained public retirement systems. In this framework migration is always Pareto-improving and thus the inflow, even of unskilled workers, should

[2]Recent trends show an increase in migration of highly-qualified temporary workers with respect to unskilled labour: 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 taken 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 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).

[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.

[4]A large body of literature focuses on how migration between developed economies affects pension design and on how the latter provides incentives for mobile workers to enter/leave a country. See for instance Jousten and Pestieau (2001) and Breyer and Kolmar (2001).

not be opposed, at least on economic grounds. However, excluding the labour 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 labour 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[5]. 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[6]. 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 analyse the impact of the inflow of low-qualified workers on relative wages is the following (Johnson, 1997):

$$\frac{\Delta z}{z} = \frac{1}{\sigma}\left[\frac{\Delta D}{D} - \frac{\Delta\frac{H}{L}}{\frac{H}{L}}\right] \tag{1}$$

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

Eq. (1) shows that, as long as migration alters the relative supply of skilled to unskilled workers, the wage premium changes provided that σ is finite. Namely, due to the arrival of relatively more unskilled migrants $\Delta(H/L)/(H/L) < 0$ and, ceteris paribus, $\Delta z/z > 0$ — i.e. for given relative demand of workers ($\Delta D = 0$) the wage premium z increases.

[5] 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 labour in the production function.

[6] 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).

Although the effect of migration on relative wages is still a contentious issue from the empirical point of view (Borjas, 1999), most studies find that migration has a small positive effect on z. LaLonde 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 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[7]. A number of European country studies confirm this result (Winter-Ebmer and Zweimuller, 1999; Venturini, 1999).

Though the impact of immigration on wages is not large, the assumption that they do not respond at all to migration is still not appropriate. Rather, the low effect of immigration on wages can be explained as the result of a *reallocation* process started by migration itself. In this paper we focus on an endogenous reallocation process taking place via the education decision. Migration affects the skill composition of the labour supply and it lowers H/L, but it also triggers a price effect which works in the opposite direction, reducing the effect of migration on z. Once the wage premium is allowed to change in response to the arrival of unskilled migrants, the endogeneity of H must be addressed. Indeed, the effects of current and expected changes in the wage premium on the human capital investment decision are widely documented[8].

The role of endogenous skill upgrading has long been recognised in the theoretical literature as an adjustment mechanism to migration flows[9]. This issue is not yet reflected by empirical studies which are still based on the assumption that relative skill supplies are exogenous with respect to the wage premium: for instance, LaLonde and Topel (1997) notice that the small impact of migration on wages is obtained under the assumption that other inputs (apart from migrant labour) are held fixed.

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[10]. To

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

[8] Topel (1997) reports evidence of a positive relation between returns to schooling and college enrollments. See also Freeman (1986) and Card (1999).

[9] In Chiswick (1989) natives react to migration via changes in human capital investment both on the intensive and the extensive margin (higher labour productivity and higher number of people investing). See also Greenwood and McDowell (1986) and Chiswick et al. (1992). Other authors focus on alternative reallocation processes working via geographical mobility (Topel, 1997) or sectorial composition (Winkelman and Zimmermann, 1992).

[10] This literature actually abstracts from any type of endogenous reallocation process in response to migration. For instance, Canova and Ravn (1997) focus on questions close to ours and use a calibrated real business cycle model where wages and the wage premium can vary but the number of skilled workers is exogenous.

succinctly capture endogenous skill upgrading we assume that it is instantaneous (i.e. it occurs within a generation) and it involves only two educational levels[11].

3. The model

Our theoretical model allows for the presence of skilled and unskilled workers and for the relative wage to change in response to migration. Moreover, 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.

These extensions allow us 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 and to combine the implications of the intragenerational redistribution generated by a pension system operating as a demogrant program and that associated to migration.

We consider a two period overlapping generations model (OLG) of a small (developed) open economy. Capital is perfectly mobile and the interest rate is given at the world level r. The resident labour force is immobile whilst international workers migrate from less developed countries, increasing the labour input in the recipient country[12]. 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[13]. 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 benchmark scenarios according to the migrants'/recipient country's behaviour[14]. In the first one we observe a complete assimilation of migrants whose offspring cannot be distinguished from residents (*assimilation* scenario). In the second one, migrants

[11]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. By the same token, also the downward pressure on unskilled wages caused by immigration may require time to manifest itself because of, for instance, an initially low but increasing substitutability between migrants and unskilled residents. The timing of the model will allow to capture in a simple way the interaction between changes in skill patterns and wages.

