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Regional Insurance and Migration

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Abstract

A dynamic model of migration is developed to study whether labor mobility can hedge people against region-specific shocks, making private or public insurance redundant. The model adopts a novel timing for migration, which is argued to be the time frame suitable for analyzing risk-sharing issues. It also innovates on the existing literature by solving individual migration through convexification of the set of actions. The results show that the role of migration as an insurance mechanism is small: labor mobility cannot fully remove income differentials between regions. It is also shown that a fiscal stabilization scheme is, in general, optimal; moreover, any pure risk-sharing mechanism has no influence on migration flows.

Keywords: Mobility under uncertainty; stabilization policy

JEL classification: *D*81; *E*32; *F*15; *H*70; *R*23

I. Introduction

By joining the European Monetary Union (EMU), individual countries give up the exchange rate instrument and the ability to use independent monetary policies. At the same time, they have less leeway to pursue an active fiscal policy. This process is likely to involve a lack of instruments for coping with regional imbalances. Mundell (1961) identifies three main mechanisms for absorbing idiosyncratic shocks within a currency area: price flexibility, factor mobility and fiscal transfers. According to the empirical literature surveyed in Bayoumi and Eichengreen (1999), EMU does not meet any of these criteria.[1] In particular, whereas the central fiscal system itself acts as an automatic stabilizer in countries or federations of states, this mechanism cannot be at work in EMU because the European Union (EU) central budget is too small.

So far, enlargement of the EU's central budget and transfer programs does not seem to be an available option from a political point of view. Nor is it

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[1]See also Obstfeld and Peri (1998).

reasonable to expect a dramatic increase in price flexibility after EMU. Therefore, it is necessary to explore how alternative devices work in buffering regional shocks; here we focus on labor mobility. In this spirit, Wildasin (1995, pp. 529–530) claims that "the integration of labor markets can itself insure workers from income risk, obviating the need for any explicit private or public insurance".

In this paper, it is argued that the equilibrating role of labor mobility and fiscal transfers definitely indeed depends on the persistence of regional imbalances, and it is shown that they are not alternative adjustment mechanisms in the context of temporary idiosyncratic shocks. Interest in temporary shocks is generated by the ongoing debate on regional insurance in the EMU; i.e., arrangement of some kind of stabilization scheme through an increase in interregional transfers. The debate has repeatedly stressed the distinction between risk-sharing (or stabilization) and long-run redistribution across regions. To separate risk insurance from redistribution we need to highlight the distinction between permanent and transitory shocks. Any long-run redistributive policy should be concerned with long-term inequalities, whereas pure risk-sharing schemes should be concerned only with temporary, unexpected income fluctuations.[2]

In this paper, we focus on temporary shocks (risk-sharing) and develop a model of labor mobility in a dynamic, stochastic environment. Three main features of the model allow us to deal with the relationship between risk-sharing and migration. First, we consider recurrent uncertainty, as opposed to long-run inequalities. Under ongoing uncertainty, any present income differential between regions can be reversed by a new shock. It follows that rational agents take into account the possibility of return migration and this influences their current migration decisions.[3] Second, we model risk-averse agents. This is crucial when dealing with risk insurance.[4] Third, we introduce a novel timing for migration: it takes place prior to realization of the shock. In other words, an agent first decides where to work and only after working does he receive his wage and know his own income with certainty. This timing arises directly from the aim of the paper. By definition, risk exists if a decision-maker, when choosing among alternatives, does not know with certainty their future outcome. Risk-averse agents insure themselves before knowing the realization of the shock: this is where the distinction between insurance and redistribution comes in. Given that we are looking at migra-

[2]The point was first made by von Hagen (1992). The persistence of the shocks turns out to be fundamental for empirical evaluation of the insurance provided through a centralized fiscal system; see Asdrubali, Sorensen and Yosha (1996), Bayoumi and Masson (1995), and Fatás (1998).

[3]As in Bertola and Ichino (1995), Dixit and Rob (1994b) and Hercowitz and Pines (1991).

[4]The assumption of a linear utility function is made by Bertola and Ichino (1995), Burda (1995) and Hercowitz and Pines (1991).

tion as a substitute for an insurance mechanism, the information constraints should be the same in both cases. A second reason to assume an adjustment lag for migration is that, trivially, moving requires time.

We also model a simple, centrally provided stabilization mechanism, which works through a tax/transfer activity, and study the interplay between fiscal insurance and migration.

We address these issues by looking at two different economies. We begin by assuming that migration is decided by a social planner that moves people between locations according to the expected income differential. Individuals either are moved or stay, and they bear the risk once they are in a region. In a simple framework with recurrent uncertainty and time-consuming migration, this assumption allows us to explore the effectiveness of labor mobility versus fiscal transfers in eliminating regional income differentials.

