Migration and public expenditure: the host country point of view

Giorgio Basevi
Alessandro Tarozzi

Department of Economics, University of Bologna

Introduction footnote

The flows of migration from neighbouring countries into the European Union have, since its inception, been more relevant than those of internal migration. Thus, labour movements from relatively less industrialized countries of the EU —such as Italy in the 50's— towards the relatively more advanced ones —such as France and Germany— quickly vanished after the European Community was established among the initial six members. Later, migration from Portugal and Spain towards the richer EU countries was again greatly reduced, when those countries, as Italy and Greece before them, also became members of the Community. Migration flows from Turkey, on the other hand, were slowed down only by specific restrictions, particularly in Germany, and will probably be no longer relevant once the customs union between the EU and Turkey is completed. In the meantime, migrants from Southern Mediterranean, Eastern European, and other extra-EU countries keep pressing at the EU borders. The recent flow of illegal immigrants from Albania, particularly into Italy and Greece, is only the latest and more dramatised example of a larger and continuing phenomenon.

Thus the issue of labour migration, as well as its legal or illegal aspects, is strictly intertwined —both theoretically and empirically— with the issue of economic integration, particularly when this takes place among countries that are relatively more advanced than their neighbours.

In this paper, as an attempt at exploring some theoretical basis of these phenomena, we consider a country into which immigration takes place exogenously. footnote The model used to describe its economy is based on overlapping generations. People go through two periods in their life. During the first period they work, consume and save, in order to afford consumption also in the second period, when they will no longer work.

The government taxes labour income in order to finance public expenditure, which takes the form of transfers to retired workers. footnote Thus government expenditures may be interpreted as a pension scheme based on the "pay as you go" system. Workers are both natives of the country, and immigrants. Without attaching any particular value judgment to it, we make the assumption that the government of the host country, in optimising its behaviour, takes into account only the utility of indigenous residents. footnote

We assume that the exogenous rate of immigration is higher than the rate of growth of native population. Also, we assume that, relative to a previous situation when the pension scheme was put in place, the rate of growth of indigenous population has fallen below the rate of interest. Thus promises of a "pay as you go" pension scheme can no longer be kept, and a new scheme based on capitalisation becomes superior. In such a situation, immigration is beneficial, in the sense that the government is able to keep the promises based on the "pay as you go" pension scheme, by drawing on the higher demographic fertility of the immigrant population.

Immigrants come and work in the host country either legally or illegally. Besides exploring the viability of the old pension scheme through immigration, we are interested in endogenising the share of total immigrants that come in legally, and in explaining the decision by legal immigrants to retire in the host country, or to return to their country of origin after their working period. We analyse two fiscal means through which the government of the host country can influence these decisions. They are the rate of labour income taxation, and the share of pension that the government will transfer to legal immigrants, in case they decide to return home, rather than remain in the host country, after retirement.

In Section 2 we present the structure of the basic model. Section 3 examines how the government can maximise the welfare of its natives by using fiscal instruments, that are related to the income of immigrants during both the working and the retirement periods of their life. Section 4 presents the conclusions that can be drawn from our analysis, and indicates directions for further research.

The model

In order to make welfare comparisons of alternative situations we take the point of view of the country into which immigration flows, i.e. the host country.

The following function specifies the utility of consumers, footnote as they work in period t and retire in period $t+1$:

$$U_t = c_{t,t}^{\alpha} c_{t,t+1}^{1-\alpha} \qquad \#$$

The economy produces only one good, according to the following production function:

$$Y_t = K_t^{\beta} L_t^{1-\beta} \qquad \#$$

Resident population footnote at time t (i.e. R_t) is made up of native workers ($N_{t,t}$), native retired people ($N_{t-1,t}$), newly immigrated workers ($M_{t,t}$), and retired guest workers ($M_{t-1,t}$):

$$R_t = (N_{t,t} + M_{t,t}) + (N_{t-1,t} + M_{t-1,t}) = L_{t,t} + N_{t-1,t} + M_{t-1,t} \qquad \#$$

where $L_{t,t} \equiv N_{t,t} + M_{t,t}$ is total labour force at time t. We assume that native people do not migrate, so that:

