BANCA D'ITALIA

Temi di discussione

del Servizio Studi

On the Mechanics of Migration Decisions: Skill Complementarities and Endogenous Price Differentials

by Mariassunta Giannetti

Number 366 - February 2000

Sintesi

Il contenuto di questo lavoro esprime esclusivamente le opinioni dell'autore; pertanto, non rappresenta la posizione ufficiale della Banca d'Italia

Il lavoro ha l'obiettivo di sviluppare un modello teorico diretto ad analizzare la dinamica delle migrazioni all'interno di un paese e i loro effetti sulle disparità regionali.

Importanti caratteristiche delle migrazioni interne non trovano spiegazione nella letteratura esistente, che generalmente attribuisce i flussi migratori a differenze nei salari reali. L'evidenza empirica, infatti, mostra che solo le componenti della popolazione con più alto livello d'istruzione, che sono generalmente più mobili, migrano dalle regioni più povere alle regioni più ricche, dove il livello dei salari è più elevato; i lavoratori con più basso livello d'istruzione, invece, talora migrano dalle regioni ricche alle regioni relativamente più povere.

Il lavoro suggerisce che l'alto tasso di mobilità dei lavoratori con elevato livello di istruzione è dovuto al fatto che il loro capitale umano è meglio remunerato nelle regioni dove maggiore è la dotazione di capitale umano, grazie all'esistenza di complementarità tra i lavoratori all'interno di una regione.

La complementarità tra i lavoratori impiegati all'interno di una regione aumenta la produttività nel settore dei beni commerciabili nelle regioni più ricche di capitale umano; dal momento che al crescere della produttività in questo settore aumenta il prezzo d'equilibrio dei beni e dei servizi non commerciabili, emergono incentivi per i lavoratori con più basso livello d'istruzione a migrare verso le regioni meno produttive. Infatti, i lavoratori scarsamente dotati di capitale umano beneficiano in misura minore dell'esternalità positiva dovuta alla concentrazione di capitale umano, ma devono sopportare il costo più elevato dei beni e servizi che ne consegue.

A causa dei flussi migratori all'origine delle differenze di produttività, le disparità regionali sono persistenti nello stato stazionario del modello e non si ha alcun processo di convergenza, così come si è osservato all'interno di alcuni paesi dell'Unione europea dalla fine degli anni settanta.

ON THE MECHANICS OF MIGRATION DECISIONS: SKILL COMPLEMENTARITIES AND ENDOGENOUS PRICE DIFFERENTIALS

by Mariassunta Giannetti*

Abstract

Why are skilled workers more mobile than average? What determines positive migration flows toward relatively poorer regions or states of a country? How can one explain the sharp decrease in the mobility rate observed within European countries notwithstanding persistent regional disparities?

This paper aims to answer these questions using skill complementarities and endogenous price differentials between the richest and the poorest regions. If the skill premium is increasing in the average level of human capital of a location, and the price of non-traded goods is higher in the more human capital intensive regions, the more skilled the workers are, the stronger are the economic incentives to migrate towards the richest regions. In contrast, the least skilled workers have an incentive to migrate to the poorest regions to minimize their living costs.

In this context, interregional cost-of-living differentials arise endogenously if the self-selection of migrants affects total factor productivity in the traded goods sector, as pointed out by Balassa (1964) and Samuelson (1964). Moreover, if the process of capital accumulation provokes faster convergence in interregional wage differentials than in living costs, convergence in per capita GDP may hinder migration to the richest regions, even if it leaves large regional disparities.

Contents

* Bank of Italy, Research Department.

1. Introduction[1]

Why are skilled and educated workers more mobile than average? What determines positive migration flows toward relatively poorer regions or states of a country? How can one explain the sharp decrease in the mobility rate observed within European countries notwithstanding persistent regional disparities?

In this paper, I suggest that skill complementarities among workers employed in the same location and cost-of-living differentials can help explain these unresolved puzzles on internal migration. I show that if the skill premium is increasing in the average level of human capital of a location and there are endogenous differences in the price of non-traded goods, the more skilled the workers are, the stronger the economic incentives to migrate towards the richest regions will be. In contrast, the least skilled workers have an incentive to migrate to the poorest regions to minimize their living costs.

But what explains interregional cost-of-living differentials? I suggest that if the self-selection of migrants affects total factor productivity in the traded goods sector, differences in the price of non-traded goods arise endogenously, as pointed out by Balassa (1964) and Samuelson (1964). I also show that convergence in per capita GDP may hinder migration to the richest regions, even if it is incomplete and leaves large regional disparities. This happens if the process of capital accumulation provokes faster convergence in interregional wage differentials than in living costs.

Migration choices are modeled using a two-location overlapping generations model, as in Galor (1986). However, the context is very different. Galor studies international labor migration between two countries with different rates of time preference. In contrast, I assume that the two locations are identical ex ante, with the exception of the initial level of capital intensity, and introduce a further element of heterogeneity among workers. Among workers born in a location, skill levels are different and, therefore, also their labor

---

[1] This paper benefited from comments from Tim Kehoe, David Levine, Marco Pagano, Massimo Roccas, Carlos Végh and an anonymous referee. I also wish to thank participants at the 1999 Spring Midwest Macroeconomics Conference at the University of Pittsburgh and, in particular, Russell Cooper, and the 1999 European Meeting of the Econometric Society. Of course, any remaining errors and shortcomings are mine alone and the views expressed are not necessarily those of the Bank of Italy. Email: giannetm@tin.it

productivity. This creates different incentives to migrate even for workers born in the same location at the same time.

Moreover, the model incorporates skill complementarities, so that steady state equilibria with asymmetric distribution of skills may arise even if the locations are ex ante identical. In this respect, this paper is close to the studies that point out the existence of skill complementarities and local externalities due to the concentration of human capital to explain the persistency of productivity differentials among countries or regions and the lack of convergence in per capita income. In a seminal paper, Lucas (1988) uses differences in the average level of human capital to explain growth differentials. The microeconomic foundation of this external effect of human capital is the sharing of knowledge and skills among workers that occurs through both formal and informal interaction. Random meetings which take place with higher probability within a limited geographic area favor the "cross-fertilization" of ideas that is the engine of growth in Lucas's framework. A related point is made by Kremer (1993). In order to explain productivity differentials, he assumes a production function in which the productivity of each worker depends on other workers' ability whatever is his/her ability. According to Kremer's interpretation, the production process comprises many tasks, all of which must be successfully completed for the product to have full value, and skill refers to the probability that a worker will successfully complete a task. Under these conditions, it is optimal to put high-skill workers together. Moreover, total factor productivity and, therefore, wages and output are a steeply increasing function of skills.

My contribution is to show that skill complementarities and local externalities arising from the concentration of human capital may also account for the high mobility rate of talented workers. If there are skill complementarities, very talented workers face strong incentives to migrate where most talented workers are concentrated, because the skill premium is higher. If migration costs are high or there are huge differences in the relative price of facilities, especially housing, only individuals who expect large increases in their wages will move to the most productive regions. Otherwise, the wage gain from migrating is offset by the higher costs of facilities in the richest regions, and it may even be advantageous to move to relatively poorer and low-cost locations.

The model also has important implications for the effects of migration on regional convergence. The productivity differentials that arise endogenously because of the self-selection of migrants interrupts the process of regional convergence and permit poverty traps to arise, as in Azariadis and Drazen (1990). Therefore, in my model migration hinders convergence as in Faini (1996). However, the explanation is very different. In Faini's paper migration provokes regional divergence because it does not allow the marginal productivity of capital to decrease in the initially wealthier location and the issue of self-selection of migrants is not addressed. In the model presented here, the convergence process is arrested because the self-selections of migrants makes differences in total factor productivity arise and, therefore, the possibility of poverty traps emerges.

This paper is organized as follows. Section 2 describes a number of unexplained features of internal migration. Sections 3 and 4 describe the long-run equilibria and the transitional dynamics of the model respectively. Conclusions follow in Section 5.

2. Stylized facts

This section summarizes a number of unexplained features of internal migration, which suggest the importance of skill complementarities and living-cost differentials in explaining this phenomenon.

The first striking fact is the remarkably higher mobility rate of skilled workers relatively to the average mobility rate of the population. This is evident if one looks at the experience of Southern Europe, especially, Italy and Spain. Despite the pronounced regional disparities existing within these two countries, in the last two decades the rate of internal migration has been very low and, as noticed by *The Economist* in its "Survey on Italy" of November 1998, limited to the most talented and skilled young people who move to the richest regions. Figures 1.a-1.b and 2.a-2.b show clearly that the low average migration rate across the regions[2] of these two countries hides the high migration rate of the most educated components. If, as is common practice, skills are proxied with educational attainments, one

[2] I look at migration flows across the 20 Italian regions and the 17 Spanish regions, respectively.

can claim that the most skilled components of the population are also the most mobile. Borjas, Bronaras and Trejo (1992) present evidence that on average movers are more skilled than non-movers in the US as well.

Different skill levels influence not only the propensity to move, but also the direction of migrant flows. In particular, the richest cities and regions seem to attract especially skilled workers. Borjas, Bronaras and Trejo (1992), for instance, notice that in the US the most skilled workers move to the states where wage dispersion and skill remuneration are highest, while the contrary is true for less skilled ones. These authors also present evidence that the skill endowments of different locations have an important influence on the direction of internal migration flows, with skilled workers migrating where the concentration of human capital is highest. This suggests another unexplained puzzle of the pattern of internal migration that regards the direction of migrant flows. Although any neoclassical model would predict that individuals should migrate to the richest regions until real wages are equalized, this is not the case. Even if the richest regions are often those with positive net migration flows, gross migration flows are significant in both directions. Therefore, for a full comprehension of internal migration it seems necessary to take this feature into account as well. This is even more important when one looks at European data, since in the eighties and the nineties population in Europe appears scarcely responsive to economic incentives in taking migration decisions. Spain is the most enlightening example. The Spanish regions with the highest net inflows of migrants over the period 1988-1992 are not the richest ones. Migrants seem to go mostly to Comunidad Valenciana and Canaries and only after these to the richer Baleares, Madrid and Catalunya. Moreover, in addition to the relatively poorer Castilla y Leon and Extremadura, they also leave the relatively rich Pais Vasco[3]. Some descriptive statistics on the regions with the greatest migration inflows and outflows are presented in Tables 1.a-1.c. On average regions receiving net migration inflows are well off in terms of per capita GDP, rate of unemployment, importance of the industrial sector in the GDP and endowment of human capital, even if they are not the most developed regions. This

---

[3] In the case of Pais Vasco, the loss of population could be justified by the activity of the ETA terrorist movement.

raises questions as to why migrants do not respond to what are usually considered the economic incentives to migrate.

Moreover, if one looks at the net inflows of the most educated workers, the richest regions Baleares, Madrid and Catalunya, which have a significantly above the average endowment of skilled population, are among the four regions with the highest net inflows (still surprisingly, with the Canaries). Hence, even in the Spanish case there is evidence that skilled workers move to the richest regions where the average level of human capital measured by the educational attainment of resident population is also higher. If skilled workers are attracted by locations with a high concentration of human capital because of skill complementarities, what incentives might less skilled workers have to move to poor and high unemployment regions, like Aragon and Andalusia, as noted by Antolin and Bover (1997)? These authors draw on survey data to conclude that people move mainly in search of cheaper housing and better quality of life. This seems to be confirmed by regional consumption price indices, which are significantly lower-than-average in poorer regions[4].

The sharp living-cost differentials between the Center-North and the South may have been a deterrent to migration in Italy as well. Although in Italy, as shown in tables 2.a-2.c, the poorest Southern regions are also those with highest net out-migration, only the most educated individuals migrate. In an empirical study, Giannetti (1999) shows that the migration of workers with different endowments of human capital among Italian regions has very different determinants and that a high concentration of skilled people in a region is a major pull factor for skilled workers alone.

The negative effect on mobility arising from cost-of-living differentials and, especially, housing prices has also been documented for Britain by Cameron and Muellbauer (1998), who interpret the sharp decline in 1987-89 in the migration to the South-East as prima facie evidence for strong discouragement from high relative housing prices. Indeed, the eighties were characterized by a housing price boom in the South-East.