However, a more satisfactory answer requires an analysis of how temporary shocks affect the individual decision to move. Here, one key problem is that migration is a binary decision and, in general, people cannot diversify geographical risk by moving, since they cannot diversify their geographical location.[5] We solve this problem by allowing the individual to choose not a location, but a probability of moving. The resulting convexification of the set of actions provides a convenient analytical framework for dealing with migration and it greatly simplifies the aggregation of individual decisions.

Our main result is that the role of migration in absorbing regional idiosyncratic shocks is small: labor mobility cannot fully remove income differentials between regions. It is well known that a positive marginal cost of migration generates an inaction zone—a region of the state space where not moving is optimal. Dixit and Rob (1994a, 1994b) show that ongoing uncertainty greatly magnifies this region.[6] In our model, due to the time lag, inaction can be optimal even with no migration costs.

A second conclusion is that, even in a fully integrated labor market, a centrally provided stabilization mechanism is, in general, optimal. The optimality of a fiscal insurance scheme needs to be qualified. Indeed, individuals (and regions) can also insure themselves privately; they can share idiosyncratic risks via interregional capital mobility and they can smooth consumption through borrowing and lending. Here, we completely disregard the role of capital markets and constrain the model to only incorporate

[5]The relationship between risk insurance and migration is explored by Stark (1991). In Stark's analysis, migration is decided by the household, not the individual. It follows that, by diversifying destination areas among the household's members, migration provides a way of reducing the risk to family wages. Note, incidentally, that Wildasin's (1995) framework avoids this problem, since people migrate after the uncertainty is resolved.

[6]A related point is made by Burda (1995): fixed mobility costs plus uncertain future gains create an option value of waiting for migration.

shocks that cannot be insured privately, due to market imperfections.[7] Although it would certainly be worth exploring how alternative market mechanisms for consumption smoothing interact with migration and fiscal transfers, we leave this task for future research.[8]

We also show that labor mobility and fiscal transfers are mutually exclusive only under extreme circumstances. Moreover, any pure risk-sharing mechanism has no influence on migration flows. On the contrary, attempts to reduce long-run regional inequalities might prevent labor mobility from working in the right direction. Previous research on regional insurance in the EMU concludes that Europe needs a stabilization mechanism which does not excessively overlap with redistribution;[9] our results confirm that a clear distinction between temporary and permanent idiosyncratic shocks is of crucial importance.

The paper proceeds as follows. The formal framework is outlined in Section II and the social planner problem is solved in Section III. Section IV models migration as an individual decision, by introducing migration lotteries. Section V concludes.

II. The Analytical Framework

Consider an economy populated by a *continuum* of identical, infinitely lived agents, characterized by an instantaneous utility function $u : C \rightarrow R^+$, defined over the single, non-storable consumption good; assume $u' > 0$, $u'' \leqslant 0$ and time separability. Agents maximize their expected utility discounting future periods at the constant rate $\beta < 1$.

There are two regions, h and f. n_t^i indicates the number of inhabitants in region i at time t, where $i = \{h; f\}$; $n_t = \{n_t^h; n_t^f\}$ is the distribution of population between regions. Every agent i is endowed with one unit of labor,

[7]The literature on regional insurance in the EMU assumes, implicitly or explicitly, that capital markets can provide only incomplete insurance against asymmetric shocks. Empirical studies find that this insurance is, in fact, very limited; see Sorensen and Yosha (1998) and von Hagen and Hammond (1998).

[8]See Bertola (1999) for a model of job-to-job mobility with imperfect consumption smoothing over time.

[9]The main reason is that the long-run real exchange rate depends on neither the nominal exchange rate regime nor the empirical significance of short-run price rigidities. von Hagen and Hammond (1998) point out how moral hazard problems inherent in a fiscal transfer mechanism are reduced when the mechanism does not entail permanent redistribution across regions. Moreover, as a matter of political practicability, transfers across regions should be clear and conscious, since distributive issues too often underlie requests for greater local autonomy. Mélitz and Vori (1993) and Italianer and Vanheukeler (1997) design a scheme that tries to capture the main benefits of regional insurance without involving systematic income redistribution.

which he supplies inelastically in region i. Population is constant over time and, without loss of generality, we normalize $n_t^h + n_t^f = 1$.

In each region a non-tradable consumption good is produced according to the following production function:

$$y_t^i = n_t^i \bar{y} + \theta_t^i, \tag{1}$$

where y_t^i is the production in region i at time t, $\bar{y}$ is the constant marginal productivity of labor and $\theta_t^i \geqslant 0$ is a region-specific shock, which follows a first-order Markov process. $\theta_t = \{\theta_t^h; \theta_t^f\}$ is the realization of the random process. We also assume $\theta_t^h + \theta_t^f = \theta$ where θ is independent of time. The assumption of additive shocks, plus the constant marginal productivity of labor, guarantees that total production is constant over time:[10] $\bar{Y} = \bar{y} + \theta$.