$$N_{t,t} = N_{t-1,t}(1+n) \qquad \#$$

where n is the given constant rate of growth of native population. Total immigrants ($M_{t,t}$) may reside and work legally ($\bar{M}_{t,t}$) or illegally ($\tilde{M}_{t,t}$) in the host country:

$$M_{t,t} \equiv \bar{M}_{t,t} + \tilde{M}_{t,t} \qquad \#$$

For simplicity we assume that both flows of immigration —legal and illegal— grow at the same rate m, so that:

$$M_{t,t} = M_{t-1,t-1}(1+m) \qquad \#$$

and that:

$$M_{t-1,t} = \bar{M}_{t-1,t} = \delta \bar{M}_{t-1,t-1} \qquad \#$$

where δ is the share of young legal immigrants that decide to remain in the host country after retirement. Note that in (ref: delta) we have implicitely assumed that all illegal immigrants must return to their country of origin after retirement.

The rate of immigration m is exogenous. The government of the host country provides public expenditure in the form of transfers paid to retired people, financed by taxation of labour incomes. Thus the government budget constraint is:

$$(N_{t-1,t} + \delta \bar{M}_{t-1,t-1}) g_t + (1-\delta) \bar{M}_{t-1,t-1} \theta g_t = \tau \omega_t \bar{L}_t \qquad \#$$

where

$$\bar{L}_t = N_{t,t} + \bar{M}_{t,t} = L_{t,t} - \tilde{M}_{t,t}$$

is the legal labour force, and where g_t is the basic per capita government transfer in real terms, τ is the rate of labour income taxation, and ω_t is the real wage. Note that in (ref: gbudget1) we have assumed that labour taxes are levied only on legal labour income, and that the same applies to government transfers. We have also assumed that legal immigrants returning to their country of origin after retirement receive only a part ($0 \leq \theta \leq 1$) of the basic transfer paid to all other (both native and immigrated) retired residents. Collecting terms in (ref: gbudget1) we get:

$$\{N_{t-1,t} + [\delta + \theta(1-\delta)]\bar{M}_{t-1,t-1}\}g_t = \tau\omega_t\bar{L}_t \quad \#$$

Consumers face different budget constraints, according to their status:
a) if they are natives, or legal immigrants that decide to retire in the host country:

$$p_t c_{t,t} + p_{t+1} c_{t,t+1} = (1-\tau)\omega_t p_t + p_{t+1} g_{t+1} \quad \#$$

b) if they are legal immigrants that decide to retire in their original country:

$$p_t \bar{c}_{t,t} + p_{t+1} \bar{c}_{t,t+1} = (1-\tau)\omega_t p_t + p_{t+1}\theta g_{t+1} \quad \#$$

c) if they are illegal immigrants:

$$p_t \tilde{c}_{t,t} + p_{t+1} \tilde{c}_{t,t+1} = (1-\chi)\omega_t p_t \quad \#$$

where χ is the rate of "taxation" that criminal organisations collect on illegal labour income to help them enter and work in the country illegally. As a first step, we assume that $\chi = \tau$. footnote We shall also assume that this tax is paid to foreign criminal organizations, whose members do not consume or save anything in the form of the host country product. Thus the tax revenue to criminal organisations is a complete loss of national product. footnote

Total residents' consumption at time t is

$$C_t = c_{t,t}(N_{t,t} + \delta\bar{M}_{t,t}) + \bar{c}_{t,t}(1-\delta)\bar{M}_{t,t} + \tilde{c}_{t,t}\tilde{M}_{t,t} + \\ + c_{t-1,t}(N_{t-1,t} + \delta\bar{M}_{t-1,t-1}) \quad \#$$

where the first three terms on the right hand side correspond to consumption by working residents (natives, legal and illegal immigrants), while the last term correspond to consumption by retired (native and immigrated) residents. Notice that this implies that international trade is only of an inter-temporal nature, i.e. it is assumed to be made up only of a flow of exports of the host country product, which is transferred by the government to those immigrants that decide to return in their country of origin after retirement. footnote Thus a structural trade surplus must be balanced by a structural international transfer of income.