Finally, one should notice that the mobility rate has sharply decreased since the mid-seventies in Italy as well as in Britain and Spain despite persistent income and

[4] Mauro and Spilimbergo (1998) provide more evidence on this point.

unemployment differentials. Pissarides and Wadsworth (1989) and Bentolila (1997) attribute this trend to the increase in the national rate of unemployment, which decreases the probability of finding a job in another region and reduces the benefits of migration. This argument, though, does not provide any explanation for the high mobility of the most skilled workers and the self-selection of migrants. The argument of Faini and Venturini (1994), who suggest that the relationship between migration and income is non-linear and, therefore, an increase in the standard of living may reduce mobility, suffers from the same problem.

Can the evolution of cost-of-living differentials and skill premia explain the reduction in mobility rates, besides the different behavior of individuals with different endowments of human capital? In Section 4 I show that this may be the case. In the sixties and the early seventies, European countries experienced a process of convergence that has left large internal regional disparities, which would not justify the sharp decrease in net migration toward the wealthiest regions. Section 4 shows how convergence in capital intensities across regions may hinder migration to the North if it causes faster convergence in wage differentials than in living costs.

3. A simple model of migration decisions and productivity differentials

This section studies migration decisions under the assumption that the skill premium is increasing in the average level of human capital of a location, owing to the existence of skill complementarities. The empirical relevance of skill complementarities and the positive externalities deriving from the concentration of human capital have been documented in a number of empirical studies, such as Rauch (1991). When one takes skill complementarities into account, I show that it is straightforward to account for the higher-than-average mobility rate of the most skilled workers. In fact, if there are fixed migration costs, only individuals who benefit most from high skill premia find it optimal to migrate to regions where the average level of human capital is higher.

However, if one takes into account the general equilibrium effects of differences in total factor productivity originating from differences in the average level of human capital, the flows of the least skilled migrants to the poorest regions can also be explained. If the self-selection of migrants affects total factor productivity in the traded goods sector, differences in the price of non-traded goods arise endogenously, as pointed out by Balassa (1964) and Samuelson[5] (1964). In fact, if the total factor productivity in the traded goods sector is an increasing function of the average skill level of a region, the price of non-traded goods is higher in regions where the most skilled workers reside[6]. In turn, this reduces the incentive for the least skilled workers to migrate to the richest regions. Furthermore, if preferences are non-homothetic and individuals with lower income spend relatively more to satisfy their basic living expenditures, whose prices differ across regions because they include non-traded goods, such as housing, in equilibrium the least skilled workers may have an incentive to move to the poorest regions in order to minimize their living costs. In this way, one can explain two of the most important features of internal migration without positing any imbedded preference to remain in the region of origin or having depopulation of the poorer regions, as most of the existing literature (see, for instance, Bertola, 1993 and Faini, 1996).

I study internal migration within a country with two regions, the North (*N*) and the South (*S*). Workers may decide to establish their activity in either of the two regions.

First, I describe the two locations and their inhabitants and then the production technology.

I rely on a simple overlapping generation framework with infinite periods. The demography is described as follows. During each period, a two-period lived generation of workers is born. Each generation consists of a continuum of workers, whose mass may eventually differ across regions[7]. The aggregate mass of the population is P. Workers are heterogeneous, since they differ in their skill level. Each worker is endowed with one unit of labor, but skill differentiates workers' endowments of efficiency units of labor services. A worker of type *i* has skills s_i. This is equivalent to saying that she is endowed with s_i units

---

[5] The Balassa-Samuelson effect is a tendency for countries with higher productivity in tradables compared with non-tradables to have a higher price level.

[6] Kravis and Lipsey (1982) show that price levels vary systematically across countries, with more productive countries having higher price levels.

[7] The relative mass of the population of the two regions is totally irrelevant for the results of the model.

of labor services. Skills are drawn from a fixed distribution with c.d.f. $F : R^+ \to [0,1]$, which is equal across regions[8]. Hence, the average skill level of workers is equal across regions before migration decisions are taken.

The existence of a continuum of workers is a simplifying assumption that allows us to study aggregate implications of skill complementarities without worrying about strategic interaction among migrants, and ensures that the entire distribution F is always fully represented.

The agents of this economy live two periods: they decide where to live when they are born, work in the first period of their life and consume in both periods. The preferences of an individual of type *i*, who is young at time *t*, are represented by the following utility function, which is linear in the consumption of traded goods:

$$U(C^t_{y,t,i}, C^t_{t+1,i}) = C^t_{y,t,i} + \frac{C^t_{y,t+1,i}}{1+\beta} \quad \text{if} \quad C^t_{x,t,i} \geq \overline{C}_x \ . \tag{1}$$

The utility of an individual of type *i* born at time *t* is increasing and linear in the consumption of traded good (*Y*) at time *t* and *t+1*, $C^t_{y,t,i}$ and $C^t_{y,t+1,i}$ respectively; β is the intertemporal discount rate, which is equal to the international interest rate, ρ. Utility is defined for values of consumption of non-traded good *X* above the basic living expenditures, $\overline{C}_x$ [9]. For simplicity's sake I consider only consumption of non-traded goods at time *t*, $C^t_{x,t,i}$, but all the results remain unchanged if consumption of non-traded goods over the two periods of life is used to define basic living expenditures.

According to this utility function, consumers derive positive utility only from income net of living costs, which differ according to the region of residence. As a consequence of the non-homotheticity of preferences, poor consumers have a smaller portion of their budget left over after satisfying basic living expenditures to save and consume at their discretion.

---

[8] The implications of relaxing this assumption will be examined at the end of this section.

[9] This utility function may be seen as a specialized version of the non-homothetic utility function estimated by Atkenson and Ogaky (1996) to capture differences in the rate of intertemporal substitution of consumption between rich and poor consumers. Since intertemporal substitution is not the focus of my model, I adopt a linear utility function, which significantly simplifies calculations without biasing the results.

This assumption reflects the fact that there are some basic expenditures, such as housing[10], which constitute a bigger share of expenditure for individuals with lower income and whose cost may differ across regions.

As is shown below, this has important implications on migration decisions, because least skilled consumers are consequently better off living in low-cost, low-productivity regions. Moreover, the results would not be affected if one explicitly considered that consumption of non-traded goods increases with income, although the algebra would be considerably more complicated when one studies the convergence to the steady state in Section 4.

Different types of agents differ only in their budget constraint. The wage rate, $w(s_i, \bar{s}_t^r)$, depends on their skills and location. In fact, workers' remuneration depends positively not only on their own skills, s_i, but also on the average level of skills of other workers employed in the same location at time *t*, $\bar{s}_t^r$. This means that skills of individuals employed in the same location are complementary[11]. As shown below, these skill complementarities determine a strategic complementarity in the location decisions of workers and, as a result, multiple steady states arise in the model, as pointed out by Cooper and John (1988).

Government lump sum transfers among individuals of different types belonging to the same generation, T_{ti}, guarantee that each individual can afford at least her basic living expenditures. This assumption is grounded on the fact that there are subsidies for poorer and less skilled individuals, which are homogeneous within a country and do not take into account regional price differentials. Sometimes, as in Spain, these subsidies are higher in less developed regions and this, of course, reinforces the incentive to migrate to poorer regions.

---

[10] The basic living expenditures whose cost differs across regions may also include goods, such as food. Although this is commonly considered a traded good, its price differs across locations because it also includes the services necessary for distribution (See Kravis and Lipsey, 1982, on this point). The income net of these basic living expenditures may be used for true traded goods, such as travel or the accumulation of financial wealth.

[11] See Rauch (1991) for empirical evidence on this point.

In what follows, I show that even without distortive taxation, there may be economic incentives to migrate to poorer and low-productivity locations.

Each worker is endowed with one unit of labor that she offers inelastically and can borrow and lend at the international interest rate. The price of the traded good is normalized to 1, and the initial holdings of foreign bonds and capital are equal to zero.

Under these assumptions, the intertemporal budget constraint of an individual with skill s_i, who is born at time *t* in region *r* and does not migrate, is:

(2) $$C^t_{y,t,i} + \frac{C^t_{y,t+1,i}}{1+\rho} = w(s_i, \bar{s}^r_t) - p^r_t \overline{C}_x + T_{ti} + \Omega^f .$$

The disposable income to buy traded goods is equal to the wage rate minus the basic living expenditures in region *r*, $p^r_t \overline{C}$ plus the government transfers, (which could be negative), T_{ti}, and the profits of the production sector of the economy, Ω^f, which are distributed equally among all workers.

To differentiate the natives of region *r* from the immigrants, I assume that any worker who migrates from region *j* to region *r* incurs a fixed migration cost C^{12}. Hence, the intertemporal budget constraint of an individual with skill s_i, born at time *t* in region *j* and migrating to region *r* is:

(3) $$C^t_{y,t,i} + \frac{C^t_{y,t+1,i}}{1+\rho} = w(s_i, \bar{s}^r_t) - p^r_t \overline{C}_x - C + T_{ti} + \Omega^f .$$

To maximize their utility, agents will locate in the region where they can enjoy higher consumption of traded goods. Therefore, agents will choose the location that guarantees higher income net of any moving costs and non-traded good expenditures.

On the production side, there are two sectors producing traded and non-traded goods. Both sectors employ capital, *K*, and labor services, *L*. Output depends on the efficiency units of labor services, which are determined by workers' skill level, and not on the mass of workers that are employed. In fact, workers differ in the efficient units of labor services they are endowed with. Total factor productivity in the traded goods sector also depends on the average skill level of workers employed in the region. Intuitively, firms' productivity is higher if there are good consultants and reliable firms providing intermediates and other supplies nearby[13]. In this respect, the production function of the traded goods sector may be regarded as a version of the "o-ring" production function[14] introduced by Kremer (1993). In this way, I formalize the positive externalities generated by the concentration of skilled workers, which have been found in several empirical studies (See, for instance, Rauch, 1991). Alternatively, regional differences in technology may be imputed to directed technical change, as suggested by Acemoglu (1998). In this case, the region, where the concentration of skilled workers is higher optimally adopts technologies, which increase the productivity of the most skilled workers relative to the least skilled ones. In this case as well, complementarities among high skill workers are the driving force of regional skill premia differentials, because this would not emerge if skill biased technological change did proceed at the same pace in both regions.

Sectoral outputs are represented by Cobb-Douglas production functions:

(4)
$$\begin{aligned} Y_t^r &= \bar{s}_t^r (K_{yt}^r)^\alpha (L_{yt}^r)^{1-\alpha} \\ X_t^r &= A_x (K_{xt}^r)^\nu (L_{xt}^r)^{1-\nu} \end{aligned},$$

where Y_t^r and X_t^r are the output levels of the traded and non-traded goods sectors respectively in region *r,* where $r \in \{N, S\}$, at time *t*. The output of the traded goods sector can either be used as a consumption good or transformed into a capital good, while the output of the non-traded sector can only be used as a consumption good. Moreover, I assume that the production of the traded good is relatively more capital intensive. In terms of the

---

[12] One may think of C as a quantity of traded good that is lost because of migration.

[13] This element seems to be important in determining firms' profitability. In fact, in a number of surveys conducted by the European Commission among firms, it has been pointed out that the poor availability of legal and consulting services figures highly among the relative factors of disadvantage in lagging regions (European Economy, 1990).

[14] In the cited paper, Kremer proposes a production function describing processes subject to mistakes in many tasks and refers to the example of the space shuttle *Challenger*, whose explosion was caused by the malfunction of one of this components (the O-ring). That is why he talks of O-Ring production function.

parameters of the model, this implies: $\alpha > \nu$. This assumption relies on the fact that the non-traded goods sector comprises a larger proportion of services production, which is less capital intensive than goods production.