There are no markets for sharing risk.[11] Each period per-capita income w_t^i is:

$$w_t^i = \bar{y} + \frac{\theta_t^i}{n_t^i}. \tag{2}$$

In the economy there is a central *fiscal authority*, whose objective is to maximize total individual utility. The fiscal authority taxes individual incomes at the flat rate τ_t. A constant proportion γ of the revenues is redistributed equally among individuals. The remaining $(1 - \gamma)$ is wasted; it can be thought of as the amount of resources needed in order to maintain the central fiscal authority.[12] After taxes and transfers, per-capita income is:

$$w_t^{id} = \bar{y} + \frac{\theta_t^i}{n_t^i} + \tau_t \left[(\gamma - 1)\bar{y} + \gamma\theta - \frac{\theta_t^i}{n_t^i} \right]. \tag{3}$$

We now introduce *migration*. The timing is such that migration is prior to the realization of the shock. Migration takes place at the end of each period; hence, the period $t + 1$ distribution of population (n_{t+1}) is determined at the end of period t, when realization of the shock (θ_{t+1}) is still unknown. Note

[10] We could have allowed for aggregate fluctuations, but, since we are focusing on risk insurance, only income differentials matter. The main shortcoming of this simplification is that migration serves no efficiency purpose.

[11] Since there is no storable good in the economy, individuals cannot achieve insurance indirectly by consumption smoothing over time.

[12] Technically, the parameter γ is needed in order to introduce some kind of inefficiency, otherwise we would get the trivial conclusion that it is always optimal to provide complete stabilization.

that in this model, gross migration and net migration coincide; therefore we can assume, without loss of generality,

$$E_t\left(\frac{\theta^f_{t+1}}{n^f_t}\right) \geqslant E_t\left(\frac{\theta^h_{t+1}}{n^h_t}\right), \tag{4}$$

so that, if any migration occurs at time t, it takes place from region h to region f.

Within each period t, first the fiscal authority fixes the tax rate τ_t, given the current distribution of population n_t and the realization of the shock θ_t. Agents receive their income, pay taxes to and get a transfer from the central government. Once w^{id}_t is known, migration is decided and n_{t+1} is determined. In the case where no migration is planned, then, for the monotonicity of the utility function, the whole income is consumed. If, on the contrary, an agent moves, then he has to pay a migration cost, z_t, measured in consumption units, where the subscript t refers to the period in which the cost is to be paid. At the end of the period, after consuming $w^{id}_t - z_t$, the agent migrates, so that at period $t+1$ he will be able to work in the new region, getting w^{jd}_{t+1}. It is worth stressing that the timing of migration does not apply to the fiscal decision. We return to this assumption later on.

III. The Social Planner Problem

We now assume that a social planner can move people between locations and tax/transfer personal income. The social optimum solves the following maximization problem:

$$\max_{\tau_t, n^i_{t+1}} E_0\left[\sum_{t=0}^{\infty}\beta^t(n^h_t u(c^h_t) + n^f_t u(c^f_t))\right] \tag{5}$$

s.t.

$$n^h_t c^h_t + n^f_t c^f_t \leqslant [1-\tau_t(1-\gamma)](\bar{y}+\theta), \tag{6}$$

$$c^i_t = \bar{y} + \frac{\theta^i_t}{n^i_t} + \tau_t\left[(\gamma-1)\bar{y} + \gamma\theta - \frac{\theta^i_t}{n^i_t}\right] - Z_t(\Delta n^i_{t+1}), \tag{7}$$

$$n^i_0,\ \theta^i_0 \text{ given,}$$

where E_0 is the expectation operator conditional on information available at time zero.

The expression inside brackets in (5) is the discounted sum of total utilities: the utility of agents living in region h, multiplied by the number of inhabitants in that region, plus the same expression for region f. Constraint (6) ensures that total consumption in the two regions, plus the government's waste of resources, cannot exceed total output. Constraint (7) gives individual consumption in each region, where $Z_t\ (\Delta n^i_{t+1})$ is the total cost of migration, a generic function of the number of people that migrate:

$$Z_t(\cdot) = \begin{cases} Z(\Delta n^i_{t+1}) & \text{if } \Delta n^i_{t+1} < 0 \\ 0 & \text{if } \Delta n^i_{t+1} \geqslant 0, \end{cases} \tag{8}$$

with $\Delta n^i_{t+1} = n^i_{t+1} - n^i_t$. We assume differentiability of the cost function with $Z'_t(\cdot) > 0 \Leftrightarrow \Delta n^i_{t+1} < 0$. The cost of migration is shared equally among all agents, which implies $Z_t = z_t$. Finally, the control variables at time t are the current tax rate τ_t and the next-period distribution of population n_{t+1}.