Optimisation by producers implies that the two factors of production are paid their marginal productivities:

$$\begin{cases} r_{t+1} = \beta k_t^{\beta-1} \\ \omega_t = (1-\beta)k_t^{\beta} \end{cases} \quad \#$$

where r_{t+1} is the rate of return to capital, equal to the interest rate, from period t to period $t+1$, and

$$k_t \equiv K_t/L_t \equiv K_t/(N_{t,t} + \bar{M}_{t,t} + \tilde{M}_{t,t}) \quad \#$$

Optimisation by consumers —natives, legal and illegal immigrants— determines per capita consumption in the two periods:

$$\begin{cases} c_{t,t} = \alpha\left[(1-\tau)\omega_t + \frac{p_{t+1}}{p_t} g_{t+1}\right] \\ \bar{c}_{t,t} = \alpha\left[(1-\tau)\omega_t + \frac{p_{t+1}}{p_t}\theta g_{t+1}\right] \\ \tilde{c}_{t,t} = \alpha(1-\tau)\omega_t \end{cases} \quad \#$$

$$\begin{cases} c_{t,t+1} = (1+r_{t+1})(1-\alpha)\left[(1-\tau)\omega_t + \frac{p_{t+1}}{p_t} g_{t+1}\right] \\ \bar{c}_{t,t+1} = (1+r_{t+1})(1-\alpha)\left[(1-\tau)\omega_t + \frac{p_{t+1}}{p_t} \theta g_{t+1}\right] \\ \tilde{c}_{t,t+1} = (1+r_{t+1})(1-\alpha)(1-\tau)\omega_t \end{cases} \quad \#$$

Total capital accumulation results from domestic saving. We assume that the country builds its own capital stock by costless moulding of the consumption good into physical capital, and that it does so only on the basis of its own saving (by nationals, legal and illegal immigrants), without borrowing from abroad. Thus

$$\begin{aligned} K_{t+1} = &\left[(1-\alpha)(1-\tau)\omega_t - \alpha \frac{p_{t+1}}{p_t} g_{t+1}\right](N_{t,t} + \delta \bar{M}_{t,t}) + \\ &+ \left[(1-\alpha)(1-\tau)\omega_t - \alpha \frac{p_{t+1}}{p_t} \theta g_{t+1}\right](1-\delta)\bar{M}_{t,t} + \\ &+ (1-\alpha)(1-\tau)\omega_t \tilde{M}_{t,t} \end{aligned} \quad \#$$

Note that, in deriving (ref: indcons2), we have used the intertemporal equilibrium condition

$$1 + r_{t+1} = \frac{p_t}{p_{t+1}} \quad \#$$

In (ref: capital) we have also assumed that capital is wholly consumed by retired workers, who leave no bequests to the young generation. footnote

In order to compare different situations, we refer only to the utility derived from consumption by native residents. In other words, we assume that the welfare of immigrants is of relatively minor concern to the government of the host country. footnote Focusing on the utility function of native residents, we can see that, for given τ and g, it depends univocally on ω_t, and therefore on the capital/labour ratio k_t. Thus we need to make explicit the determinants of per-worker stock of capital. From (ref: capital) this is equal to:

$$\begin{aligned} k_{t+1} = &\frac{\left[(1-\alpha)(1-\tau)\omega_t - \alpha \frac{p_{t+1}}{p_t} g_{t+1}\right](N_{t,t} + \delta \bar{M}_{t,t})}{N_{t+1,t+1} + \bar{M}_{t+1,t+1} + \tilde{M}_{t+1,t+1}} + \\ &+ \frac{\left[(1-\alpha)(1-\tau)\omega_t - \alpha \frac{p_{t+1}}{p_t} \theta g_{t+1}\right](1-\delta)\bar{M}_{t,t}}{N_{t+1,t+1} + \bar{M}_{t+1,t+1} + \tilde{M}_{t+1,t+1}} + \\ &+ \frac{(1-\alpha)(1-\tau)\omega_t \tilde{M}_{t,t}}{N_{t+1,t+1} + \bar{M}_{t+1,t+1} + \tilde{M}_{t+1,t+1}} \end{aligned} \quad \#$$