[12]Here we are implicitly assuming that perfect capital mobility does not prevent labour mobility from less developed to more industrialised countries. This happens, for instance, when the world capital market is segmented; or when there are differences in the technology employed by the two groups of countries.

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

[14]In Section 3.6 we analyse further migration scenarios.

return to their country upon retirement with their descendants (*return migration* scenario).

3.1. Consumers

When young, residents can either invest in education and work as skilled workers (type $\mathcal{H}$ agents) or they can work as unskilled workers (type $\mathcal{L}$ agents). Agents differ in their ability to acquire skills. We represent this heterogeneity by assuming that investing in education requires the payment of an idiosyncratic cost[15] c_j, distributed on the interval $[0, c^{\text{Max}}]$ with continuous 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 their second period income[16]. 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 out of their savings and pensions.

The recipient country operates a balanced redistributive 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[17]. 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:

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

[15] This is a simple way to perform a cost–benefit analysis of the educational investment and it is used, for instance, in Aghion and Howitt (1999) in their treatment of education and skill biased technological progress, in Saint-Paul (1994) and in Razin and Sadka (1995).

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

[17] 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 they pay can always be represented as a linear combination of a purely redistributive Beveridge-type benefit and a contribution-related part, which in our two-period OLG economy can also be interpreted as a Bismarckian component. Given the objectives of the paper, we focus only on the former although, where relevant, we highlight how the presence of a contributory component would affect the analysis.

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

$$\omega_t^j = \begin{cases} \hat{\pi}_t - c^j & \text{if } j \in \mathcal{H} \\ \hat{w}_t & \text{if } j \in \mathcal{L} \end{cases}$$

where $\hat{\pi}_t = \pi_t(1-\tau)$ is the net of payroll tax wage of a skilled worker[18] and $\hat{w}_t = w_t(1-\tau)$ 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 $V_t^j(\omega_t^j, p_{t+1}, r)$ whose maximisation determines the decision to invest in human capital: notice that ω_t^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 $\omega_t^{\mathcal{H}} \geq \omega_t^{\mathcal{L}}$. The last agent who finds it profitable to invest is characterised by an education cost c_t^* satisfying the following condition[19]:

$$c_t^* = \hat{\pi}_t - \hat{w}_t \tag{3}$$

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

$$e_t^* = \left[\int_0^{c_t^*} g(c)\, \mathrm{d}c \right] = G(c_t^*) \tag{4}$$

In order to determine π_t and w_t we introduce production.

3.2. Production

The production function is Cobb–Douglas:

$$Y_t = H_t^{\alpha} L_t^{\gamma} K_t^{1-\alpha-\gamma} \tag{5}$$

where Y_t is the production in the representative firm at time t; H_t and L_t are respectively the skilled and the unskilled labour inputs and K_t is capital; α, γ, $(\alpha+\gamma) \in (0, 1)$. The Cobb–Douglas specification offers a simple framework

[18] 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.

[19] If the pension system is partially redistributive, it is possible to show that the cut off level of costs is $\tilde{c}_t = (\pi_t - w_t)(1 - \alpha\tau)$, 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.

within which to explore the implications of abandoning perfect substitutability between skilled and unskilled workers[20]: the idea is that they do not just 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[21].

By the assumption of small open economy, equating the marginal productivity of capital to the constant interest rate r, solving for K_t and substituting in (5) we obtain:

$$Y_t = AH_t^{1-\beta}L_t^{\beta} \tag{6}$$

where $\beta = \gamma/(\alpha + \gamma)$ and $A = (1 - \alpha - \gamma/r)^{1/(\alpha+\gamma)}$ is a positive constant.

The representative firm acts competitively. Given the unskilled wage w_t, the demand for unskilled labour is:

$$L_t^D = \left(\frac{\beta A}{w_t}\right)^{1/(1-\beta)} e_t^* N \tag{7}$$

where $H_t = e_t^* N$ and e_t^* is the share of the resident population N investing in education at t, to be determined in equilibrium. Given e_t^*, the unskilled labour supply is:

$$L_t^S = (1 - e_t^*)N + M \tag{8}$$

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 recognised in the recipient country[22].