Migration

It is instructive to start by assuming that there is no fiscal authority in the economy. This corresponds to problem (5)–(7) with $\tau = 0$ in every period and with migration as the only choice variable for the planner.

The optimality condition for migration policy is:

$$\begin{aligned}
&[n^h_t u'(c^h_t) + n^f_t u'(c^f_t) + \lambda_t] z'_t(\Delta n^h_{t+1}) \\
&\quad \leqslant \beta E_t \left\{ \left[u(c^h_{t+1}) - \frac{\theta^h_{t+1}}{n^h_{t+1}} u'(c^h_{t+1}) \right] - \left[u(c^f_{t+1}) - \frac{\theta^f_{t+1}}{n^f_{t+1}} u'(c^f_{t+1}) \right] \right\} \\
&\qquad + (-1)^k \beta E_t \{ [n^h_{t+1} u'(c^h_{t+1}) + n^f_{t+1} u'(c^f_{t+1}) + \lambda_{t+1}] z'_{t+1}(\Delta n^i_{t+2}) \},
\end{aligned} \tag{9}$$

where $k = 2$ if $i = h$; $k = 1$ if $i = f$.

The important result we get from (9) is that labor mobility does not guarantee individual income equalization between regions and, in general, $(\theta^f_t / n^f_t) \neq (\theta^h_t / n^h_t)$. What prevents migration from removing regional differences in per-capita income? The model emphasizes two causes: the mobility cost and the time lag of migration.

For the moment, disregard that moving is costly and set $Z_t(\cdot) = Z'_t(\cdot) = 0$. If there were no time lag of migration, then (9) would collapse into $(\theta^f_t / n^f_t) = (\theta^h_t / n^h_t)$, implying $c^h_t = c^f_t = c$ at every date: migration would guarantee a constant stream of consumption. This is exactly Wildasin's (1995) result in the case of no migration costs. However, if the time lag of migration is introduced, this result no longer holds and per-capita income can differ across regions though migration is costless. Moreover, with risk-averse agents, per-capita consumption is not even equal in expected terms. It also follows that migration flows are unaffected by regional income differentials when shocks are i.i.d. If realization of the shock today is of no use in forecasting the next-period income differential, the best decision is just to do nothing. This conclusion becomes crucial in order to understand the links between fiscal insurance and migration.

Now introduce migration costs. It is well understood that with a positive marginal cost, no moves are made until the productivity differentials across regions exceed a certain threshold.[13] This inaction zone is magnified, in our model, because of the possibility of returning, represented by the last term in (9). If, at time t, some return migration is expected at time $t+1$, then according to (9), the discounted expected increment in total utility has to be at least equal to the marginal costs of migration: those borne at time t and those expected to be paid at time $t+1$, discounted by a factor β.

Migration and Fiscal Policy

We now turn to the general problem (5)–(7) where the planner can choose both migration and fiscal transfers. Optimal migration and taxation solve the following system:

$$
\begin{aligned}
&[n_t^h u'(c_t^h) + n_t^f u'(c_t^f) + \lambda_t] z_t'(\Delta n_{t+1}^h) \\
&\quad \leqslant \beta E_t \left\{ \left[u(c_{t+1}^h) - (1-\tau_t) \frac{\theta_{t+1}^h}{n_{t+1}^h} u'(c_{t+1}^h) \right] \right. \\
&\qquad \left. - \left[u(c_{t+1}^f) - (1-\tau_t) \frac{\theta_{t+1}^f}{n_{t+1}^f} u'(c_{t+1}^f) \right] \right\} \\
&\qquad + (-1)^k \beta E_t \{ [n_{t+1}^h u'(c_{t+1}^h) + n_{t+1}^f u'(c_{t+1}^f) + \lambda_{t+1}] z_{t+1}'(\Delta n_{t+2}^i) \},
\end{aligned}
\tag{10}
$$

$$
n^h u'(c_t^h) \left[(\gamma-1)\bar{y} + \gamma\theta - \frac{\theta_t^h}{n^h} \right] + n^f u'(c_t^f) \left[(\gamma-1)\bar{y} + \gamma\theta - \frac{\theta_t^f}{n^f} \right] \geqslant 0,
\tag{11}
$$

where $k = 2$ if $i = h$; $k = 1$ if $i = f$.

[13]To get interior solutions we should assume $\lim_{x \to 0^-} Z_t'(x) = 0$.

The optimality condition for migration policy (10) parallels that without fiscal authority (9) except that now the tax rate enters into determination of the per-capita disposable income. As before, the main conclusion is that migration cannot fully eliminate regional income differentials.