Note that, from the government budget constraint (ref: gbudget1), we have:

$$g_t = \frac{\tau \omega_t \bar{L}_t}{N_{t-1,t} + [\delta + \theta(1-\delta)]\bar{M}_{t-1,t-1}} \quad \#$$

Leading forward (ref: gt) by one period, substituting the expression for ω_{t+1}, and dividing numerator and demominator by $N_{t,t}$ we get: footnote

$$g_{t+1} = \frac{\tau(1-\beta)k_{t+1}^{\beta}\left[(1+n) + \frac{\bar{M}_0}{N_0}(1+m)\left(\frac{1+m}{1+n}\right)^t\right]}{1 + [\delta + \theta(1-\delta)]\frac{\bar{M}_0}{N_0}\left(\frac{1+m}{1+n}\right)^t}$$

Assuming $m > n$ and taking the limit for $t \to \infty$, we get the steady state value:

$$g_M^* = \frac{\tau(1-\beta)(k_M^*)^\beta(1+m)}{\delta+\theta(1-\delta)} \qquad \#$$

where the $*$ and the index M denote the value of a variable in steady states with migration.

Similarly, dividing by $N_{t,t}$ both numerator and denominator in (ref: smallk), we get:

$$\begin{aligned} k_{t+1} = & \frac{\left[(1-\alpha)(1-\tau)(1-\beta)k_t^\beta - \alpha\frac{p_{t+1}}{p_t}g_{t+1}\right](1+\delta\bar{Q}_t)}{1+n+(1+m)\bar{Q}_t+(1+m)\tilde{Q}_t} + \\ & + \frac{\left[(1-\alpha)(1-\tau)(1-\beta)k_t^\beta - \alpha\frac{p_{t+1}}{p_t}\theta g_{t+1}\right](1-\delta)\bar{Q}_t}{1+n+(1+m)\bar{Q}_t+(1+m)\tilde{Q}_t} + \\ & + \frac{(1-\alpha)(1-\tau)(1-\beta)k_t^\beta\tilde{Q}_t}{1+n+(1+m)\bar{Q}_t+(1+m)\tilde{Q}_t} \end{aligned} \qquad \#$$

where

$$\bar{Q}_t \equiv \frac{\bar{M}_0}{N_0}\left(\frac{1+m}{1+n}\right)^t;\text{ and } \tilde{Q}_t \equiv \frac{\tilde{M}_0}{N_0}\left(\frac{1+m}{1+n}\right)^t$$

For $t \to \infty$ (ref: smallk2) becomes:

$$k_M^* = \frac{(1-\alpha)(1-\tau)(1-\beta)(k_M^*)^\beta}{1+m} - \frac{\alpha g_M^*\bar{M}_0\frac{p_{t+1}}{p_t}[\delta+\theta(1-\delta)]}{(1+m)(\bar{M}_0+\tilde{M}_0)}$$

and defining

$$\bar{\mu} \equiv \frac{\bar{M}_0}{\bar{M}_0+\tilde{M}_0}\text{ ; and }\tilde{\mu} \equiv \frac{\tilde{M}_0}{\bar{M}_0+\tilde{M}_0} = 1-\bar{\mu}$$

we have:

$$k_M^* = \frac{(1-\alpha)(1-\tau)(1-\beta)(k_M^*)^\beta - \alpha\bar{\mu}g_M^*\frac{p_{t+1}}{p_t}[\delta+\theta(1-\delta)]}{1+m}$$

Substituting for g_M^* from (ref: gm1) we get

$$k_M^* = (1-\beta)(k_M^*)^\beta\frac{(1-\alpha)(1-\tau)-\alpha\tau\bar{\mu}(1+m)\frac{p_{t+1}}{p_t}}{1+m} \qquad \#$$

We assume that the rate of growth of native population, n, is lower than r. Thus a ”pay as you go” pension scheme —possibly based on a higher native rate of growth that has steadily decreased— is no longer viable and has become inferior to one based on capitalisation, if the country is demographically isolated from the rest of the world. However, as demographic growth in other countries, and immigration from them, are assumed to be higher, the government should control the financing of its pension transfers so as to make $m = r > n$. By so doing it maximises the intergenerational welfare of natives with a ”pay a as you go” pension scheme.