Given w_t and substituting (7) in the expression for the marginal productivity of

[20]Topel (1999) lists a number of studies which reject the assumption of perfect substitutability of (adjusted for productivity differentials) workers with different skill levels. Notice that the Cobb–Douglas specification implies the same elasticity of substitution between capital and unskilled/skilled labour. We are aware that introducing capital–skill complementarity would fit the actual elasticity of substitution between factors better; however, in this paper we abstract from it.

[21]Saint-Paul (1999) uses a Cobb–Douglas production function in H and L to study the impact of wage convergence on economic activity under east–west labour mobility. Notice that the unit elasticity of substitution of the Cobb–Douglas production function is not crucial for our results. It will be clear as we go along that the results on endogenous skill upgrading hold as long as the elasticity of substitution between the two types of labour is finite. The results of the redistribution analysis hold if the elasticity of substitution is finite and sufficiently low. This is further discussed in Section 3.5.2.

[22]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 a baby boom.

skilled labour, the competitive wage π_t of skilled agents and the skill premium z_t are:

$$\pi_t = a w_t^{-[\beta/(1-\beta)]} \tag{9}$$

$$z_t = \frac{\pi_t}{w_t} = a w_t^{-[1/(1-\beta)]} \tag{10}$$

where a is a positive constant. Both π_t and z_t are negative functions of w_t. From (3) and (9) we observe that the cut off level of the education cost decreases when the unskilled wage increases, that is $\mathrm{d}c_t^*/\mathrm{d}w_t < 0$. Hence the higher w_t, the smaller the share e_t^* of the total resident population investing in education.

3.3. Equilibrium

Consider the equilibrium in the labour market at time t. Substituting (4) into (7) and (8) and imposing the equilibrium in the unskilled labour market we obtain:

$$\left(\frac{\beta A}{w_t}\right)^{1/(1-\beta)}\left[\int_0^{c_t^*} g(c)\,\mathrm{d}c\right]N = \left[1 - \int_0^{c_t^*} g(c)\,\mathrm{d}c\right]N + M \tag{11}$$

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

$$\left[1 + \left(\frac{\beta A}{w_t}\right)^{1/(1-\beta)}\right]G(c_t^*) = 1 + m \tag{12}$$

Eqs. (3) and (12) jointly determine the equilibrium wage and the equilibrium share of skilled population e_t^*.

Consider now what happens at time $t+1$. We describe an *assimilation* scenario as a situation where the old migrants stay in the recipient country and have the same rights as residents and where their offspring have the same preferences, distribution of costs and fertility behaviour[23] as the descendants of the native born at time t. The equilibrium condition at time $t+1$ is:

$$\left[1 + \left(\frac{\beta A}{w_{t+1}}\right)^{1/(1-\beta)}\right]G(c_{t+1}^*) = 1 \tag{13}$$

When migrants are assimilated to residents, migration increases the size of the native born population at time $t+1$ from N to $N+M$. Eq. (13) holds also for the

[23]The simplifying assumption that the migrants' offspring cannot be distinguished from the residents' descendants gives rise to a straightforward dynamics of wages and investment in human capital. The more realistic assumption of a gradual assimilation process would affect the dynamics of the model without altering its main insights. We go back to this point in Section 3.4.2.

return migration case, where migrants return to their origin country with their offspring. 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, intragenerational redistribution and interest groups

Rearranging (12), the equilibrium condition at t is represented in Fig. 1. The $G(c_t^*)$ curve is equal to 1 when w_t goes to zero and drives the wage differential to infinity. It then falls monotonically and it reaches zero for $c_t^* = (1-\tau)\left(aw_t^{-[\beta/(1-\beta)]} - w_t\right) = 0$. When the education choice does not depend on migration, $G(c_t^*)$ reduces to a horizontal line passing through e_t^*. The $(1+m)/[1+(\beta A/w_t)^{1/(1-\beta)}]$ 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 $G(c_t^*)$ at w_t^* and e_t^*, which represent, respectively, the equilibrium unskilled wage and the equilibrium share of skilled population before migration occurs, as Fig. 1 shows.