As far as the optimal fiscal policy is concerned, from the FOC (11) we find:

$$\text{if } \gamma \in [0, \underline{\gamma}_t] \Rightarrow \tau_t = 0, \tag{12}$$

$$\text{if } \gamma \in (\underline{\gamma}_t, \bar{\gamma}_t) \Rightarrow \tau_t \in (0, 1), \tag{13}$$

$$\text{if } \gamma \in [\bar{\gamma}_t, 1] \Rightarrow \tau_t = 1, \tag{14}$$

where:

$$\underline{\gamma}_t = \min\left[\frac{\bar{y} + \dfrac{\theta_t^h}{n_t^h}}{\bar{y} + \theta}; \frac{\bar{y} + \dfrac{\theta_t^f}{n_t^f}}{\bar{y} + \theta}\right], \quad \bar{\gamma}_t = \max\left[\frac{\bar{y} + \dfrac{\theta_t^h}{n_t^h}}{\bar{y} + \theta}; \frac{\bar{y} + \dfrac{\theta_t^f}{n_t^f}}{\bar{y} + \theta}\right]. \tag{15}$$

This is an important result; it states that when individual per-capita income differs across regions $[(\theta_t^f/n_t^f) \neq (\theta_t^h/n_t^h)]$, then a centrally provided stabilization mechanism is welfare improving as long as it is not too wasteful[14] $(\gamma > \underline{\gamma}_t)$.

A few features of the model affect the relative desirability of fiscal transfers versus migration. The first is the assumption that there are no time lags between the occurrence of the shock and the payment of fiscal transfers. This assumption, which is crucial for the solution of the model, is intended to capture the actual working of a risk-sharing scheme, with the reallocation of resources occurring after the uncertainty is resolved. Of course, it can be argued that the choice of the optimal tax rate is, in itself, a time-consuming process.[15] This consideration does not invalidate the conclusion that, *ex post*, a positive tax rate might be optimal; it rather suggests that if a stabilization scheme is provided, it should be automatic with respect to the regional business-cycle conditions. Second, the persistence of the shocks affects both the relative cost of migration versus fiscal transfers[16] and the effectiveness of

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[14] When the fiscal system is extremely inefficient ($\gamma \leq \underline{\gamma}_t$) the optimal tax rate is zero; if, on the contrary, (14) holds, then $c_t^h = c_t^f = c$ and fiscal transfers guarantee full income equalization.

[15] This would imply that, *ex ante*, the choice between migration and fiscal transfers should be based only on their relative cost.

[16] For instance, with long-run income differentials, labor mobility would impose only a one-time cost, while the fiscal policy would impose a lasting drag cost.

labor mobility in reducing regional income differentials.[17] Finally, modeling the shocks' generating process as a Markov process influences the optimal amount of migration. However, the qualitative conclusion of the paper would hold with a more general process. It would certainly be worth having a model where these latter two issues could be explicitly addressed, by using specific parameterization of the stochastic process of the shocks. We leave this for future extensions.

To clarify the main point of this section, consider the most classical example of geographical risk: rainfall affecting regional crops. For the sake of simplicity, assume that the social planner can move farmers between regions at zero cost. Once migration is decided, farmers have to plant the seeds and wait for the rain to fall—migration is prior to the realization of the shock. As we have argued, this timing characterizes risk-sharing issues. The problems arise because weather forecasts might be wrong. In such a case, the allocation of people between regions is not optimal, *ex post*. The planner would like to modify past decisions, but seeds are already in the ground and farmers cannot be moved until the end of the crop season. Still, the planner can redistribute the harvest between regions—take from the "lucky" and give to the "unlucky" region—provided it is not too wasteful ($\gamma > \underline{\gamma}_t$).

Summing up, if the future were certain—as it is in the case of long-run income differentials—we can only get perfect equalization of per-capita income with costless mobility. Ongoing uncertainty—short-run income fluctuations—reduces the incentives to migrate because of the possibility of return migration. The time lag of migration magnifies this inaction zone in a non-trivial way. Then, even an optimally planned reallocation of labor cannot get rid of unexpected idiosyncratic income fluctuations, and a centrally provided stabilization mechanism is, in general, optimal.

Migration and regional insurance are mutually exclusive only under extreme circumstances: either when the tax-transfer mechanism is very efficient (i.e., for $\gamma \in [\bar{\gamma}_t, 1]$ a full insurance scheme is optimal) or when the future is certain and migration is costless (in this case, labor mobility guarantees consumption equalization between regions). In general (ongoing uncertainty, costly migration and wasteful fiscal transfers) both migration and a positive tax rate are optimal.