In order to reach this situation, the government will have to select the appropriate labour tax rate $\tau = \tau^*$ that is enough to finance such a scheme under the golden rule $m = r$. Thus, making use of the equation

$$\frac{p_{t+1}}{p_t} = \frac{1}{1+r^*} = \frac{1}{1+m} \qquad \#$$

and solving (ref: kstar1) for the steady state level of k_M^*, we obtain:

$$k_M^* = \left[\frac{(1-\beta)(1-\alpha+\alpha\tau^*(1-\bar{\mu})-\tau^*)}{1+m} \right]^{\frac{1}{1-\beta}} \quad \#$$

It follows that the steady state level of the real wage is:

$$\omega_M^* = (1-\beta)\left[\frac{(1-\beta)(1-\alpha+\alpha\tau^*(1-\bar{\mu})-\tau^*)}{1+m} \right]^{\frac{\beta}{1-\beta}} \quad \#$$

so that

$$g_M^* = \frac{\tau^*(1-\beta)(1+m)}{\delta+\theta(1-\delta)}\left[\frac{(1-\beta)(1-\alpha+\alpha\tau^*(1-\bar{\mu})-\tau^*)}{1+m} \right]^{\frac{\beta}{1-\beta}} \quad \#$$

Controlling the status of immigrants through fiscal policy

The optimal level of income taxation

We have assumed that the government sets $\tau = \tau^*$ so as to maximise intergenerational welfare, for a given rate of growth m of total immigration. However, the utility attained by residents with migration, depends on the share of legal immigrants that decide to repatriate after retirement, and on the share of immigrants that are illegal. In fact these shares determine the capital stock and the wage rate of the economy. Thus, overall there are two fiscal instruments, θ and τ, through which the government can try to maximise the level of utility of its nationals in the presence of migration. From (ref: utility) and (ref: c1budget) we have:

$$U_{Mt} = \alpha^\alpha[(1+r_{t+1})(1-\alpha)]^{1-\alpha}\left[(1-\tau)\omega_t + \frac{p_{t+1}}{p_t}g_{t+1} \right]$$

Making use of (ref: grule), this becomes:

$$U_{Mt} = \alpha^\alpha[(1+m)(1-\alpha)]^{1-\alpha}\left[(1-\tau^*)\omega_t + \frac{1}{1+m}g_{t+1} \right]$$

Substituting the steady state values of ω_M^* and g_M^* from (ref: omegam) and (ref: gm2) we get:

$$U_M^* = A_M\left(1-\tau^* + \frac{\tau^*}{\delta+\theta(1-\delta)} \right)\left(\frac{(1-\beta)[1-\alpha-\tau^*(1-\tilde{\mu}\alpha)]}{1+m} \right)^{\frac{\beta}{1-\beta}} \quad \#$$

where

$$A_M \equiv (1-\beta)\alpha^\alpha[(1-\alpha)(1+m)]^{1-\alpha} \quad \#$$

Since U_M^* and τ^* are at their optimal level, we must have:

$$0 = \left.\frac{\partial U_M^*}{\partial \tau}\right|_{\tau=\tau^*} = A_M\frac{\beta}{1+m}[1-\alpha\tilde{\mu}] \bullet$$
$$\bullet \left(1-\tau^* + \frac{\tau^*}{\delta+\theta(1-\delta)} \right)\left(\frac{(1-\beta)[1-\alpha-\tau^*(1-\tilde{\mu}\alpha)]}{1+m} \right)^{\frac{2\beta-1}{1-\beta}} +$$
$$+ A_M\left(1 - \frac{1}{\delta+\theta(1-\delta)} \right)\left(\frac{(1-\beta)[1-\alpha-\tau^*(1-\tilde{\mu}\alpha)]}{1+m} \right)^{\frac{\beta}{1-\beta}}$$

from which we get:

$$\tau^* = \beta + \frac{(1-\alpha)(1-\beta)}{[1-\alpha\tilde{\mu}]} - \frac{\beta}{1-[\delta+\theta(1-\delta)]} \quad \#$$

Note that, for given $\theta < 1$, the optimal rate of labour income taxation in (ref: taustar) is lower the higher is the share δ of immigrants that decide to remain in the host country after retirement, and the higher is the ratio θ. Moreover it is higher the larger is the share $\tilde{\mu} = 1 - \bar{\mu}$ of immigration which is illegal. While the last result appears intuitive, the first two may seem puzzling. Further analysis is required.