If the number of skilled workers is independent of migration, i.e. if $e_t^* = \bar{e}$ is constant, the arrival of unskilled workers shifts the Ψ curve upwards to Ψ_1: the equilibrium unskilled wage decreases to $\underline{w}_t$ but e_t^* is unchanged. Indeed, for fixed e_t^*:

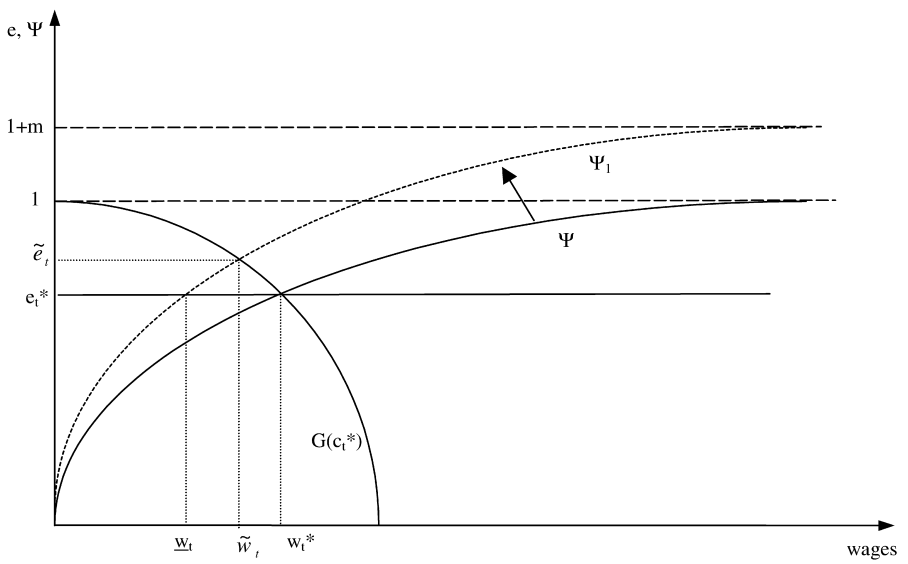

Fig. 1. The impact of migration on wages and on the share of skilled residents.

$$\frac{\mathrm{d}w_t}{\mathrm{d}m}\Big|_{e_t^*=\bar{e}} = -\frac{1}{\Lambda w_t^{-(2-\beta)/(1-\beta)}\bar{e}} < 0 \tag{14}$$

where $\Lambda = 1/1-\beta(\beta A)^{1/1-\beta}$ is a positive constant. 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). We concentrate on the following explanation for these empirical findings: the arrival of new unskilled workers lowers w_t and, at the same time, it induces a shift of native workers from the unskilled to the skilled labour sector[24]. Migration has therefore two effects: it changes the skill premium and, through endogenous skill upgrading, it increases the number of skilled agents, creating additional *interest groups*. The total resident population can in fact be divided in three groups, whose lifetime income is differently affected by migration: the skilled agents $\mathscr{H}$, the unskilled agents $\mathscr{L}$ and the 'otherwise unskilled' skilled agents[25] $\mathscr{H}^M$; this last group identifies those agents who invest in human capital only after migration pressure. While the creation of additional interest groups strictly depends on the endogeneity of e_t^* with respect to m, the increase in across-group inequality is present also if migration does not affect the education choice, but the *size* of the change is different.

Formally, substituting c_t^* in (12) and implicitly differentiating, we find that:

$$\frac{\mathrm{d}w_t}{\mathrm{d}m} = -\frac{1}{\left[\Lambda w_t^{-2-\beta/1-\beta}e_t^*\right] + \left[f(w_t)\right]G'(c_t^*)},$$

where $f(w_t) = (1-\tau)[1+(\beta A/w_t)^{1/1-\beta}]\{1+[a\beta/(1-\beta)](1/w_t)^{1/(1-\beta)}\}$ is a non-negative function. Immigration lowers unskilled workers' wage $[\mathrm{d}w_t/\mathrm{d}m < 0]$ but the change in educational choices induced by migration partially counterbalances this effect. Indeed, for $G'(c_t^*)$ different from zero:

$$\left|\frac{\mathrm{d}w_t}{\mathrm{d}m}\Big|_{e_t^*=\bar{e}}\right| > \left|\frac{\mathrm{d}w_t}{\mathrm{d}m}\right|$$

In Fig. 1, the new equilibrium $(\tilde{w}_t, \tilde{e}_t)$ is characterised by a lower unskilled wage and a higher share of skilled population than the ones we observe in the absence of

[24]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.