Firms maximize profits taking factor and output prices as given. There is a firm for each sector in each region and firms property is equally distributed among all the consumers in the economy, who receive firms' profits. Per capita profits of firms producing good *j* in region *r* are: $\pi_{jt}^{r} \equiv \frac{Output_{jt}^{r}}{P} - \rho \frac{K_{jt}^{r}}{P} - \frac{1}{P} \int_{s_i \in S^r} w(s_i, \bar{s}^r) dG^r(s_i)$, where $w(s_i, \bar{s}^r)$ is the wage rate of type *i* in region *r* and S^r is the support of the distribution of skills in region *r*, G^r . The aggregate per capita profits of this two-region economy are: $\Omega^f \equiv \pi_y^N + \pi_y^S + \pi_x^N + \pi_x^S$ Profits are equally distributed to the young generation, which has mass *P*. As is always the case with constant returns to scale production functions, profits will be equal to zero in equilibrium.

Labor is fully employed in both regions, and factors can move freely across sectors and regions. Moreover, I assume that the economy is open to capital flows and the economy is relatively small so that the interest rate is fixed at its world level, ρ. Under these assumptions, which will be relaxed in the next section, the economy is always in steady state and there is no transitional dynamics. In what follows, I refer to steady state variables by omitting time subscripts. Moreover, the relevant variables are presented per unit of efficiency of labor services, rather than per worker, because labor services, and not the mass of workers, are the relevant input.

The steady-state equilibrium capital per unit of efficiency of labor services in the traded and non-traded goods sectors, which maximize profits, are respectively:

(5)
$$k_y^r = \left(\frac{\bar{s}^r \alpha}{\rho} \right)^{\frac{1}{1-\alpha}}$$
$$k_x^r = \left(\frac{p^r A_x \nu}{\rho} \right)^{\frac{1}{1-\nu}} .$$

Hence, the steady-state equilibrium wage rate per efficiency units of labor is:

(6) $$w^r \equiv w(1,\bar{s}^r) = (1-\alpha)\left(\frac{\alpha}{\rho}\right)^{\frac{\alpha}{1-\alpha}} (\bar{s}^r)^{\frac{1}{1-\alpha}} .$$

Since labor is perfectly mobile across sectors, the price of non-traded goods in region *r* is obtained by equating the wage rate in the two sectors within region *r*:

(7) $$p^r = B(\bar{s}^r)^{\frac{1-\nu}{1-\alpha}}$$

where $B \equiv \dfrac{(1-\alpha)^{1-\nu}\left(\dfrac{\alpha}{\rho}\right)^{\frac{\alpha(1-\nu)}{1-\alpha}}}{A_x(1-\nu)^{1-\nu}\left(\dfrac{\nu}{\rho}\right)^{\nu}}$.

Therefore, the actual remuneration of a worker endowed with s_i efficiency units of labor services in region *r* will be:

(8) $$w(s_i,\bar{s}^r) = s_i w^r .$$

The remuneration of a worker with skill s_i in region *r* is an increasing function of his own skill, s_i, and of the average skill level of the region where he works, $\bar{s}^r$ which, of course, depends on migrants' skills. Strategic complementarities arise from the interaction of individual and regional average skill levels because the cross-derivative, $w_{s_i\bar{s}^r}$, is positive.

All variables depend in equilibrium on the average skill level of the population of region *r*. Therefore, to describe fully the steady state equilibrium it is necessary to establish how this is determined.

As previously noted, a worker with skills s_r migrates from region *j* to region *r* if her income net of migration costs and expenditure on non-traded goods guarantees higher consumption of traded goods.

Formally, workers migrate from region *j* to region *r* if the following inequality is satisfied:

(9) $$s_i(w_t^r - w_t^j) > (p_t^r - p_t^j)\overline{C}_x + C .$$

A symmetric steady state equilibrium, in which no skilled worker migrates from the region of origin, always exists. No one migrates if she expects that the average skill level of the workers active in each region are equal, that is if $\bar{s}^j = \bar{s}^r$. In this case, the total factor productivity in the non-traded sector remains equal in the two regions, and neither wage nor price differentials emerge. Inequality [1] is never satisfied so that no one actually finds it optimal to migrate.

However, since skills are strategic complements, this does not need to be the unique steady state equilibrium. If a worker expects the most skilled workers born in region *j* to migrate to region *r,* he may find it optimal to move to region *r* as well, because her own productivity is increasing in the average skill level of workers producing in the same location. If all workers share the same expectations in equilibrium, skills may be asymmetrically distributed between the two regions, even if these are symmetric ex ante. In fact, not only is the productivity of a skilled worker increasing in her own skill level, but also the difference between the productivity of a worker employed in the North and one employed in the South is increasing in the skill level of this worker. This means that, for given beliefs about the distribution of skills between the two regions, the more skilled the workers are, the more beneficial it is to move to the location with the higher concentration of skills.

Moreover, if past history influences workers' beliefs and the distribution of skills in the past was uneven, the asymmetric equilibrium may become the focal point of this "coordination game" among workers.

Let's assume without loss of generality that, if an asymmetric equilibrium emerges, the most skilled workers migrate to the North.

Proposition 1. Equilibria with asymmetric distribution of skills. *In an asymmetric equilibrium, in which productivity in the traded goods sector is higher in the North than in the South, the following conditions are satisfied:*

i) *All workers with skills $s_i \geq \bar{\bar{s}}$ migrate from the South to the North, because the skill premium is higher in the most productive region. $\bar{\bar{s}}$ is the least s_i such that: $s_i(w^N - w^S) \geq (p^N - p^S)\overline{C}_x + C$.*

ii) *All workers with skills* $s_i \leq \underline{\underline{s}}$ *migrate from the North to the South, because the skill premium the North offers is not high enough to compensate the higher cost of non-traded goods for the least skilled workers.* $\underline{\underline{s}}$ *is defined as the highest value of* s_i *which satisfies the following inequality:* $s_i(w^i - w^i) \geq (p^i - p^i)\overline{C}_i + C$.

iii) *The average skill levels in the North and the South are respectively:*

$$\bar{s}^N = \frac{\int\limits_{\{s_i \in R^+ : s_i \geq \underline{\underline{s}}\}} dF(s_i)}{\int\limits_{\{s_i \in R^+ : s_i \geq \underline{\underline{s}}\}} dF(s_i) + \int\limits_{\{s_i \in R^+ : s_i \geq \bar{\bar{s}}\}} dF(s_i)} \cdot \int\limits_{\{s_i \in R^+ : s_i \geq \underline{\underline{s}}\}} s_i dF(s_i) + \frac{\int\limits_{\{s_i \in R^+ : s_i \geq \bar{\bar{s}}\}} dF(s_i)}{\int\limits_{\{s_i \in R^+ : s_i \geq \underline{\underline{s}}\}} dF(s_i) + \int\limits_{\{s_i \in R^+ : s_i \geq \bar{\bar{s}}\}} dF(s_i)} \cdot \int\limits_{\{s_i \in R^+ : s_i \geq \bar{\bar{s}}\}} s_i dF(s_i) \tag{10}$$

$$\bar{s}^S = \frac{\int\limits_{\{s_i \in R^+ : s_i \leq \bar{\bar{s}}\}} dF(s_i)}{\int\limits_{\{s_i \in R^+ : s_i \leq \underline{\underline{s}}\}} dF(s_i) + \int\limits_{\{s_i \in R^+ : s_i \leq \bar{\bar{s}}\}} dF(s_i)} \cdot \int\limits_{\{s_i \in R^+ : s_i \leq \bar{\bar{s}}\}} s_i dF(s_i) + \frac{\int\limits_{\{s_i \in R^+ : s_i \leq \underline{\underline{s}}\}} dF(s_i)}{\int\limits_{\{s_i \in R^+ : s_i \leq \underline{\underline{s}}\}} dF(s_i) + \int\limits_{\{s_i \in R^+ : s_i \leq \bar{\bar{s}}\}} dF(s_i)} \cdot \int\limits_{\{s_i \in R^+ : s_i \leq \underline{\underline{s}}\}} s_i dF(s_i). \tag{11}$$

iv) *Firms in both sectors maximize profits given* $w_t(s_i, \bar{s}_t^r)$, ρ, p_t^N, and p_t^S.

v) *Non-traded goods markets and labor markets clear in the North as well as in the South. Moreover, the government budget constraint is balanced in each period:* $\int\limits_{R^+} T_{ti} dF(s_i) = 0$.

Proposition 2. Existence of asymmetric equilibria. *An asymmetric equilibrium exists if either i) or ii) or both are satisfied when the average skill level in the two regions is determined according to iii). Any asymmetric equilibrium in which the most skilled workers migrate to the North must satisfy conditions i)-v). However, there may be more than one equilibrium satisfying these conditions depending on the shape of the c.d.f. F.*

Notice that $\bar{\bar{s}}$ and $\underline{\underline{s}}$ depend on the wage rate and, therefore, on the capital stock employed in production in each region, in addition to total factor productivity, which is equal to the regional endowment of human capital. However, in a steady state the capital stock depends on the average skill level of region *r*. Therefore, the solution of the equations in Proposition 1, part *iii)* implies solving a system of simultaneous equations in $\bar{s}^N$ and $\bar{s}^S$.

In an asymmetric equilibrium, the most skilled workers in the more productive region receive a skill premium that is high enough to compensate the higher cost of living plus migration costs. Hence, one observes a significant flow of the most skilled and educated workers towards the richest and highest-cost regions, as in Italy or the US. In contrast, the least skilled workers have an incentive to move from the most productive region to the less productive one, because the skill premium they receive is not sufficient to compensate the higher cost of living in the North. Workers with intermediate levels of skills prefer not to move from the region of origin in order not to spend the fixed migration cost, since the difference in skill remuneration between the two regions just about compensates the difference in living costs.

The observed net migration flows depend on the distribution of skills in the population. For instance, the fact that the mobility rate is lower in Spain than in Italy and there are higher flows towards the poorest regions may be explained by differences in the composition of population. In fact, while Italian residents with at least a high school diploma account for 11% of the overall population in 1980 (20% in 1992), in Spain the percentage of skilled workers according to this definition was only 5% in 1980 (8% in 1992).

Government transfers have an important role in explaining why the results of the model do not apply to international migrations. For instance, why do unskilled workers not migrate from the US to Mexico to minimize their living expenditures? Besides the fact that migration costs are presumably higher, government support is very likely greater in their home country and this changes migration incentives. By contrast, why does one observe conspicuous flows of migrants from the poorest to the richest countries? Besides differences in technology that may introduce differences in labor remuneration for any skill level, inhabitants of countries at different stages of development differ substantially in what they consider basic living expenditures. In this case, the mechanism that passes through differences in living costs and hinders migration flows is weakened, and significant flows of labor become possible.

If taxes/subsidies are proportional to income rather than lump sum, the incentive to migrate to the richest regions is even lower, since workers cannot benefit completely from the higher skill premium.

The self-selection of migrants has clear implications for regional disparities. Per capita GDP in the North is higher, not only because the most productive workers, who receive higher wages, are in the North, but also because the self-selection of migrants increases total factor productivity in the traded goods sector in the North and decreases it in the South.

The results have been derived under the simplifying assumption that population size is not affected by migration flows. However, the results of the model are completely unchanged if migration affects the population size (the mass of the new generation) without modifying the distribution of skills. By contrast, if newborns inherited the skill level from their parents, the distribution of skills in the new generation would depend on the characteristics of individuals working in the region during the previous period. In this case, it could happen that the new generation born in the region losing its more skilled workers is less skilled and migration flows decrease because of this endogenous change in the distribution of skills that also accentuates regional disparities. However, if one thinks that skills depend not only on education but also on innate ability (presumably correlated with educational achievements) the assumption does not appear too restrictive and allows us to focus on the consequences of self-selection of migrants on uneven development.

In what follows, I show that the decrease in the mobility rate may also be the result of the process of capital accumulation and partial regional convergence, assuming that the distribution of skills is unchanged by migration and that an asymmetric equilibrium exists. The dynamics of migration decisions is analyzed as the two regions' per capita GDP converges because of the process of capital deepening. In order to do so, it is necessary to introduce dynamics in the model, which I do in the next section.

4. The dynamics of migration and convergence

The asymmetric steady state of the model with skill complementarities and endogenous price differentials can account for the pattern of migration observed within the

European Union in the eighties. The model showed that a steady state, in which only the most skilled workers are responsive to differences in productivity and, therefore, to real wages differentials, is perfectly consistent with economic rationality if the skill premium is increasing in the average skill level and basic living costs differ across regions. However, the "static" version of the model does not explain why the mobility rate within the European countries decreased sharply over the eighties, despite the fact that the process of regional convergence was not completed and in fact came to an halt in those years.