The optimal level of transfer to non-resident immigrants

Considering again equation (ref: Um), we can see that U_M^* is a negative function of θ. It follows that, for given δ and τ, the value of θ that maximises the nationals' utility would be $\theta = 0$. In other words, if the quota $1 - \delta$ of legal immigrants that decide to retire in their home country is exogenous, it is clear that the government of the host country, since it cares only about its nationals' utility (or rather, its permanent residents' utility), should minimise the amount of transfer paid to immigrants that retire in their country of origin. Such a policy, in the situation described by our model, it would be tantamount to confiscating their pension credit.

The choice to retire in the home country

Assume, however, that the quota $1 - \delta$ of legal immigrants that retire in their home country is a positive function of the share θ of the basic transfer, to which they are entitled if they return home. In other words, let us assume that

$$\delta = f(\theta) \text{ with } f' < 0 \quad \#$$

Let us also assume that the share of illegal immigrants is a decreasing function of τ. In fact illegal immigrants are supposed not to have other choice than going back to their country of origin after retirement, obviously without any transfer from the host country government. As they pay ”taxes” like legal immigrants —in the sense that they get the same net real wage—, but get no transfer when retired in their home country, their incentive to be legal rather than illegal is primarily a negative function of τ, footnote which for them corresponds to a pure loss of income. Thus we assume:

$$\tilde{\mu} = \varphi(\tau) \text{ with } \varphi' < 0 \quad \#$$

From (ref: Um) we have:

$$\begin{aligned} U_M^* &= A_M\left(1-\tau^* + \frac{\tau^*}{\delta+\theta(1-\delta)}\right)\left(\frac{(1-\beta)[1-\alpha-\tau^*(1-\tilde{\mu}\alpha)]}{1+m}\right)^{\frac{\beta}{1-\beta}} \\ &= F_M\left(1-\tau^* + \frac{\tau^*}{\delta+\theta(1-\delta)}\right)[1-\alpha-\tau^*(1-\tilde{\mu}\alpha)]^{\frac{\beta}{1-\beta}} \end{aligned} \quad \#$$

where

$$F_M \equiv A_M\left(\frac{1-\beta}{1+m}\right)^{\frac{\beta}{1-\beta}} \quad \#$$

Substituting (ref: deltaf) and (ref: muf) we get:

$$U_M^* = F_M\left(1-\tau^* + \frac{\tau^*}{f(\theta)+\theta(1-f(\theta))}\right)[1-\alpha-\tau^*(1-\varphi(\tau^*)\alpha)]^{\frac{\beta}{1-\beta}} \quad \#$$

Let us specifically assume that:

$$\delta = f(\theta) = \delta_0 + \delta_1\theta \text{ with } \delta_1 < 0 \qquad \#$$

with

$$\begin{cases} f(1) = 0 \\ f(0) = \rho \leq 1 \end{cases} \qquad \#$$

In words, ρ is the share of immigrants that remain in the host country after retirement, when the host country government does not trasfer anything to them in case they were to return home. Thus the complementary parameter $1 - \rho$ measures the immigrants' desire to return home when retired. footnote Note also that in (ref: ass2) we have assumed that, if immigrants were to receive the whole of the basic transfer when they retire in the home country, then they will all decide to return home.