IV. Lotteries over Migration

We now model migration as an individual decision. Two main difficulties arise. First, the decision to migrate is a binary variable. In general this is not a problem, and job-search models provide a suitable framework of analy-

[17]Indeed, the lower the persistence of the shocks, the less the effectiveness of migration, because of the time lag and the possibility of return migration.

sis.[18] However, given the focus of this paper, the treatment of migration as an either–or decision is puzzling, because it makes the relationship between mobility and insurance unclear: individuals cannot diversify risk by diversifying locations.

Second, once individual decisions have been derived, they must be aggregated in order to obtain the macro-dynamics. A coordination problem arises: when should migration flows stop? Without the time lag of migration, we could appeal to some equilibrium force and conclude that migration stops when its cost equals the expected gains. But it would be difficult to justify such a mechanism in our model, because wages are unknown when migration is decided and because there is a continuum of agents, each acting competitively.

In order to avoid both complications, we follow Hansen (1985) and Rogerson (1988) and convexify the set of actions, through the introduction of lotteries over migration decisions. This corresponds to an economy in which individuals in region i choose both a probability of migration p_t^i and actuarially fair insurance contracts. Preferences are computed according to the expected utility of outcomes. After that, the solution of the representative agent's problem can be supported as a competitive solution, and this greatly simplifies the analysis. In fact, we just have to solve the region i representative agent problem.[19]

Now migration can be studied as a continuous programming problem, where the choice variable is a probability of migration p_t^i. Aggregation of individual decisions becomes a trivial task: while at the individual level p_t^i represents the probability of migrating, at the aggregate level it gives the proportion of people that actually move. The underlying assumption of perfect coordination among agents in one region is extreme, but it is conservative from the point of view of our results.

Assume that the individual cost of migration z is fixed. In terms of the preceding section, this corresponds to a constant marginal cost $Z_t'(\cdot) = z$. None of the results would change with a more general specification of the cost function, provided that the marginal cost of migrating is strictly positive.

As in Section III, we assume that the central fiscal authority chooses τ_t in order to maximize the total sum of individual utilities. The optimal fiscal policy solves:

$$\max_{\tau_t \in [0,1]} E_0 \left\{ \sum_{t=0}^{\infty} \beta^t [\hat{n}_t^h u(w_t^{hd} - p_t^h z) + \hat{n}_t^f u(w_t^{fd})] \right\}, \tag{16}$$

[18] See, for instance, McCall and McCall (1987).

[19] Note that, *ex ante*, all agents in region i are identical and they act competitively; it follows that the choice of p_t^i will be the same for all of them; see Hansen (1985, Appendix).

where w_t^{id} is given by (3) and $\hat{n}_t$ comes from the solution to the period $t-1$ individual migration problem. Problem (16) is recursive in its structure; we know that the solution is going to be a time-invariant function of the states:

$$\tau_t^* = g(\theta_t, \hat{n}_t). \tag{17}$$

As far as the agent's decision is concerned, he chooses a probability of migration, given the value of the state variables $s_t \equiv \{\theta_t, n_t, \tau_t\}$. The region h representative agent problem is:

$$V(h; s) = \max_{p^h \in [0,1]} \{u(w^{hd} - p^h z) + \beta E[(1 - p^h)V(h; s') + p^h V(f; s')]\}, \tag{18}$$

where $V(h; s)$ is the value function and the primes refer to next-period state variables. Next-period population in region h is $(1 - p^h)n^h$. In other words, at time t an individual living in region h chooses the probability of migrating which maximizes the total sum of current and expected future utilities. Today's return function is $u(w^{hd} - p^h z)$. Future flows of utility are given by the appropriate expected value function: $E[V(h; s')]$ if the agent actually does not migrate and $E[V(f; s')]$ if he migrates, each multiplied by the corresponding probability. The next-period value function contains future tax rates, that are unknown at time t. The agent forms expectations according to (17) Problem (18) is also recursive and it admits a time-invariant policy function:

$$m_t^* = m(i_t, s_t). \tag{19}$$

Definition. A rational-expectations *equilibrium* for the economy is an allocation $\{\hat{n}_t, \theta_t, p_t^i, \tau_t\}$ such that: (i) τ_t is the solution to problem (16), given $\{\hat{n}_t, \theta_t\}$ and the individual migration function (19); (ii) p_t^i is the solution to problem (18) given s_t and the policy function (17); (iii) the resource constraint of the whole economy is satisfied.

Agents solve their decision problem internalizing the fiscal authority's policy function and the fiscal authority fixes the tax rate taking into account the agent's first-order condition. Note that, under the assumption of a balanced budget in every period, we can disregard condition (iii).