In order to examine this issue, this section studies the dynamics of migration as the process of capital accumulation proceeds in the two regions of the economy. To study the interaction of migration flows with the process of capital deepening, it is necessary to introduce dynamics into the model. Hence, I introduce adjustment costs, which are a quadratic function of the variation in capital per efficiency unit of labor: $\phi \frac{(k_{t+1} - k_t)^2}{2k_t}$. The reader should consider that it is costly for the economy to change the capital intensity of the technique of production and that these costs are born by each firm. In this way, the model has a transitional dynamics and does not jump immediately to the steady state, as in the previous section, even if capital can flow freely into the economy.

I study migration flows as the economy converges to an asymmetric steady state and regional convergence is occurring. In this context, which accurately represents the experiences of Italy and Spain, I investigate if and under what conditions the model presented in the previous section can account for the dramatic change in the observed pattern of migration.

To avoid indeterminacy problems due to the interdependence of investment and migrations decisions, it is necessary to assume that that total factor productivity in the traded good sector at time *t* depends on the average skill level of workers employed in that region at *t-1*. In this way, when firms invest, total factor productivity in the traded sector is given. Migration decisions at time *t* are taken after investment decisions are observed. These dynamic complementarities are often used in the literature and find empirical support (see, for instance, Cooper and Haltiwanger, 1996). In addition, to reduce the size of the dynamic system that describes this two-region economy, I assume that the ratio of capital intensities in the two sectors of region *r* at *t=0* is equal to the steady state ratio of capital intensities. As shown in the appendix (Proposition 1.A), this implies that the process of capital deepening proceeds at the same rate in both sectors of a region. In this way, in order to study the dynamics, one can focus on the capital per efficiency units of labor services of the traded goods sector in region *r*. Therefore, for notational simplicity, the subscript *y* is omitted. Finally, on the consumer side, it is necessary to modify the model in order to take into account the fact that, since the economy is growing, the index of basic living expenditures, $\overline{C}_x$, also increases over time. Therefore, I assume that $\overline{C}_x = \gamma \frac{w_t^S}{p_t^S}$, where $\frac{w_t^S}{p_t^S}$ is the ratio of nominal wages per unit of labor services to the price of non-traded goods in the South, while γ is a constant, with a value between 0 and 1.

In order to decide next period capital per efficiency units of labor services, firms maximize profits net of adjustment costs and the cost of capital, ρ. The objective function for a firm of the traded goods sector is: $\pi_{t+1}^r = y_{t+1}^r - \rho k_{t+1}^r - \phi \frac{(k_{t+1}^r - k_t^r)^2}{2k_t^r}$. Maximizing profits, firms do not take into account the fact that a higher value of k_t decreases adjustment costs at *t+1*. This assumption may be justified on two grounds. First, the time horizon of firms may be the same as that of workers, so that they do not internalize next period adjustment costs. Alternatively, previous period capital intensity may be interpreted as an economy-wide variable that cannot be affected by the decision of a single firm. Of course, in equilibrium, economy-wide and individual variables must coincide.

The growth rate of capital per efficiency units of labor services in the economy is determined according to the first order conditions for profit maximization and is:

$$\frac{k_{t+1}^r - k_t^r}{k_t^r} = \frac{1}{\phi}[\alpha \overline{s}_t^r (k_{t+1}^r)^{\alpha-1} - \rho]. \tag{12}$$

From equation [2], it is clear that the growth rate of capital intensity in region *r* is an increasing function of the marginal productivity of capital.

The equilibrium paths of this two-region economy are described by the capital intensity sequences which satisfy equation [2] for both regions. However, one also needs to take into account the fact that, in equation [2], $\overline{s}_t^r$ is determined according to part iii) of proposition 1, and, therefore, depends on capital intensity in both regions. In fact, $\bar{s}_t^r$ is function of migrations decisions at *t*, that is, of $\overset{=}{s}_t$ and $\underline{\underline{s}}_t$. Migration decisions, in turn, depend on capital intensity at time *t* and on the average skill level at *t-1*. In fact, the remuneration of labor services and the price of non-traded goods depend on the current level of capital intensity and the level of total factor productivity in the traded goods sector in region *r*, equal to the previous period average skill level in this region. Therefore, $\bar{s}_t^r = g^r(k_t^N, k_t^S, \bar{s}_{t-1}^N, \bar{s}_{t-1}^S) = h^r(k_{t-1}^N, k_{t-1}^S, \bar{s}_{t-1}^N, \bar{s}_{t-1}^S)$, where the second equality is obtained considering that equation [2] must hold in both regions and substituting for k_t^N and k_t .

Therefore, the dynamics of the model is described by the following system of four first order difference equations:

$$k_t^N - k_{t-1}^N\left(1-\frac{\rho}{\phi}\right)-\frac{\alpha}{\phi}\bar{s}_{t-1}^N\left(k_t^N\right)^{\alpha-1}k_{t-1}^N = 0$$

$$k_t^S - k_{t-1}^S\left(1-\frac{\rho}{\phi}\right)-\frac{\alpha}{\phi}\bar{s}_{t-1}^S\left(k_t^S\right)^{\alpha-1}k_{t-1}^S = 0$$

(13)

$$\bar{s}_t^N = h^N(k_{t-1}^N, k_{t-1}^S, \bar{s}_{t-1}^N, \bar{s}_{t-1}^S)$$

$$\bar{s}_t^S = h^S(k_{t-1}^N, k_{t-1}^S, \bar{s}_{t-1}^N, \bar{s}_{t-1}^S),$$

with initial conditions: $\bar{s}_0^N$, $\bar{s}_0^S$, k_0^N and k_0^S.

The steady states of this dynamic system are the same as the equilibria of the economy without transitional dynamics described in the previous section. To establish under which conditions an asymmetric steady state of the type described in proposition 1 is locally stable, the system is linearized around the steady state (see appendix for details). Proposition 3 gives a sufficient condition for local stability of system [3] in the neighborhood of an asymmetric steady state.

Proposition 3. Sufficient condition for the local stability of an asymmetric steady state. *A sufficient condition for the local stability of an asymmetric steady state is that the* *value of the density function associated with the c.d.f. F is sufficiently close to zero at* $\overset{=}{s}$ *and* $\underset{=}{s}$ [15].

Proof. See appendix.

Under the condition stated in Proposition 3, the regional average skill level is not significantly affected by migrants' skills in the neighborhood of the steady state.

Lemma 1. The effects of migration on total factor productivity. *Assume that the density function f, associated to the c.d.f., F is continuous in the neighborhood of the steady state values of* $\underset{=}{s}$ *and* $\overset{=}{s}$. *Then, if the sufficient condition for stability stated in proposition 3 holds, the variation of* $\bar{s}_t^r, r \in \{N, S\}$, *around the steady state can be neglected, because it is close to zero.*

Proof. The value of $\bar{s}_t^r$ linearized around the steady state can be written as follows: $\bar{s}_t^r - \bar{s}^r = \left.\frac{\partial \bar{s}_t^r}{\partial \underset{=}{s}_t}\right|_{ss} (\underset{=}{s}_t - \underset{=}{s}) + \left.\frac{\partial \bar{s}_t^r}{\partial \overset{=}{s}_t}\right|_{ss} (\overset{=}{s}_t - \overset{=}{s})$. As shown in the appendix carrying out the linearization of the dynamic system, $\left.\frac{\partial \bar{s}_t^r}{\partial \underset{=}{s}_t}\right|_{ss}$ and $\left.\frac{\partial \bar{s}_t^r}{\partial \overset{=}{s}_t}\right|_{ss}$ can be written respectively as: $\left.\frac{\partial \bar{s}_t^r}{\partial \underset{=}{s}_t}\right|_{ss} = f(\underset{=}{s})\Theta_1$ and $\left.\frac{\partial \bar{s}_t^r}{\partial \overset{=}{s}_t}\right|_{ss} = f(\overset{=}{s})\Theta_2$. Proposition 3 requires that $f(\underset{=}{s})$ and $f(\overset{=}{s})$ be close enough to zero for local stability. Therefore, $\bar{s}_t^r - \bar{s}^r$ is negligible as well. This implies that the variations of $\bar{s}_t^r$ between *t* and *t+1* are also negligible in the neighborhood of the steady state.

In what follows, I assume that the sufficient condition stated in Proposition 3 is satisfied and examine the evolution of migration flows, while the system converges to an asymmetric steady state, starting from the neighborhood of this steady state.

---

[15] I continue to refer to steady state variables' values by omitting the time subscript.

It is assumed that in *t=0* the South has less capital per efficiency unit of labor services and is less productive than the North: $k_o^S < k_o^N$ and $s_o^S < s_o^N$. Moreover, in order to analyze the effects of capital deepening, I assume that the initial levels of capital per efficiency units of labor services are lower than the steady state levels in both regions. Does convergence in the stock of capital per efficiency units of labor services bring a change in the pattern of migration flows as the one observed, for instance, in Italy?

In order to answer this question, it is necessary to examine the dynamics of the variables that migration decisions depend on.

As I said, my primary objective is to study the transition dynamics toward the asymmetric steady state under the assumption that there is convergence in capital intensity. This happens under the conditions stated in lemmas 1 and 2.

Lemma 2. Sufficient Condition for convergence. *If in t=0, the South is further away from the steady state than the North ($k^S - k_0^S > k^N - k_0^N$), then during the adjustment process there is convergence in the level of capital intensity between the two regions.*

Proof. The previous inequality can be equivalently stated using logarithm variables as long as $k^S < k^N$: $\ln k^S - \ln k_0^S > \ln k^N - \ln k_0^N$. Substituting the expressions of steady states capital intensities determined in the previous section one obtains: $\ln k_0^N - \ln k_0^S > \frac{1}{1-\alpha}\left(\ln \bar{s}^N - \ln \bar{s}^S\right)$. This implies that the marginal productivity of capital per efficiency units of labor services is greater in the South $(\ln \alpha + \ln \bar{s}^S - (1-\alpha)\ln k^S)$ than in the North $(\ln \alpha + \ln \bar{s}^N - (1-\alpha)\ln k^N)$ during the whole adjustment process, since, if the sufficient condition for stability holds, variations in the regional average skill level may be neglected (see lemma 1). Hence, from equation [2], it follows that the rate of growth of capital intensity is greater in the South.

Moreover, if the sufficient condition for convergence is satisfied in t=0, it holds throughout the adjustment process. In fact, from the solution of the dynamic system it turns out that $k_t^r - k^{r*} = (k_0^r - k^{r*})\left(\frac{\phi}{\phi + (1-\alpha)\rho}\right)^t$, and, therefore, $\frac{k_t^N - k^{N*}}{k_t^S - k^{S*}} = \frac{k_0^N - k^{N*}}{k_0^S - k^{S*}}$.

As a consequence of the convergence process, the interregional wage gap decreases during the adjustment process.

Corollary 1. The interregional wage gap. *The wage gap,* $w_t^N - w_t^S$*, decreases during the adjustment process. It never becomes equal to zero, because in the steady state the distribution of skills between North and South is asymmetric.*

Proof. Taking the variables in logarithm form the wage differential is: $\ln(w_t^N) - \ln(w_t^S) = \ln(\bar{s}_{t-1}^N) - \ln(\bar{s}_{t-1}^S) + \alpha\left[\ln(k_t^N) - \ln(k_t^S)\right]$. The variation of the wage differential between *t* and *t-1*, $\Delta(\ln(w_t^N) - \ln(w_t^S))$ is negative if and only if $\Delta[\ln(\bar{s}_{t-1}^N) - \ln(\bar{s}_{t-1}^S)] + \alpha \cdot \Delta\left[\ln(k_t^N) - \ln(k_t^S)\right] < 0$. This is always true, because based on lemma 2 the first term is negligible, while the second is always negative under the conditions stated in lemma 2.

On the basis of the above results one can determine the dynamics of migration flows. To study the dynamics of migration, it is necessary to look at the path of the decision variables, which determine migration decisions, as stated in proposition 1. In particular, it is necessary to distinguish between migration to the North and migration to the South.