Making use of both (ref: deltass) and (ref: ass2), we have:

$$\begin{cases} 0 = \delta_0 + \delta_1 \\ \rho = \delta_0 = -\delta_1 \end{cases} \qquad \#$$

Thus $f(\theta)$ becomes:

$$f(\theta) = \rho(1 - \theta) \qquad \#$$

The choice to immigrate illegally

Let us also assume that

$$\tilde{\mu} = \varphi(\tau) = \tilde{\mu}_0 + \tilde{\mu}_1\tau \text{ with } \tilde{\mu}_1 < 0 \qquad \#$$

with

$$\begin{cases} \varphi(1) = 0 \\ \varphi(0) = \lambda \leq 1 \end{cases} \qquad \#$$

In other words, λ is the maximum share of immigrants that enter the country illegally, and it corresponds to the zero level of labour income taxation ($\tau = 0$). Conversely, when $\tau = 1$, all immigrants enter the country legally, footnote i.e. $\lambda = 0$. Thus we have:

$$\begin{cases} 0 = \tilde{\mu}_0 + \tilde{\mu}_1 \\ \lambda = \tilde{\mu}_0 = -\tilde{\mu}_1 \end{cases} \qquad \#$$

so that the $\varphi(\tau)$ function becomes:

$$\varphi(\tau) = \lambda(1 - \tau) \qquad \#$$

Substituting, we get:

$$U_M^* = F_M\left(1 - \tau^* + \frac{\tau^*}{\rho(1-\theta)^2 + \theta}\right)[1 - \alpha - \tau^*(1 - \lambda(1 - \tau^*)\alpha)]^{\frac{\beta}{1-\beta}} \qquad \#$$

from which it can be seen that, in order to mazimise U_M^* by controlling θ, it is enough to minimize $\rho(1-\theta)^2 + \theta$ with respect to θ. Thus, the first order condition requires:

$$\frac{\partial[\rho(1-\theta)^2+\theta]}{\partial\theta} = -2\rho(1-\theta^*)+1 = 0$$

or

$$\theta^* = 1 - \frac{1}{2\rho} \qquad \#$$

Note that, since it cannot be negative, the optimum value of θ^* reduces to $\theta^* = 0$ when $\rho \leq 1/2$. This means that, if more than half of guest workers decide to return home after retirement even without getting any transfer, it is better for the goverment not to pay them anything, so as to increase the amount of resources available to nationals. Note also that:

$$\frac{\partial\theta^*}{\partial\rho} = \frac{1}{2\rho^2} > 0$$

i.e., the lower the desire by immigrants to return home after retirement (as measured by $1-\rho$), the higher the share of pensions that the government will pay them in case they do retire in their home country.

We can now solve for the optimal value τ^* in terms of the optimal values of δ and θ. footnote Considering that (ref: deltass) implies

$$\delta^* = \delta_0 + \delta_1\theta^* = \rho - \rho\frac{2\rho-1}{2\rho} = 1/2$$

and recalling that:

$$\tau^* = \beta + \frac{(1-\alpha)(1-\beta)}{[1-\alpha\tilde{\mu}]} - \frac{\beta}{1-[\delta+\theta(1-\delta)]}$$

we substitute (ref: mutilde) and get

$$\tau^* - \frac{(1-\alpha)(1-\beta)}{[1-\alpha\lambda(1-\tau^*)]} = \beta - \frac{2\beta}{1-\theta^*} \qquad \#$$

Substituting (ref: tetastar) we have an equation of second degree in τ^*:

$$\alpha\lambda(\tau^*)^2 + [1-\alpha\lambda(\beta(1-4\rho)+1)]\tau^* - [(1-\alpha)(1-\beta)+\beta(1-4\rho)(1-\alpha\lambda)] = 0 \qquad \#$$

We would like to know how τ^* depends on the parameters α, β, λ, and ρ. Before doing so, however, we want first to check the form that the expression takes when all migration is legal, i.e. when $\lambda = 0$. In this case we have

$$\tau^* = 1-\alpha(1-\beta)-4\beta\rho$$

so that the optimal tax rate τ^* is clearly decreasing in ρ. In other words, the lower the degree of attachment to their country of origin on the part of immigrants, as measured by $1-\rho$, the higher the optimal rate of labour income taxation.

Returning to the case of both legal and illegal migration, unfortunately no closed form can be meaningfully analysed for the roots of equation (ref: tausquare). We have therefore proceeded to their numerical interpolation for different values of the parameters α, β, λ, and ρ.