Migration

As before, we consider first, for simplicity, the case of no fiscal authority: $\tau_t = 0$ and $w_t^i = w_t^{id}$ for every t. The FOC for the region h representative agent problem (18) is:

$$u'(c^h)z = \beta E[V(f;\, s') - V(h;\, s')] + \beta E[(1-p^h)V'(h;\, s') + p^h V'(f;\, s')] + \mu, \qquad (20)$$

where μ is the Lagrange multiplier associated with $p^h \in [0, 1]$. When $p^h > 0$—when some migration takes place—the Lagrange multiplier becomes zero. Condition (20) thus implies that the cost of migration, measured in utility units, has to be equal to the expected gains. By the envelope theorem:

$$E_t\{V'(h;\, s_{t+1})\} = E_t\left[\frac{n_t^h \theta_{t+1}^h}{(n_{t+1}^h)^2} u'(c_{t+1}^h)\right] \geqslant 0,$$

$$E_t\{V'(f;\, s_{t+1})\} = -E_t\left[\frac{n_t^h \theta_{t+1}^f}{(n_{t+1}^f)^2} u'(c_{t+1}^f)\right] \leqslant 0. \qquad (21)$$

When p_t^h increases, expected per-capita income in region h increases too, since in the next period there will be fewer inhabitants among whom to share the shock; the reverse is true for region f. This explains the signs of the derivatives in (21), which, in turn, ensure that no region will eventually become depopulated. Note also that p_t^h depends on the expected future probability of migration: if the agent expects some positive probability of returning from f to h, this reduces the value of p_t^h that maximizes (20).

As in Section III, the main conclusion is that the role of migration in reducing regional income fluctuations is small. Migration can only provide limited insurance against idiosyncratic shocks. Once again, we may stress the role of the mobility cost and the time lag of migration. From (20) we get an inaction zone when the weighted cost of migration exceeds the expected gains. We also get an inaction zone with costless migration and i.i.d. shocks. In this case the optimality condition reduces to $E[V(h;\, s')] = E[V(f;\, s')]$ and the value function does not depend, in expectation, on the location of the agents.

Migration and Fiscal Policy

The picture is complicated by the introduction of the fiscal authority, because of its interplay with migration. Consider first the migration decision. Optimal migration solves:

$$u'(c^h)z = \beta E[V(f; s') - V(h; s')] + \beta E[(1 - p^h)V'(h; s') + p^h V'(f; s')] + \mu, \tag{22}$$

which is the same as (20) except that here the disposable income depends on τ. Define the expected value of the next-period tax rate $\tau^e_{t+1} = E_t [g(\theta_{t+1}, n_{t+1})]$. Conditions (21) become:

$$E_t\{V'(h; s_{t+1})\} = E_t\left\{\left[\frac{(1 - \tau^e_{t+1})n^h_t \theta^h_{t+1}}{(n^h_{t+1})^2} + \frac{\partial \tau^e_{t+1}}{\partial p^h_t}\left[(\gamma - 1)\bar{y} + \gamma\theta - \frac{\theta^h_{t+1}}{n^h_{t+1}}\right]\right] u'(c^h_{t+1})\right\},$$

$$E_t\{V'(f; s_{t+1})\} = -E_t\left\{\left[\frac{(1 - \tau^e_{t+1})n^h_t \theta^f_{t+1}}{(n^f_{t+1})^2} - \frac{\partial \tau^e_{t+1}}{\partial p^h_t}\left[(\gamma - 1)\bar{y} + \gamma\theta - \frac{\theta^f_{t+1}}{n^f_{t+1}}\right]\right] u'(c^f_{t+1})\right\}. \tag{23}$$

The interaction between migration and fiscal transfers is captured by three terms. There is an "expected stabilization effect": migration is decided on the basis of the expected disposable income differential. If the fiscal authority policy function is not degenerate, then, at least in some period, $\tau^e_{t+1} > 0$, reducing the expected income differential between regions. *Ceteris paribus*, migration will be lower.

The second channel is a "disposable income effect" $\partial p^h_t / \partial \tau_t$: the fiscal policy determines per-capita disposable income, which agents use to pay the cost of migration. In general this effect can either increase or decrease migration flows. From (22) we know that τ_t only enters in the LHS term $u'(w^{hd} - p^h z)$. Differentiating we get:

$$\text{if } \gamma \geqslant \frac{\bar{y} + \dfrac{\theta^h_t}{n^h_t}}{\bar{y} + \theta} \Rightarrow \frac{\partial[u'(w^{hd} - p^h z)]}{\partial \tau_t} \leqslant 0 \Rightarrow \frac{\partial p^h_t}{\partial \tau_t} \geqslant 0, \tag{24}$$

$$\text{if } \gamma \leqslant \frac{\bar{y} + \dfrac{\theta^h_t}{n^h_t}}{\bar{y} + \theta} \Rightarrow \frac{\partial[u'(w^{hd} - p^h z)]}{\partial \tau_t} \geqslant 0 \Rightarrow \frac{\partial p^h_t}{\partial \tau_t} \leqslant 0. \tag{25}$$