Proposition 4. Migration flows to the North. *If capital accumulation has a limited effect on the price of non-traded goods (*$\alpha - \nu$ *relatively small), or fixed migration costs are relatively high, migration flows from the South to the North decrease over time. Therefore, if any of these sufficient conditions hold, as the system approaches the steady state, only the most skilled workers migrate to the North.*

Proof. Migration to the North decreases as $\overset{=}{s}_t$ rises. According to proposition 1, $\overset{=}{s}_t$ is defined as: $\overset{=}{s}_t \equiv \dfrac{\left(p_t^N - p_t^S\right) \cdot \gamma \cdot \dfrac{w_t^S}{p_t^S} + C}{w_t^N - w_t^S}$.

It follows from corollary 1 that a sufficient condition for this to increase is that $\dfrac{\left(p_t^N - p_t^S\right) \cdot \gamma \cdot \dfrac{w_t^S}{p_t^S}}{w_t^N - w_t^S}$ rises. In fact, since the interregional wage differential is decreasing,

$\frac{C}{w_t^N - w_t^S}$ is increasing over time. It is shown in the appendix that this sufficient condition holds as long as differences in factor intensities in the two sectors are not too pronounced, that is, if $\alpha - \nu$ is relatively small. In fact, in this case, convergence in the price of non-traded goods proceeds at a sufficiently slower pace than convergence in wage differentials.

Alternatively, if C is relatively high the effect of the increase in the ratio of migration costs to the wage differential prevails over the first term and the eventually fast convergence in the cost of living across the two regions. Therefore, the migration flow to the North decreases in this case as well.

The difference in factor intensities between the two sectors, $\alpha - \nu$, plays an important role in determining the effects of convergence on migration flows, because it measures the degree to which an increase in capital intensity in region *r* is reflected in an increase in the price of non-traded goods. If this were large, since during convergence to the asymmetric steady state capital accumulation proceeds faster in the South, the difference in the price of non-traded goods would decrease relatively faster than the wage differential. In fact, using logarithms, the non-traded price differential and the wage differential may be written respectively as:

$$\text{(14)} \qquad \begin{aligned} \ln p_t^N - \ln p_t^S &= \ln \bar{s}_{t-1}^N - \ln \bar{s}_{t-1}^S + (\alpha - \nu)(\ln k_t^N - \ln k_t^S) \\ \ln w_t^N - \ln w_t^S &= \ln \bar{s}_{t-1}^N - \ln \bar{s}_{t-1}^S + \alpha(\ln k_t^N - \ln k_t^S). \end{aligned}$$

From the above equations it is evident that the narrowing of the gap in capital intensities across regions has a larger effect on interregional wage differentials than on non-traded goods price differentials. This effect is more pronounced the smaller is $\alpha - \nu$. Thus, convergence in capital intensities may hinder migration to the North if it causes sufficiently faster convergence in wage rates than in living costs.

Describing the long-run equilibrium of this economy, I showed that there might be positive migration flows to the relative less productive regions as well. Proposition 5 establishes sufficient conditions under which these flows are increasing over time while the economy converges to the asymmetric steady state and standards of living improve.

Proposition 5. Migration flows to the South. *Migration flows to the South are increasing as the system approaches the steady state, if fixed migration costs are relatively small in comparison to differences in living costs and convergence in wage rates is sufficiently faster than convergence in living costs (if $\alpha - \nu$ is relatively small).*

Proof. Migration to the South increases if $\underline{\underline{s_t}} \equiv \dfrac{\left(p_t^N - p_t^S\right) \cdot \gamma \cdot \dfrac{w_t^S}{p_t^S} - C}{w_t^N - w_t^S}$ increases. From the linearization around the steady state, it is evident that this is possible only if fixed migration costs are relatively small in comparison to differences in living costs. Moreover, in order to make this possible, as in proposition 4 the increase in capital intensity must have a limited effect on the price of non-traded goods ($\alpha - \nu$ must be relatively small). The proof is analogous to that for proposition 4 and is, therefore, omitted.

The existence of migration flows to the South may further reduce the net migration flow to the richest region. Individuals with a lower skill level, who benefit less from skill complementarities, may take advantage of lower living costs in the relatively poorer locations. In this case, convergence in capital intensities may spur migration to the South, because, as noted above, it leads to faster convergence in wage rates than in living costs.

The model has also interesting implications for long-run convergence in regional per capita GDP. The self-selection of migrants generates differences in total factor productivity, which yield an equilibrium with an asymmetric distribution of income. An initial economic disadvantage (lower capital intensity in the model) has long-run effects because the self-selection of migrants perpetuates the uneven distribution of skills and gives rise to a “poverty trap”. This may explain the changing dynamics of migration and convergence within the European Union where, as has been widely noticed (Fabiani and Pellegrini, 1997; Giannetti, 1998), not only did internal migration drop in the eighties, but also the process of regional convergence appears to have come to a halt.

From a normative point of view, whether the concentration of the most skilled workers and the consequent regional disparities maximize social welfare or not depends on the shape of the distribution of skills within the population. There are two contrasting effects at work. On the one hand, the self-selection of migrants increases total factor productivity in the

North and this in turn increases the output of workers employed in the North. On the other hand, the opposite is true in the South. The net effect on total output depends on whether the increase in output in the North is larger or smaller than the decrease in the South. This depends on the shape of the distribution of skills in the population, *F*. In particular, if the mass of workers remaining in the South is very large with respect to the mass of migrants, the self-selection of migrants reduces aggregate GDP and, therefore, a social planner would seek to limit migration flows. Moreover, if capital accumulation were performed by a social planner, he or she would internalize the effect of investment today on the next period adjustment cost of capital. Therefore, convergence to the steady state should be faster, under assumptions on the parameters that guarantee stability as in Proposition 3.

5. Conclusions

In this paper, a model has been presented which shows how heterogeneity in migrants' skill level and explicit consideration of living costs can help to explain some of the puzzles surrounding internal migration.

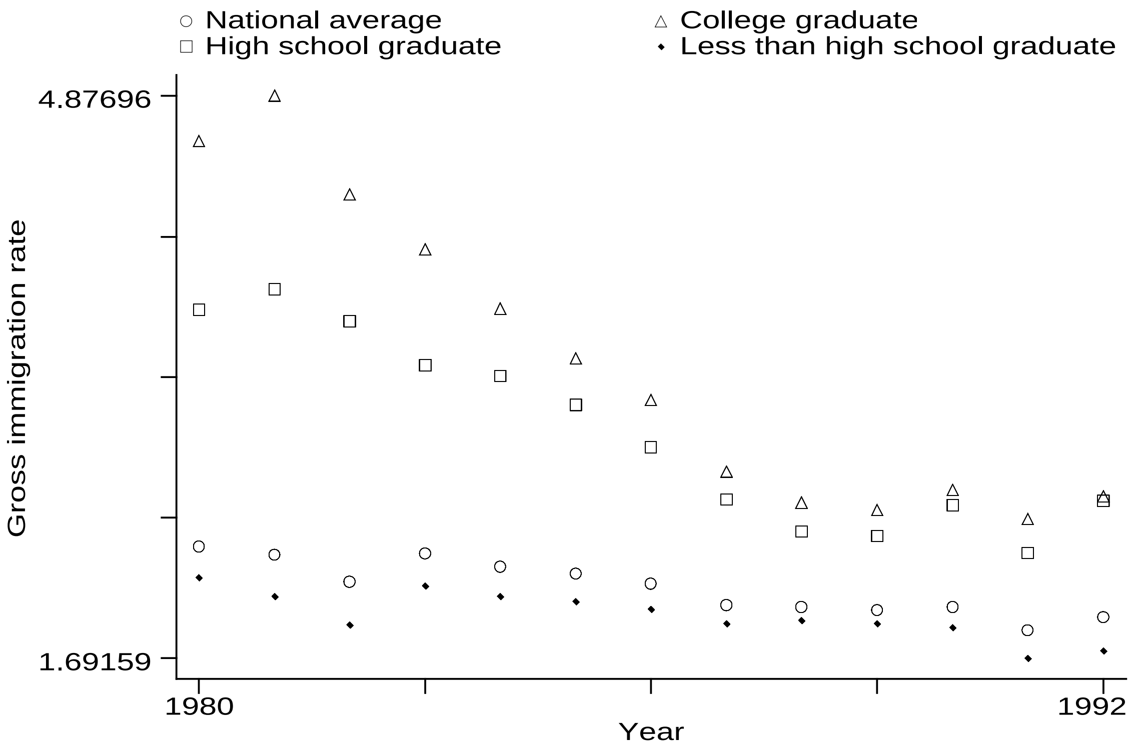
The model has also shown how the self-selection of migrants may generate poverty traps for regions that start from less favorable conditions, because it leads to differences in total factor productivity in the traded goods sector. However, there is no danger of depopulation for the poorer regions, as models that merely consider wage differentials would forecast, because forces are at work leading unskilled workers to migrate to these regions.

The mechanisms proposed in the model may help explain the changing dynamics of migration and convergence within the European Union where, as has been widely noted, not only did internal migration drop during the eighties, but also the process of regional convergence appears to have come to an halt. The dynamics of the model could be enriched by analyzing the interaction between migration and human capital accumulation. Intuitively, in this case the effects of the brain drain on regional disparities would be even stronger, because incentives to invest in human capital would be stronger in the "North", where the skill premium is higher.

The conclusions of the model may also have interesting policy implications when one considers the integration of Eastern European economies into the European Union. Allowing free mobility of labor between Eastern and Western Europe may create a poverty trap for transition economies, since the most educated and skilled individuals would be the ones with strongest incentives to migrate. Furthermore, Eastern Germany might be subject to the kind of “brain drain” that has been pointed out in the model, since it is perfectly integrated with Western Germany and what is considered basic living expenditure is likely to converge faster to Western European standards.

Figure 1.a.

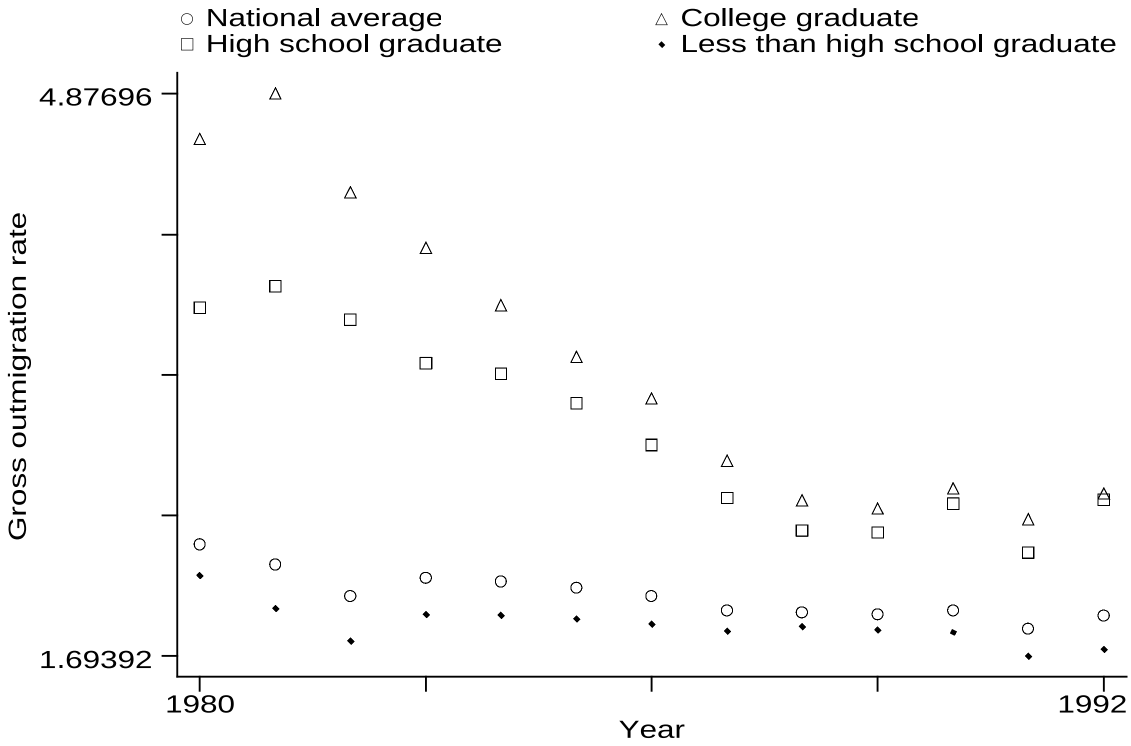
ITALY: GROSS IMMIGRATION RATE



Source: National Bureau of Statistics (ISTAT).