By so doing we can, in particular, obtain two results that are of interest from the point of view of this paper. In fact we can see that τ^*, the optimal tax rate on labour income is (i) increasing in λ, and (ii) decreasing in ρ.

As for (i), the higher the maximum rate of immigrants that enter the country illegaly, as measured by λ, the higher is the optimal rate of taxation of labour income. This first result is intuitive: illegal immigrants do not contribute to financing the pension scheme, but neither they draw on its resources. However, by increasing the host country's labour force, they tend to reduce the real wage, and therefore the taxation base for the pension scheme. It follows that a higher rate of labour income taxation is required to finance the scheme.

As for (ii), the higher the share of legal immigrants that prefer to remain in the host country after retirement, as measured by ρ, the lower the optimal rate of labour income taxation. This may be puzzling, and is certainly not as intuitive as the first result. However, it follows from legal immigrants being "exploited" if they decide to repatriate, since in this case they are not paid the full amount of the pension ($\theta < 1$). Thus residents (and also remaining immigrants) may extract revenue from repatriating immigrants by raising the labour income tax. The higher the share of repatriating immigrants, the higher the incentive to raise the income tax, whence the result follows.

Conclusions and future extensions

We conclude that, while immigration is generally beneficial in the steady state with a "pay as you go" scheme of pensions, the optimal degree of transfer of pensions to immigrants that return home depends negatively on the share of immigrants that strongly desire to return home after retirement. footnote

Moreover, the optimal degree of labour income taxation is increasing with the share of immigrants that are "home-sick" enough, after retirement.

Our model has also taken into account illegal migration. We have assumed that illegal immigrants get the same net wage as legal immigrants, but, instead of paying taxation on their labour income, they pay a fee to the criminal organisations that help their illegal immigration.

It has been shown that, beside influencing the share of legal immigrants that decide to remain in the country after retirement, the government, by controlling the rate of labour income taxation, can also optimise with respect to the share of immigrants that come illegally into the country.

In conclusion, two interesting results stand out: (i) the higher the maximum rate of immigrants that enter the country illegaly, the higher is the optimal rate of taxation of labour income; (ii) the higher the share of legal immigrants that prefer to remain in the host country after retirement, the lower the optimal rate of labour income taxation.

Appendix

$$\tau^* = \frac{-[1-\beta(1-4\rho)\alpha\lambda-\alpha\lambda]}{2\alpha\lambda} \pm \frac{\left\{[(1-\alpha\lambda)-\beta(1-4\rho)\alpha\lambda]^2+4\alpha\lambda[(1-\alpha)(1-\beta)+\beta(1-4\rho)(1-\alpha\lambda)]\right\}^{1/2}}{2\alpha\lambda}$$

$$\frac{\partial\tau}{\partial\lambda} = \frac{1}{2\alpha\lambda^2} + \frac{1}{4\alpha\lambda}\frac{1}{\left\{[(1-\alpha\lambda)-\beta(1-4\rho)\alpha\lambda]^2+4\alpha\lambda[(1-\alpha)(1-\beta)+\beta(1-4\rho)(1-\alpha\lambda)]\right\}^{1/2}} + - \frac{1}{2\alpha\lambda^2}\left\{[(1-\alpha\lambda)-\beta(1-4\rho)\alpha\lambda]^2+4\alpha\lambda[(1-\alpha)(1-\beta)+\beta(1-4\rho)(1-\alpha\lambda)]\right\}^{1/2}$$

BaseTar Basevi G., Tarozzi A. (1997), "The choice to migrate: where to work and where to live", Dipartimento di Scienze Economiche, Università di Bologna, July.

Daveri Daveri F., Faini R. (1995), "Where do migrants go? Risk-aversion, mobility costs and the locational choice of migrants", Banca d'Italia, *Temi di discussione del Servizio Studi*, n. 290, December.

Faini Faini R. (1995), "Increasing Returns, Migration and Convergence", *Journal of Development Economics*, 49 (1), April, pages 121-36.

Panos Hatzipanayotou P., Gatsios K., Michael M. (1997), ”Trade liberalisation and public good provision: migration promoting or migration demoting”, paper presented at the Annual Congress of the European Economic Association, Toulouse, August 31-September 2.