[25]In order to study these we need to introduce social security. We do this in the next Section 3.5.

migration. 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. $\tilde{w}_t \in [\underline{w}_t, w_t^*]$. Therefore the redistribution of resources and the change in across-group inequality is lower when e_t^* adjusts to migration.

3.4.2. 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. Eq. (13) illustrates 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 return to their pre-migration levels. This conclusion holds both in the *assimilation* and in the *return migration* case. Looking at the time paths of the main variables, we therefore observe:

$$\begin{aligned} e_{t-1}^* &= e_{t+1}^* < e_t^* \\ w_{t-1} &= w_{t+1} > w_t \\ \pi_{t-1} &= \pi_{t+1} < \pi_t \end{aligned} \tag{15}$$

and note that the impact of migration on the relevant variables lasts only for one period[26].

3.5. Pension system

In this section we first discuss the effects of migration on the social security budget constraint focusing on the case where τ is fixed and p_t is variable[27]. We first develop the sustainability analysis and then investigate how the attitudes of natives 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 financial sustainability analysis

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

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

$$\tau e_t^* N \pi_t + \tau(1 - e_t^*) N w_t + M \tau w_t = p_t N \tag{16}$$

The first term represents contributions paid by the skilled workers. The second

[26] If there is not immediate convergence of the cost distributions of migrants' offspring to those of residents', the variables under discussion go back to their pre-migration levels only gradually.

[27] Appendix is devoted to the analysis of migration and social security under a variable τ_t and a fixed p.

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:

$$\tau e_t^* \pi_t + \tau(1 - e_t^*) w_t + m\tau w_t = p_t \tag{17}$$

A change in m has a direct effect on p_t via the migrants' contributions and an indirect effect via e_t^*, π_t and w_t. The change in per capita pensions p_t indicates how migration flows affect the financial sustainability of social security. In our model, total contributions are proportional to output; therefore immigration, by increasing productive inputs, raises 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. $\mathrm{d}p_t/\mathrm{d}m > 0$. 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 are positively affected by the intergenerational redistribution associated with migration.

Notice also that the increase in per capita pensions when the skill composition is endogenous is larger than the one observed when e_t^* is independent of m. This can be seen by totally differentiating Eq. (17):

$$\tau \frac{\mathrm{d}e_t^*}{\mathrm{d}m}[\pi_t - w_t] + \tau \frac{\mathrm{d}w_t}{\mathrm{d}m}[1 - e_t^* + m] + \tau\left[w_t + \frac{\mathrm{d}\pi_t}{\mathrm{d}m} e_t^*\right] = \frac{\mathrm{d}p_t}{\mathrm{d}m} \tag{18}$$

and observing that the term $\mathrm{d}e_t^*/\mathrm{d}m[\pi_t - w_t]$ in (18) is always non negative.

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 $\zeta \in [0, 1]$ of the pension that residents receive. The parameter ζ is intended to capture potential limits to pensions' exportability for international migrants[28]: 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:

$$\tau e_{t+1}^* (N + M)\pi_{t+1} + \tau(1 - e_{t+1}^*)(N + M) w_{t+1} = p_{t+1}(N + M) \tag{19}$$

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

[28]These limits characterise, for instance, the current practice of social security claims exportability for international migrants leaving Italy after a contributory period. In general, pension's exportability for international migrants (i.e. the exact value of ζ) is ruled by bilateral agreements between receiving and sending countries.

$$\tau e^{*}_{t+1}\pi_{t+1} + \tau(1 - e^{*}_{t+1})w_{t+1} = p_{t+1} \tag{20}$$

Looking at (20) 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 pension they would get in the absence of migration.