Figure 1.b

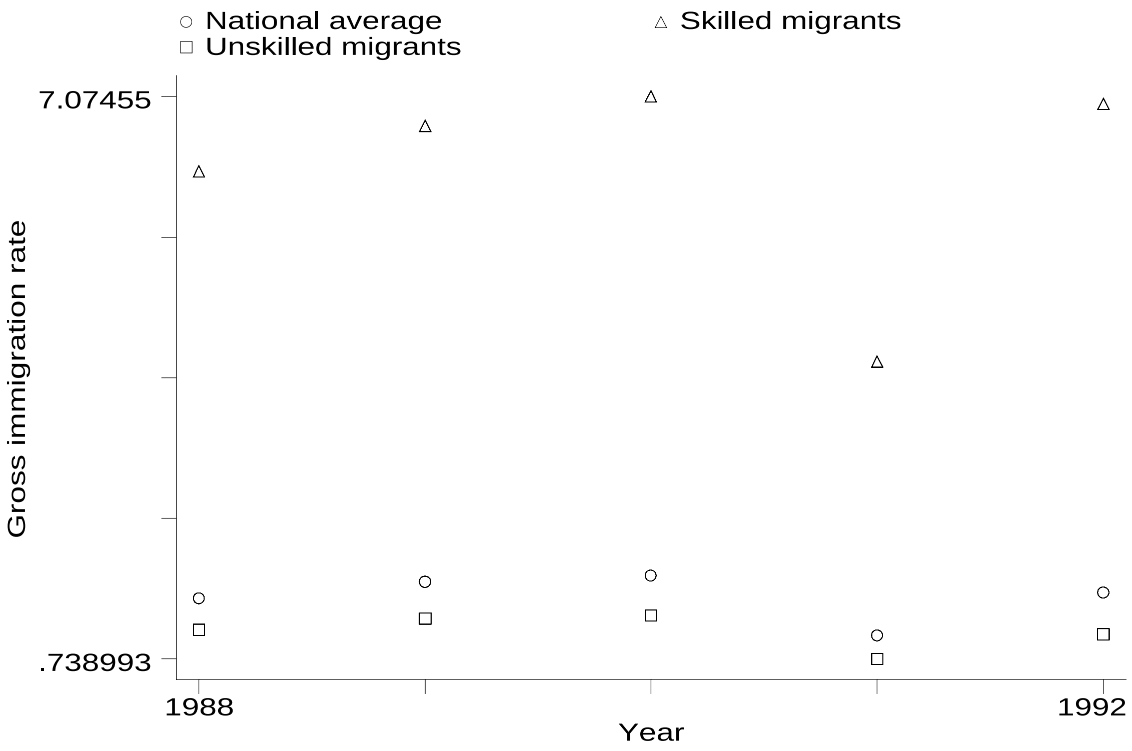
ITALY: GROSS EMIGRATION RATE



Source: National Bureau of Statistics (ISTAT).

Figure 2.a

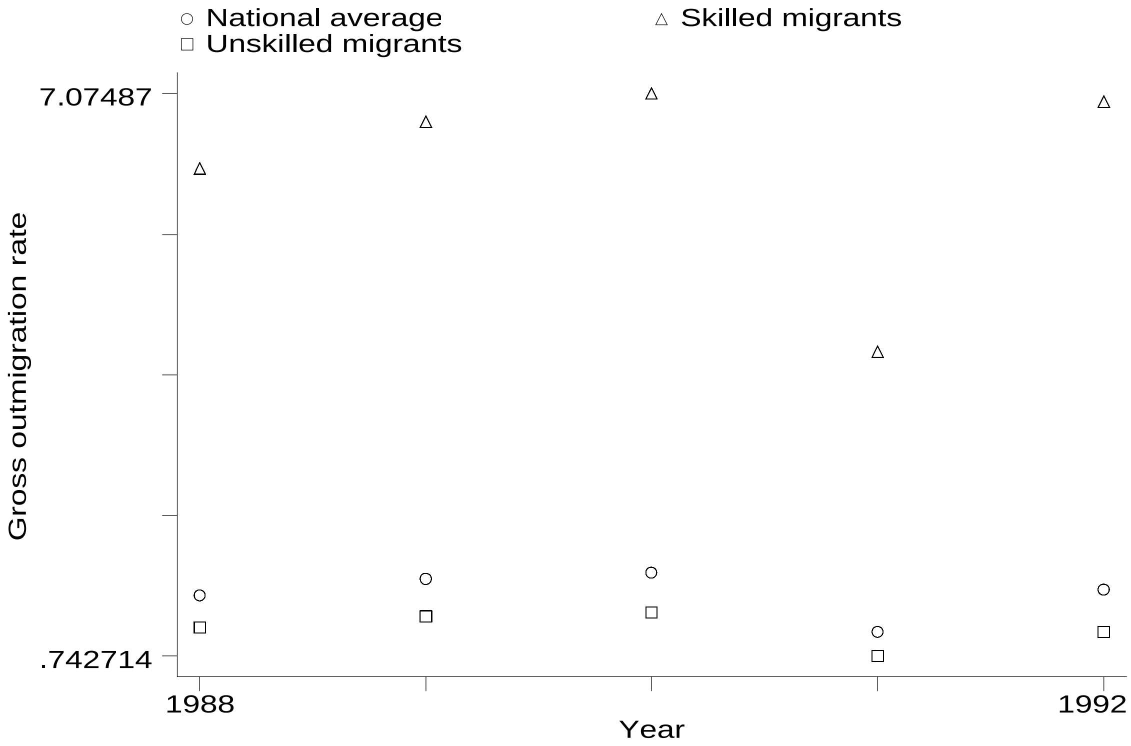
SPAIN: GROSS IMMIGRATION RATE



Source: Residential Variation Data (Estadística de Variaciones Residenciales)

Figure 2.b

SPAIN: GROSS EMIGRATION RATE



Source: Residential Variation Data (Estadística de Variaciones Residenciales)

Table 1.a

SPANISH REGIONS: DESCRIPTIVE STATISTICS (1)

Per capita GDP (2)	5387.26
Rate of unemployment	18.44
Industry's share of value added	.28
Fraction of population with a Bachelor's degree or an upper-secondary school diploma	.068

Table 1.b

SPAIN: REGIONS WITH THE HIGHEST NET IMMIGRATION (3)

Annual average net inflow of population	10599
Per capita GDP	5876.339
Rate of unemployment	16.89
Industry's share of value added	.219
Fraction of population with a Bachelor's degree or an upper-secondary school diploma	.063

Table 1.c

SPAIN: REGIONS WITH THE HIGHEST NET EMIGRATION (4)

Annual average net inflow of population	15207
Per capita GDP	4971.068
Rate of unemployment	21.9
Industry's share of value added	.3083384
Fraction of population with a Bachelor's degree or an upper-secondary school diploma	.07

Source: Residential Variation Data (Estadística de Variaciones Residenciales)

(1) All data refer to 1988 with the exception of migration flows, which are an annual average over the 1988-1992 period. (2) Per capita GDP is expressed in ECUs. (3) Comunidad Valenciana, Canaries and Baleares. (4) Castilla y Leon, Pais Vasco and Extremadura.

Table 2.a

ITALIAN REGIONS: DESCRIPTIVE STATISTICS (1)

Per capita GDP (2)	13065.21
Rate of unemployment	7.9
Industry's share of value added	.34
Fraction of population with a Bachelor's degree or an upper-secondary school diploma	.021

Table 2.b

ITALY: REGIONS WITH THE HIGHEST NET IMMIGRATION (3)

Annual average net inflow of population	16480
Per capita GDP	15496.16
Rate of unemployment	6.1
Industry's share of value added	.39
Fraction of population with a Bachelor's degree or an upper-secondary school diploma	.024

Table 2.c

ITALY: REGIONS WITH THE HIGHEST NET EMIGRATION (4)

Annual average net ouflow of population	36660
Per capita GDP	9106.643
Rate of unemployment	11.7
Industry's share of value added	.26
Fraction of population with a Bachelor's degree or an upper-secondary school diploma	.019

Source: ISTAT.

(1) All data refer to 1980 with the exception of migration flows which are an annual average over the 1980-1992 period. (2) Per capita GDP is expressed in Italian Lire. (3) Emilia and Romagna, Toscana, Lombardia, Lazio and Veneto. (4) Calabria, Puglia, Campania, Sicilia and Basilicata.

Appendix

Proposition 1A

If in t=0 the ratio of capital intensities in the two sectors is equal to the steady state ratio, $\frac{k_{x0}^r}{k_{y0}^r} = \frac{k_x^r}{k_y^r}$, then the capital-labor ratio measured in efficiency units increases at the same rate in both sectors of region r.

Proof. The ratio of marginal productivities of capital at t=0 in region r is: $\frac{MPK_{y0}^r}{MPK_{x0}^r} = \frac{\alpha\bar{s}_{-1}^r (k_{y0}^r)^{\alpha-1}}{p_0^r \nu A_x (k_{x0}^r)^{\nu-1}}$.

p_0^r is an endogenous variable that can be determined by taking into account the fact that the two sectors have a common wage rate because labor is freely mobile across sectors, and, therefore, its marginal productivity must be equal. It follows that: $p_0^r = \frac{(1-\alpha)\bar{s}_{-1}^r (k_{y0}^r)^{\alpha}}{(1-\nu)A_x (k_{x0}^r)^{\nu}}$.

Substituting for p_0^r into the ratio of marginal productivities of capital, one obtains: $\frac{MPK_{y0}^r}{MPK_{x0}^r} = \frac{\alpha(1-\nu)k_{x0}^r}{\nu(1-\alpha)k_{y0}^r}$. Since by assumption $\frac{k_{x0}^r}{k_{y0}^r} = \frac{k_x^r}{k_y^r}$, the ratio of marginal productivities of capital in t=0, must be equal to the steady state ratio of marginal productivities of capital, which is equal to 1. In fact, in the steady state the marginal productivity of capital must be equal to the international interest rate, ρ, in both sectors.

I show that this implies that capital intensity increases at the same rate in both regions, while the system converges to the steady state.

By way of contradiction, let us assume that the rate of growth of capital measured in efficiency units is higher in the traded goods sector. This would imply: $\frac{k_{x1}^r}{k_{y1}^r} > \frac{k_{x0}^r}{k_{y0}^r}$, and, therefore, $\frac{MPK^r_{y1}}{MPK^r_{x1}} < 1$. But this would be in contradiction with firms' profit maximization, because first order conditions, $\frac{1}{\phi}(MPK_{t+1} - \rho) = \frac{k_{t+1} - k_t}{k_t}$, imply that capital intensity grows faster in the sector with the higher marginal productivity.