Current taxation and redistribution increase migration flows if people living in the region which is expected to be unlucky in the next period are net recipients from the fiscal system at the time migration is decided.[20] Intuitively, in this case, net transfers to the region give households more disposable income with which to pay the cost of migration. The reverse is true if migration originates in the region that is currently the net contributor. It follows that, with temporary Markov shocks, current stabilization policy reduces migration flows.[21]

A further, minor channel connects fiscal policy to migration flows. The representative agent recognizes that current migration affects next-period stabilization policy—the term $\partial\tau^e_{t+1}/\partial p^h_t$ in (23). If, for instance, migration flows in a given period completely offset the per-capita income differential, then any tax rate different from zero would have no risk-sharing effect and, for $\gamma \neq 1$, would be an undesirable waste of resources. This effect contributes to reducing migration.

The FOCs for the fiscal policy problem (16) are:

$$\begin{aligned} &\hat{n}^h_t u'(c^h_t)\left[(\gamma-1)\bar{y}+\gamma\theta-\frac{\theta^h_t}{\hat{n}^h_t}\right]+\hat{n}^f_t u'(c^f_t)\left[(\gamma-1)\bar{y}+\gamma\theta-\frac{\theta^f_t}{\hat{n}^f_t}\right] \\ &\quad-\left(\frac{\partial p^h_t}{\partial\tau_t}\hat{n}^h_t\right)u'(c^h_t)z \\ &\quad+\left(\frac{\partial p^h_t}{\partial\tau_t}n^h_t\right)\beta E_t\Bigg\{[u(c^f_{t+1})-u(c^h_{t+1})] \\ &\quad+(1-\tau^e_{t+1})\left[u'(c^h_{t+1})\frac{\theta^h_{t+1}}{n^h_{t+1}}-u'(c^f_{t+1})\frac{\theta^f_{t+1}}{n^f_{t+1}}\right]\Bigg\}\geqslant 0. \end{aligned} \tag{26}$$

Equation (26) states that current and future expeced benefits have to exceed the costs of taxation. It differs from equation (11) of Section III because it takes into account the effect of fiscal policy on migration decisions. The first line in (26) is the marginal gain in period t utility due to taxation; the second line considers the costs of migration induced by the "disposable income effect" $\partial p^h_t/\partial\tau_t$; the last two lines consider the expected future effects of taxation on utility induced by the same channel. In general, a positive tax rate is optimal.[22]

[20]Indeed, if (24) holds, then agents living in region h are net recipients from the fiscal system.
[21]This conclusion would clearly change if we assumed that shocks are at least second-order autocorrelated.
[22]Actually, the value of γ for which τ_t is positive can be higher or lower than $\underline{\gamma}$ defined above.

The features of the model which affect the desirability of fiscal insurance versus migration are the same as those discussed in Section III. Here we stress that also the interaction between labor mobility and stabilization policies varies with the persistence of the shocks: the lower the serial correlation, the less the distortion introduced by a central insurance scheme. We know that any pure risk-sharing mechanism should only be concerned with unexpected shocks, which is equivalent either to assuming i.i.d. shocks, or, in the spirit of von Hagen and Hammond (1998), to constraining the fiscal authority to tax only the unexpected component of the shock $\theta^i_{t+1} - E[\theta^i_{t+1}|\theta^i_t]$. In both cases, migration and fiscal transfers would be independent from each other: people decide migration by forecasting next-period income differentials, and the i.i.d. component of the shock does not influence migration flows; the fiscal authority insures only the unexpected income fluctuations. Again, a clear distinction between stabilization and long-run redistribution seems to be of crucial importance.

V. Conclusions

Can migration fully buffer regional idiosyncratic shocks, making private or public insurance redundant? Our answer is rather skeptical. According to the model of labor mobility in a dynamic, stochastic environment developed here, migration cannot fully absorb regional shocks. It was also shown that, if markets for private insurance are absent (i.e., if the possibility of insuring oneself at the individual level is, at least partially, precluded by market imperfections) then a centrally provided stabilization scheme is, in general, optimal. Moreover, a pure risk-sharing mechanism not entailing long-run redistribution among regions—in the spirit of von Hagen and Hammond (1998), Mélitz and Vori (1993) and Italianer and Vanheukeler (1997)—would make migration and fiscal transfers independent from each other.

The policy implications are straightforward. In particular, the stability of the European Monetary Union may also depend on the ability to tackle temporary regional imbalances. Any concrete proposal which excessively relies on migration as an automatic adjustment mechanism risks failure.

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