If there is return migration, (20) reads:

$$\tau e^{*}_{t+1}\pi_{t+1} + \tau(1 - e^{*}_{t+1})w_{t+1} = p^{RM}_{t+1}(1 + \zeta m) \tag{21}$$

Migration affects the social security budget constraint also at time $t + 1$. Given (15), 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 number of people entitled to receive benefits is higher. Therefore individual benefits must decrease if the system is to be balanced. The following relationship between the pension benefits under assimilation and return migration holds:

$$p^{RM}_{t+1} = \frac{p_{t+1}}{1 + \zeta m} \tag{22}$$

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, *assimilation guarantees young residents at the time of migration higher pensions than return migration*. Though the latter reduces the amount of benefits the migrants are entitled to, it also decreases the number of contributors to the scheme. Thus, unless the benefits to be paid to migrants revert to zero, no exploitation can compensate for the loss of future contributions.

3.5.2. The redistribution analysis

Migration triggers complex inter and intragenerational redistributive flows; the social security scheme managed as a demogrant program initiates further intragenerational redistributive effects. In this section we investigate these focusing on how migration changes the residents' lifetime income and social security returns. The analysis throws some light on the preferences of residents over migration[29] and social security arrangements[30].

Regarding the old at time t, migration affects their lifetime income only via the

[29] 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 and under migration. Given that r is fixed, the indirect utility function only depends on lifetime income.

[30] Dustmann and Preston (2000) use the British Social Attitudes Survey to identify the role of labour market and welfare concerns in determining the attitudes towards immigration.

increase in pensions. They therefore favour migration. As far as the young at time t are concerned, we need to distinguish between the *assimilation* and the *return migration* scenario.

Assimilation. In this scenario, the comparison between lifetime incomes in the presence or in the absence of migration is independent of pensions and it therefore reduces to a comparison between first period wages. It is straightforward to conclude that skilled agents are better off under migration[31] while unskilled agents are worse off. We now analyse the impact of migration on the otherwise unskilled skilled agents. Our aim is to assess if they are better off having migration and becoming skilled rather than not experiencing migration and remaining unskilled. This comparison also determines what the preferences over migration of the $\mathcal{H}^M$ group are. Consider the agent whose cost of education corresponds to the cut off under migration c_t^*. We find the following:

$$\hat{w}_{t,nm} > \hat{w}_t = \hat{\pi}_t - c_t^* \tag{23}$$

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 profitably 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:

$$\hat{w}_{t,nm} + c_{t,nm}^* = \hat{\pi}_{t,nm} < \hat{\pi}_t \tag{24}$$

which can be rewritten as:

$$\hat{w}_{t,nm} < \hat{\pi}_t - c_{t,nm}^* \tag{25}$$

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 (Fig. 2):

$$\hat{\pi}_t - \hat{c}_t = \hat{w}_{t,nm} \tag{26}$$

[31] This result holds if the productivity of skilled workers is increasing in the number of unskilled workers. This is satisfied under a Cobb–Douglas technology and under any other production function with sufficiently low elasticity of substitution. If skilled and unskilled workers are highly substituted, then also the $\mathcal{H}$ group is worse off under migration.

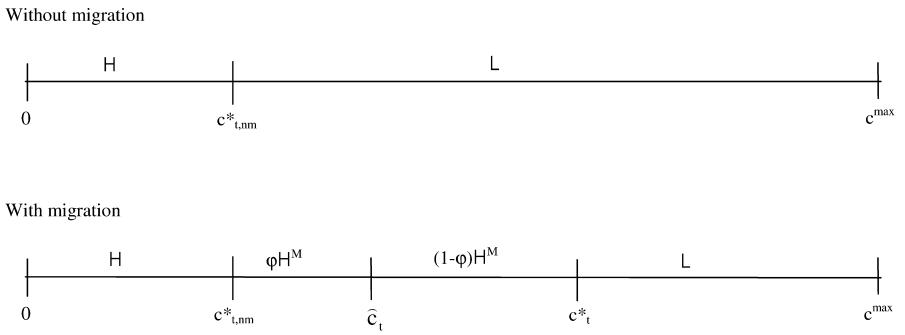

Fig. 2. Interest groups.

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

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

For the remaining $(1-\varphi)$, 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 so far 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. The effects of migration and preferences over it 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.