Local stability of the dynamic system of the economy

The matrix of coefficients of system [3] linearized around the asymmetric steady state is the following:

$$\begin{bmatrix} \frac{\partial k_t^N}{\partial k_{t-1}^N} & \frac{\partial k_t^N}{\partial k_{t-1}^S} & \frac{\partial k_t^N}{\partial \bar{s}_{t-1}^N} & \frac{\partial k_t^N}{\partial \bar{s}_{t-1}^S} \\ \frac{\partial k_t^S}{\partial k_{t-1}^N} & \frac{\partial k_t^S}{\partial k_{t-1}^S} & \frac{\partial k_t^S}{\partial \bar{s}_{t-1}^N} & \frac{\partial k_t^S}{\partial \bar{s}_{t-1}^S} \\ \frac{\partial \bar{s}_t^N}{\partial k_{t-1}^N} & \frac{\partial \bar{s}_t^N}{\partial k_{t-1}^S} & \frac{\partial \bar{s}_t^N}{\partial \bar{s}_{t-1}^N} & \frac{\partial \bar{s}_t^N}{\partial \bar{s}_{t-1}^S} \\ \frac{\partial \bar{s}_t^S}{\partial k_{t-1}^N} & \frac{\partial \bar{s}_t^S}{\partial k_{t-1}^S} & \frac{\partial \bar{s}_t^S}{\partial \bar{s}_{t-1}^N} & \frac{\partial \bar{s}_t^S}{\partial \bar{s}_{t-1}^S} \end{bmatrix}_{SS} =$$

$$= \begin{bmatrix} \frac{\phi}{\phi + (1-\alpha)\rho} & 0 & \frac{\alpha\left(\frac{\bar{s}^N \alpha}{\rho}\right)^{\frac{\alpha}{1-\alpha}}}{\phi + (1-\alpha)\rho} & 0 \\ 0 & \frac{\phi}{\phi + (1-\alpha)\rho} & 0 & \frac{\alpha\left(\frac{\bar{s}^S \alpha}{\rho}\right)^{\frac{\alpha}{1-\alpha}}}{\phi + (1-\alpha)\rho} \\ A_{31} f(\bar{\bar{s}}) + \Gamma_{31} f(\underline{\underline{s}}) & A_{32} f(\bar{\bar{s}}) + \Gamma_{32} f(\underline{\underline{s}}) & A_{33} f(\bar{\bar{s}}) + \Gamma_{33} f(\underline{\underline{s}}) & A_{34} f(\bar{\bar{s}}) + \Gamma_{34} f(\underline{\underline{s}}) \\ A_{41} f(\bar{\bar{s}}) + \Gamma_{41} f(\underline{\underline{s}}) & A_{42} f(\bar{\bar{s}}) + \Gamma_{42} f(\underline{\underline{s}}) & A_{43} f(\bar{\bar{s}}) + \Gamma_{43} f(\underline{\underline{s}}) & A_{44} f(\bar{\bar{s}}) + \Gamma_{44} f(\underline{\underline{s}}) \end{bmatrix}$$

Notice that the current period average skill level in region r depends on capital intensity and the past levels of the average skill level through the types of the least skilled individual migrating to the North, $\overline{\overline{s}}$, and the most skilled individual migrating to the South, $\underline{\underline{s}}$. The term in the third row and the first column of the matrix of coefficients, for instance, is: $\dfrac{\partial \bar{s}_t^N}{\partial k_{t-1}^N} = \left[\dfrac{\partial \bar{s}_t^N}{\partial \underline{\underline{s}}} \cdot \dfrac{\partial \underline{\underline{s}}}{\partial k_t^N} + \dfrac{\partial \bar{s}_t^N}{\partial \overline{\overline{s}}} \cdot \dfrac{\partial \overline{\overline{s}}}{\partial k_t^N} \right] \cdot \dfrac{\partial k_t^N}{\partial k_{t-1}^N}$, while

$$\frac{\partial \bar{s}_t^N}{\partial \bar{s}_{t-1}^N} = \frac{\partial \bar{s}_t^N}{\partial \underline{\underline{s}}_t} \cdot \left[\frac{\partial \underline{\underline{s}}_t}{\partial \bar{s}_{t-1}^N} + \frac{\partial \underline{\underline{s}}_t}{\partial k_t^N} \cdot \frac{\partial k_t^N}{\partial k_{t-1}^N} \right] + \frac{\partial \bar{s}_t^N}{\partial \overline{\overline{s}}_t} \cdot \left[\frac{\partial \overline{\overline{s}}_t}{\partial \bar{s}_{t-1}^N} + \frac{\partial \overline{\overline{s}}_t}{\partial k_t^N} \cdot \frac{\partial k_t^N}{\partial k_{t-1}^N} \right].$$

Moreover, $\bar{s}_t^N$ and $\bar{s}_t^S$ depend on the shape of the distribution of types, F. To be able to draw conclusions on the stability of the dynamic system it is necessary to make some assumptions about this distribution.

It helps to look at the expressions of $\dfrac{\partial \bar{s}_t^N}{\partial \underline{\underline{s}}_t}, \dfrac{\partial \bar{s}_t^N}{\partial \overline{\overline{s}}_t}, \dfrac{\partial \bar{s}_t^S}{\partial \underline{\underline{s}}_t}$ and $\dfrac{\partial \bar{s}_t^S}{\partial \overline{\overline{s}}_t}$ in the steady state:

$$\left.\frac{\partial \bar{s}_t^N}{\partial \underline{\underline{s}}_t}\right|_{ss} = \left\{ -\frac{\left[\int\limits_{\{s_i \in S: s_i \geq \underline{\underline{s}}\}} t\,dF(t) + \underline{\underline{s}} \int\limits_{\{s_i \in S: s_i \geq \underline{\underline{s}}\}} dF(t) \right]}{\int\limits_{\{s_i \in S: s_i \geq \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i \in S: s_i \geq \overline{\overline{s}}\}} dF(t)} + \frac{\left[\int\limits_{\{s_i \in S: s_i \geq \underline{\underline{s}}\}} t\,dF(t) \cdot \int\limits_{\{s_i \in S: s_i \geq \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i \in S: s_i \geq \overline{\overline{s}}\}} dF(t) \cdot \int\limits_{\{s_i \in S: s_i \geq \overline{\overline{s}}\}} t\,dF(t) \right]}{\left[\int\limits_{\{s_i \in S: s_i \geq \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i \in S: s_i \geq \overline{\overline{s}}\}} dF(t) \right]^2} \right\} \cdot f(\underline{\underline{s}})$$

$$\left.\frac{\partial \bar{s}_t^N}{\partial \overline{\overline{s}}_t}\right|_{ss} = \left\{ \frac{\left[\int\limits_{\{s_i \in S: s_i \geq \underline{\underline{s}}\}} t\,dF(t) \cdot \int\limits_{\{s_i \in S: s_i \geq \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i \in S: s_i \geq \overline{\overline{s}}\}} dF(t) \cdot \int\limits_{\{s_i \in S: s_i \geq \overline{\overline{s}}\}} t\,dF(t) \right]}{\left[\int\limits_{\{s_i \in S: s_i \geq \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i \in S: s_i \geq \overline{\overline{s}}\}} dF(t) \right]^2} - \frac{\left[\int\limits_{\{s_i \in S: s_i \geq \overline{\overline{s}}\}} t\,dF(t) + \underline{\underline{s}} \cdot \int\limits_{\{s_i \in S: s_i \geq \overline{\overline{s}}\}} dF(t) \right]}{\int\limits_{\{s_i \in S: s_i \geq \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i \in S: s_i \geq \overline{\overline{s}}\}} dF(t)} \right\} \cdot f(\overline{\overline{s}})$$

$$\left.\frac{\partial \bar{s}_t^N}{\partial \underline{\underline{s}}_t}\right|_{ss} = \left\{ -\frac{\left[\int\limits_{\{s_i\in S: s_i\le \underline{\underline{s}}\}} tdF(t)\cdot \int\limits_{\{s_i\in S: s_i\le \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i\in S: s_i\le \bar{\bar{s}}\}} dF(t)\cdot \int\limits_{\{s_i\in S: s_i\le \bar{\bar{s}}\}} tdF(t) \right]}{\left[\int\limits_{\{s_i\in S: s_i\le \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i\in S: s_i\le \bar{\bar{s}}\}} dF(t) \right]^2} + \frac{\left[\int\limits_{\{s_i\in S: s_i\le \underline{\underline{s}}\}} tdF(t) + \underline{\underline{s}} \int\limits_{\{s_i\in S: s_i\le \underline{\underline{s}}\}} dF(t) \right]}{\int\limits_{\{s_i\in S: s_i\le \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i\in S: s_i\le \bar{\bar{s}}\}} dF(t)} \right\} f(\underline{\underline{s}})$$

$$\left.\frac{\partial \bar{s}_t^S}{\partial \bar{\bar{s}}_t}\right|_{ss} = \left\{ \frac{\left[\int\limits_{\{s_i\in S: s_i\le \bar{\bar{s}}\}} tdF(t) + \underline{\underline{s}}\cdot \int\limits_{\{s_i\in S: s_i\le \bar{\bar{s}}\}} dF(t) \right]}{\int\limits_{\{s_i\in S: s_i\le \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i\in S: s_i\le \bar{\bar{s}}\}} dF(t)} - \frac{\left[\int\limits_{\{s_i\in S: s_i\le \underline{\underline{s}}\}} tdF(t)\cdot \int\limits_{\{s_i\in S: s_i\le \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i\in S: s_i\le \bar{\bar{s}}\}} dF(t)\cdot \int\limits_{\{s_i\in S: s_i\le \bar{\bar{s}}\}} tdF(t) \right]}{\left[\int\limits_{\{s_i\in S: s_i\le \underline{\underline{s}}\}} dF(t) + \int\limits_{\{s_i\in S: s_i\le \bar{\bar{s}}\}} dF(t) \right]^2} \right\} \cdot f(\bar{\bar{s}})$$

where f is the density function associated with the cumulative density function, F.

It follows that all the terms in the last two rows may be written as $A_{ij} f(\bar{\bar{s}}) + \Gamma_{ij} f(\underline{\underline{s}})$, where A_{ij} and Γ_{ij} depend on the parameter of the model and the steady state values of the variables.

If $f(\underline{\underline{s}})$ and $f(\bar{\bar{s}})$ are sufficiently close to zero in the asymmetric steady state, the previous matrix can be approximated by the following one, in which the last two rows are zeros and it is straightforward to calculate the eigenvalues:

$$\begin{bmatrix} \dfrac{\phi}{\phi+(1-\alpha)\rho} & 0 & \dfrac{\alpha\left(\dfrac{\bar{s}^N\alpha}{\rho}\right)^{\frac{\alpha}{1-\alpha}}}{\phi+(1-\alpha)\rho} & 0 \\ 0 & \dfrac{\phi}{\phi+(1-\alpha)\rho} & 0 & \dfrac{\alpha\left(\dfrac{\bar{s}^S\alpha}{\rho}\right)^{\frac{\alpha}{1-\alpha}}}{\phi+(1-\alpha)\rho} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

This matrix has eigenvalues: $\frac{\phi}{\phi+(1-\alpha)\rho}$, $\frac{\phi}{\phi+(1-\alpha)\rho}$, 0,0, which are all less than 1. Therefore, the four-dimensional dynamic system associated with it is locally stable.

Proof of Proposition 4

The migration flow to the North decreases as the two-region economy approaches the steady state if $\overset{=}{s}_t \equiv \frac{\left(p_t^N - p_t^S\right)\cdot\gamma\cdot\frac{w_t^S}{p_t^S}+C}{w_t^N - w_t^S}$ increases.

Linearizing this variable around the steady state, one obtains:

$$\overset{=}{s}_t - \overset{=}{s} < 0 \quad \leftrightarrow$$

$$\left[\frac{(p^N-p^S)\gamma\frac{w^S}{p^S}}{w^N-w^S}\right]\cdot\left[\frac{(p_t^N-p_t^S)-(p^N-p^S)}{p^N-p^S}+\frac{\frac{w_t^S}{p_t^S}-\frac{w^S}{p^S}}{\frac{w^S}{p^S}}-\frac{\left(w_t^N-w_t^S\right)-(w^N-w^S)}{w^N-w^S}\right]-$$

$$-\frac{C}{w_t^S-w_t^N}\cdot\frac{\left(w_t^N-w_t^S\right)-(w^N-w^S)}{w^N-w^S}<0.$$

This is true if:

i) The last term prevails, since $\frac{\left(w_t^N-w_t^S\right)-(w^N-w^S)}{w^N-w^S}>0$. This happens if C is relatively large in comparison to $(p_t^N-p_t^S)\gamma\frac{w_t^S}{p_t^S}$.

ii) $\frac{(p_t^N-p_t^S)-(p^N-p^S)}{p^N-p^S}+\frac{\frac{w_t^S}{p_t^S}-\frac{w^S}{p^S}}{\frac{w^S}{p^S}}-\frac{\left(w_t^N-w_t^S\right)-(w^N-w^S)}{w^N-w^S}<0$, even if C is relatively small.