Now that we have analysed how migration affects the agents' lifetime income, we focus on how migration changes the returns paid by the pension scheme and therefore agents' preferences over it. To do this, we define λ_t^j the return earned on the contributions paid into the pension scheme by a young agent belonging to group j at any time t.

$$\lambda_t^j = \frac{p_{t+1}}{\tau \pi_t} - 1, \quad j \in \mathcal{H} \tag{27}$$

$$\lambda_t^j = \frac{p_{t+1}}{\tau w_t} - 1, \quad j \in \mathscr{L} \tag{28}$$

Under no migration, using Eq. (20) to substitute for p_{t+1} in (27) and (28), it is easy to see that $\lambda_{t,nm}^{\mathscr{H}} < 0$ and $\lambda_{t,nm}^{\mathscr{L}} > 0$. Unskilled workers are net beneficiaries of the pension scheme and earn a positive return on their contributions equal to[32] $e(\pi/w - 1)$; skilled workers are net contributors and earn a negative return on their payroll tax equal to $-(1-e)(1-w/\pi)$. The difference between the two returns measures the degree of solidarity built in the system. As we can see, the redistributive pay-as-you-go scheme places a cost on skilled agents to the benefit of unskilled agents.

Under assimilation, given that the skilled (unskilled) wage increases (decreases) while pensions are constant, we find $\left|\lambda_{t,m}^{\mathscr{H}}\right| > \left|\lambda_{t,nm}^{\mathscr{H}}\right|$ and $\lambda_{t,m}^{\mathscr{L}} > \lambda_{t,nm}^{\mathscr{L}}$, where the subscript m denotes the value of λ under migration with complete assimilation. The redistribution via 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. 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 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 as a *risk sharing* device and it partly offsets the loss imposed on the unskilled by migration[33]. The decline in unskilled wages, which decreases the contributions of the unskilled, does not reduce their pensions. 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 polarises their differences even more.

We look now at the $\mathscr{H}^M$ 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 assimilation, for the $(1-\varphi)\mathscr{H}^M$ agents whose lifetime income is reduced by migration, the redistributive pension scheme amplifies the loss and it therefore strengthens their opposition to migration.

[32] We drop the time subscripts because e, w and π are constant in the absence of migration.

[33] Notice 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. In this scenario, the comparison between lifetime incomes in the presence or in the absence of migration depends both on wages and on pensions. While the impact on wages is the same as the one described under assimilation, pensions are lower than those paid under no migration or assimilation.

If we combine the changes in pensions with those in wages, for the $\mathscr{L}$ group we can conclude that the reduction in pensions adds to the decrease in wages, delivering the worst possible scenario. For the $\mathscr{H}$ group, migration moves pensions and wages in opposite directions. The relative magnitude of the changes varies with the value of ζ, m and the distribution of costs. Nothing guarantees that the skilled agents are better off under migration. However, it is easy to show that for any value of m and any distribution of costs, there exists a sufficiently low ζ such that the skilled agents' lifetime income does not decrease also under the return migration scenario. Regarding the $\mathscr{H}^M$ group, the analysis developed under the assimilation scenario applies. However, given that pensions are lower than those received under no migration or complete assimilation, φ goes down, increasing the number of those who are worse off when migrants enter the country.

The reduction in pensions for all groups is reflected by the decrease in the returns associated with the redistributive social security scheme. Namely, one can easily show by substituting (22) in (27) and (28) that $|\lambda^{\mathscr{H}}_{t,nm}| < |\lambda^{\mathscr{H}}_{t,m}| < |\lambda^{\mathscr{H}}_{t,rm}|$ where the subscript *rm* stands for return migration. This scenario grants the lowest (highest negative) return on contributions to skilled agents. If we look at unskilled residents, we find $\lambda^{\mathscr{L}}_{t,m} > \lambda^{\mathscr{L}}_{t,nm} > \lambda^{\mathscr{L}}_{t,rm}$. 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 $\lambda^{\mathscr{L}}_{t,rm} > 0$: unskilled agents may even become net contributors to the scheme.

The return migration scenario is the most unfavourable for all groups. 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.

3.6. Altering the migration model

One might wonder whether our modelling of migration captures some relevant features 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. We present here two alternative stylised migration models. First, a model of *continuous migration*, where every period a share m of migrants over the total resident population arrives and remains in the country with their offspring who are immediately assimilated. Secondly, one could postulate a model 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, Eq. (12) for the labour market equilibrium and Eq. (17) 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:

$$\begin{aligned} e^*_{t-1} &< e^*_t = e^*_{t+1} = e^*_{t+i} \\ w_{t-1} &> w_t = w_{t+1} = w_{t+i} \\ \pi_{t-1} &< \pi_t = \pi_{t+1} = \pi_{t+i} \end{aligned} \tag{29}$$

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 conclusions achieved under the assimilation scenario.

If we consider return migration of the old and assimilation of the young, it is clear that this migration model is more favourable for residents than assimilation or return migration: 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 necessarily 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 do other pension reform proposals like funding or privatisation. Moreover, instead of strengthening the support to the existing pension scheme via the reduction in its solvency problems, migration can undermine it.

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. For example, 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.

Our analysis provides a public finance assessment of the costs and benefits of migration on a pay-as-you-go pension system. It does not capture *all* the costs and

benefits of migration on the recipient country's public finance resources. If a social safety net is present, migrants may benefit from it thus increasing the expenditure on welfare; they may also affect the financing of education and health. Our stylised model highlights that, even focusing on the area where the migrants' impact is expected to be financially positive, international migration raises inter and intragenerational redistributive issues which need to be taken into account. Moreover, to answer pension issues, education and integration policies cannot be left out of the picture.

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Appendix

In the paper we assume that τ is fixed and that per capita pensions adjust to balance the social security budget. Here we focus on the opposite case where p is fixed and the payroll tax τ_t varies in response to migration[34].

For the purpose of the financial sustainability analysis, nothing changes if we assume a variable contribution rate and constant benefits. If per capita pensions are constant, the increase in the contributory base at the time of migration allows a reduction of the payroll tax rate. This too represents a softened budget constraint. We now turn to the analysis of the joint redistributive effects of migration and pensions.

The assumption that pensions are fixed implies that migration affects lifetime income only through changes in net wages. It is trivial to conclude that the old at time t are not affected by migration[35].

If we focus on the young at time t, allowing for a variable payroll tax rate not only affects their net wages. It also influences their gross wages via the positive impact that a cut in taxes has on the decision to invest in human capital, as Eq. (3)

[34] Any combination between these two polar cases can be analysed and it gives rise to different redistributive flows between and within generations.

[35] The benchmark against which we compare the results of Appendix A is the no migration case.

shows[36]: namely, w increases and π decreases. We already know that migration moves w and π exactly in the opposite direction. Given these different effects at work, we cannot reach general conclusions on the impact of migration on lifetime incomes. Furthermore, nothing guarantees that the cut in payroll taxes makes everybody better off with respect to the case where the payroll tax is unchanged. If the distribution of costs is such that the cut in taxes never reduces the gross skilled wage below its level in the absence of migration, group $\mathcal{H}$ lifetime income unambiguously goes up. Regarding group $\mathcal{L}$, we can show that when e_t^* is fixed[37], the decrease in taxes can offset the negative impact of migration on wages, delivering a higher lifetime income, provided that $\beta + \tau > 1$. If e_t^* varies owing to migration and lower payroll taxes, the same result holds under a larger set of values because the decrease in the unskilled gross wage is lower. The $\mathcal{H}^M$ group is larger when pensions are fixed and the payroll tax is variable because agents invest in education in response to migration *and* to the cut in contributions. Within this group we still find that attitudes over migration are differentiated according to the cost of education.

The results established so far do not depend on the migration scenario adopted. On the other hand, the specification of the migration model is required to study the impact of migration on future generations. Focusing on the young at time $t+1$, they are not affected by migration only as long as there is an assimilation scenario: in this case taxes, wages and the skill share return to the pre-migration level leaving the young at time $t+1$ untouched. In all the other migration models the payroll tax rate does not go back to the time $t-1$ level: namely, τ_{t+1} is lower under return migration of the old and assimilation of the young and under continuous migration; it is higher under return migration. The implications on lifetime income can be analysed along the lines developed above.

Summarising, migration relaxes the social security budget constraint at time t. However, even when all the additional resources are transferred to the current working generation via a reduction in payroll contributions, migration can generate conflicting interests among resident workers. Moreover, variable payroll taxes shift onto future generations the costs/benefits of further adjustments that some migration models may impose.

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[36]Graphically, a decrease in τ shifts the $G(c_t^*)$ curve represented in Fig. 1 to the right.

[37]This is the worst case for unskilled workers. Notice also that if e_t^* is fixed the gross skilled wage unambiguously increases with respect to the no migration level.

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