In what follows, I prove that ii) holds if $\alpha - \nu$ is not too large.

Out of the steady state, the wage rate and the price of non-traded goods in region r are respectively: $w_t^r = (1-\alpha)\bar{s}_{t-1}^r \left(k_t^r\right)^\alpha$ and $p_t^r = \dfrac{\alpha \bar{s}_{t-1}^r \left(k_t^r\right)^{\alpha-\nu}}{\nu A_x (\upsilon^r)^{\nu-1}}$, where υ^r is the steady state ratio between capital intensities in the non-traded and traded goods sectors in region r.

The dynamics w_t^r and p_t^r depend on k_t^r and s_t^r, whose variations can be neglected in the neighborhood of the steady state. Hence, continuing to linearize w_t^r and p_t^r around the steady state, one obtains:

$$(\alpha-\nu).\frac{p^N.\dfrac{k_t^N-k^N}{k^N}-p^S\cdot\dfrac{k_t^S-k^S}{k^S}}{p^N-p^S}-\alpha\frac{w^N\cdot\dfrac{k_t^N-k^N}{k^N}-w^S\cdot\dfrac{k_t^S-k^S}{k^S}}{w^N-w^S}+\alpha\cdot\frac{k_t^S-k^S}{k^S}-$$
$$-(\alpha-\nu)\cdot\frac{k_t^S-k^S}{k^S}<0.$$

Under my assumptions: $\dfrac{k_t^N-k^N}{k^N}>\dfrac{k_t^S-k^S}{k^S}$. To simplify the previous expression, it is useful to define $a_t \equiv \dfrac{k_t^N-k^N}{k^N}-\dfrac{k_t^S-k^S}{k^S}$.

The previous inequality becomes: $\left[\nu+\dfrac{\alpha w^S}{w^N-w^S}-\dfrac{(\alpha-\nu)p^S}{p^N-p^S}\right](-a_t)<0$, which may be rewritten as: $\left[\dfrac{\nu p^N}{p^N-p^S}+\alpha\dfrac{p^S}{p^N-p^S}\left(\dfrac{\dfrac{w^S}{w^N-w^S}}{\dfrac{p^S}{p^N-p^S}}-1\right)\right](-a_t)<0$.

This is always satisfied if $\alpha - \nu$ is not too large, because $p^N > p^S$ in the asymmetric steady state, and $\dfrac{\dfrac{w^S}{w^N-w^S}}{\dfrac{p^S}{p^N-p^S}}-1>-1$.

References

Acemoglu, D. (1998), "Why do new technologies complement skills? Directed Technical Change and Wage Inequality", mimeo, Massachusetts Institute of Technology.

Antolin, P. and O. Bover (1997), "Regional Migration in Spain: the effect of personal characteristics and of employment, wage and house price differentials using pooled cross-sections", *Oxford Bulletin of Economics and Statistics*, Vol. 59, pp. 215-35.

Atkenson, A. and M. Ogaki (1996), "Wealth-varying intertemporal elasticities of substitution: Evidence from panel and aggregate data", *Journal of Monetary Economics*, Vol. 38, pp. 507-34.

Attanasio, O. and F. Padoa-Schioppa (1991), "Regional Inequalities, Migration and Mismatch in Italy, 1960-1986", in F. Padoa-Schioppa (ed.), *Mismatch and Labour Mobility*, Cambridge University Press, Cambridge.

Azariadis, C. and A. Drazen (1990), "Threshold Externalities in Economic Development", *Quarterly Journal of Economics*, Vol. 105, pp. 507-34.

Balassa, B. (1964), "The Purchasing Power Parity Doctrine: A reappraisal", *Journal of Political Economy*, Vol. 72, pp. 584-96.

Barro, R. J. and X. Sala-i-Martin (1991), "Convergence across States and Regions", *Brookings Papers on Economic Activity*, Vol. 1/1991, pp. 107-58.

Bentolila, S. and J. Dolado (1991), "Mismatch and Internal Migration in Spain, 1962-1986", in F. Padoa-Schioppa (ed.), *Mismatch and Labour Mobility*, Cambridge University Press, Cambridge.

Bentolila, S. (1997), "Sticky labor in Spanish regions", *European Economic Review*, Vol. 41, pp. 591-8.

Bertola, G. (1993), "Models of economic integration and localized growth", in F. Torres and F. Giavazzi (eds.), *Adjustment and Growth in the European Monetary Union*, Cambridge UK, CEPR and Cambridge University Press.

Borjas, G. J., S.G. Bronars and S.J. Trejo (1992), "Self-Selection and Internal Migration in the United States", *Journal of Urban Economics*, Vol. 32, pp. 159-85.

Bover, O. (1997), "Migrations in Spain", Paper presented at the CEPR Conference on European Migration, 14-15 November, 1997.

Cameron, G. and J. Muellbauer (1998), "The Housing Market and Regional Commuting and Migration Choices", CEPR Discussion Paper, No. 1945.

Cooper, R and A. John (1988), "Coordinating Coordination Failures in Keinesian Models", *Quarterly Journal of Economics*, Vol. 103, pp. 441-63.

Cooper, R. and J. Haltiwanger (1996), "Evidence on Macroeconomic Complementarities", *Review of Economics and Statistics*, Vol. 78, pp. 78-93.

European Economy, various issues.

Fabiani, S. and G. Pellegrini (1997), "Education, Infrastructure, Geography and Growth: an Empirical Analysis of the Development of Italian Provinces", Banca d'Italia, Temi di discussione, No. 323.

Faini, R. and A. Venturini (1994), "Migration and Growth: the Experience of Southern Europe", CEPR Discussion Paper, No. 964.

Faini, R. (1996), "Increasing Returns, Migrations and Convergence", *Journal of Development Economics,* Vol. 49, pp. 121-36.

Faini, R. (1997), "Skilled labor, Migration and Regional Growth", Paper presented at the Joint International Seminar in International Trade and CEPR Geography Seminar.

Faini, R., G. Galli, P. Gennari and F. Rossi (1997), "An Empirical Puzzle: Falling Migration and Growing Unemployment Differentials among Italian Regions", *European Economic Review,* Vol. 41, pp. 571-79.

Galor, O. (1986), "Time Preference and International Labor Migration", *Journal of Economic Theory,* Vol. 38, pp. 1-20.

Giannetti, M. (1998), "The Effects of Integration on Regional Disparities: Convergence, Divergence or Both?", Ente Einaudi Working Paper, No. 11.

Giannetti, M. (1999), "Complementarities and Migration Decisions: An Analysis of Human Capital Movements", ISFSE Working Paper, CNR.

Goria, A. and A. Ichino (1994), "Migration and Convergence among Italian Regions", Nota di lavoro No. 51-94, Fondazione ENI Enrico Mattei, Milan.

Kravis, I. B. and R. E. Lipsey (1982), "Towards an Explanation of National Price Levels", NBER Working Paper, No. 1034.

Kremer, M. (1993), "The O-Ring Theory of Economic Development", *Quarterly Journal of Economics,* Vol. 108, pp. 551-76.

Krugman, P. (1991), *Geography and Trade,* Cambridge, MIT Press.

Lucas, R.E. (1988), "On the Mechanics of Economic Development", *Journal of Monetary Economics*, Vol. 22, pp. 3-42.

Mauro, P. and A. Spilimbergo (1998), "How do the skilled and the unskilled respond to regional shocks? The case of Spain", IMF Working Paper, No. 98/77.

Pissarides, C.A. and J. Wadsworth (1989), "Unemployment and the Inter-regional Mobility of Labour", *The Economic Journal,* Vol. 99, pp. 739-55.

Rauch, J. E. (1991), "Productivity Gains from Geographic Concentration of Human Capital: Evidence from the Cities", NBER Working Paper, No. 3905.

Rauch, J. E. (1991), "Reconciling the pattern of trade with the pattern of migration", *American Economic Review*, Vol. 81, pp. 775-96.

Samuelson, P. A. (1964), "Theoretical Notes on Trade Problems", *Review of Economics and Statistics,* Vol. 46, pp. 145-54.

The Economist (1998), "A Survey on Italy".

RECENTLY PUBLISHED "TEMI" (*)

No. 342 — *Energy Consumption, Survey Data and the Prediction of Industrial Production in Italy,* by D. J. MARCHETTI and G. PARIGI (December 1998).

No. 343 — *What Caused the Asian Currency and Financial Crisis?,* by G. CORSETTI, P. PESENTI and N. ROUBINI (December 1998).

No. 344 — *Investment and the Exchange Rate,* by F. NUCCI and A. F. POZZOLO (December 1998).

No. 345 — *Reallocation and Learning over the Business Cycle,* by F. SCHIVARDI (December 1998).

No. 346 — *Una ricostruzione omogenea di dati regionali: conti economici e reddito disponibile delle famiglie 1970-1995,* by P. BERRETTONI, R. DELOGU, C. PAPPALARDO and P. PISELLI (February 1999).

No. 347 — *Industrial Districts and Local Banks: Do the Twins Ever Meet?,* by A. BAFFIGI, M. PAGNINI and F. QUINTILIANI (March 1999).

No. 348 — *Orari di lavoro atipici in Italia: un'analisi attraverso l'Indagine dell'uso del tempo dell'Istat,* by R. TORRINI (March 1999).

No. 349 — *Gli effetti economici del nuovo regime di tassazione delle rendite finanziarie,* by R. CESARI (March 1999).

No. 350 — *The Distribution of Personal Income in Post-War Italy: Source Description, Data Quality, and the Time Pattern of Income Inequality,* by A. BRANDOLINI (April 1999).

No. 351 — *Median Voter Preferences, Central Bank Independence and Conservatism,* by F. LIPPI (April 1999).

No. 352 — *Errori e omissioni nella bilancia dei pagamenti, esportazioni di capitali e apertura finanziaria dell'Italia,* by M. COMMITTERI (June 1999).

No. 353 — *Is There an Equity Premium Puzzle in Italy? A Look at Asset Returns, Consumption and Financial Structure Data over the Last Century,* by F. PANETTA and R. VIOLI (June 1999).

No. 354 — *How Deep Are the Deep Parameters?,* by F. ALTISSIMO, S. SIVIERO and D. TERLIZZESE (June 1999).

No. 355 — *The Economic Policy of Fiscal Consolidations: The European Experience,* by A. ZAGHINI (June 1999).

No. 356 — *What Is the Optimal Institutional Arrangement for a Monetary Union?,* by L. GAMBACORTA (June 1999).

No. 357 — *Are Model-Based Inflation Forecasts Used in Monetary Policymaking? A Case Study* by S. SIVIERO, D. TERLIZZESE and I. VISCO (September 1999).

No. 358 — *The Impact of News on the Exchange Rate of the Lira and Long-Term Interest Rates* by F. FORNARI, C. MONTICELLI, M. PERICOLI and M. TIVEGNA (October 1999).

No. 359 — *Does Market Transparency Matter? a Case Study* by A. SCALIA and V. VACCA (October 1999).

No. 360 — *Costo e disponibilità del credito per le imprese nei distretti industriali* by P. FINALDI RUSSO and P. ROSSI (December 1999).

No. 361 — *Why Do Banks Merge?* by D. FOCARELLI, F. PANETTA and C. SALLEO (December 1999).

No. 362 — *Markup and the Business Cycle: Evidence from Italian Manufacturing Branches* by D. J. MARCHETTI (December 1999).

No. 363 — *The Transmission of Monetary Policy Shocks in Italy, 1967-1997* by E. GAIOTTI (December 1999).

No. 364 — *Rigidità nel mercato del lavoro, disoccupazione e crescita* by F. SCHIVARDI (December 1999).

No. 365 — *Labor Markets and Monetary Union: A Strategic Analysis* by A. CUKIERMAN and F. LIPPI (February 2000).

(*) Requests for copies should be sent to:
Banca d'Italia – Servizio Studi – Divisione Biblioteca e pubblicazioni – Via Nazionale, 91 – 00184 Rome
(fax 0039 06 47922059). They are available on the Internet at www.bancaditalia.it