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Geography, Migrations and Equilibrium Unemployment

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Abstract

We study the effects of trade integration on the regional coevolution of income, migrations and unemployment in a dynamic core-periphery model with limited labor mobility and frictions in the job matching process. Our model can help explain a recently documented empirical puzzle, i.e., the divergence of unemployment rates, together with low migrations and modest income convergence experienced by European regions over the last twenty years. By studying explicitly the transitional dynamics of the model, we also highlight a contrast between short run and long run effects of trade and policy shocks on a geographically differentiated economy.

JEL classification: F12, F15, F16.

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1 Introduction

In this paper we study the effects of integration on the regional coevolution of income, migrations and unemployment in a dynamic core-periphery model with limited labor mobility and frictions in the job matching process. Our main aim is to investigate the determinants of the geographic distribution of unemployment and to explain some recent trends observed within European regions.

We focus on three main observations. First, during the last two decades, there has been a slight tendency toward convergence in real per capita income among European regions. For instance, Quah (1996) documents a reduction over time in the cross-sectional spread of relative real incomes. In particular, he finds that the standard deviation of the regional per capita income distribution has declined by 8% between 1980 and 1989.[1] Second, we observe a marked change in the historical evolution of migration flows. European labor mobility was high, both between and within countries, in the period between 1955 and 1970. Thereafter, Europe has experienced a sharp decline in interregional and international labor mobility (see, among others, Faini et al. [1997], and Bentolila [1997]). Third, over the last two decades European regions have experienced a dramatic increase in unemployment disparities. For instance, Puga and Overman (2000) find that, between 1986 and 1996, the Gini index of regional concentration of unemployment rose by 19%. They also find that an index of polarization of regional unemployment increased by 37% in the same period.[2] Hence, a puzzle seems to arise from these stylized facts, as they show falling migrations rates despite growing unemployment differentials, and regional income convergence despite polarization and divergence of regional rates of unemployment.[3]

This paper argues that the interplay between the centripetal and centrifugal forces emphasized by the new economic geography (Fujita et al. [1999]), and imperfections in the job matching process of the kind stressed by the equilibrium unemployment theory (Pissarides [1990]) can be helpful in explaining these facts. Although the analysis of unemployment is virtually absent from models of the new economic geography[4], geographical factors seem

[1] See also Barro and Sala-i-Martin (1991).

[2] See also, among others, Obstfeld and Peri (1998).

[3] These trends are particularly evident among Spanish regions. Bentolila (1997) reports that net regional migration rates fell by almost 90% between the early sixties and the early nineties. In the same period, an index of absolute unemployment rate differentials across regions increased by almost a fivefold factor. Finally, an index of dispersion of regional per capita income fell by 35% percent in the same period.

[4] More in general, only recently there has been a growing interest in studying the relationships between trade and unemployment. For an analysis of the effects of international

to matter a great deal for regional unemployment rates. As an example, Puga and Overman (2000) find that unemployment rates are more similar across neighboring regions, despite international borders, than across regions with similar skill composition or sectoral specialization. This suggests that the geography of access to markets and to the sources of intermediate inputs can explain a relevant fraction of the regional unemployment levels. Furthermore, a recent surge of theoretical and empirical studies highlights the importance of supply side considerations for understanding the labor market outcomes and emphasizes the key role played by unemployment subsidies in explaining the high unemployment rates experienced by European countries. We believe that this literature, which treats unemployment as an equilibrium phenomenon, can also shed light on the regional evolution of European labor markets.

To combine these two approaches, we build a symmetric two-region model in which trade costs generate agglomeration economies. We introduce a fixed factor and limited labor mobility to capture centrifugal forces and hence to restrain the incentive to concentrate all the economic activities in a single region. Frictions in the job matching process lead to equilibrium unemployment and a search cost modeled in terms of intermediate goods generates a positive externality of agglomeration on the labor market. Finally, we consider a central government that provides a common unemployment subsidy. We then use this model to study the qualitative effect of trade integration on income inequality, unemployment differentials and migration flows.

In this paper, regional integration is the engine of regional evolutions. We interpret it in a broad sense so as to include the process of European institutional integration, as well as the improvement in interregional communication networks due to both technical progress and investment in road and telecommunication infrastructure. Further, as long as regional economies become increasingly weightless (Quah, 1997), a lower share of resources is to be devoted to shipment of goods. This phenomenon is thus isomorphic to a fall in trade costs.

Our main results can be summarized as follows. Starting from a symmetric equilibrium with high trade costs, trade integration triggers a wave of migrations which lead to the emergence of a core-periphery equilibrium, with strong regional disparities both in terms of per capita income and unemployment rates. Thereafter, a further reduction of trade barriers generates income convergence, which in turn reduces the incentive to migrate. At the same time, the unemployment differential still grows larger until a higher

trade on unemployment in presence of imperfections in the job matching process see, among others, Davidson, Martin and Matusz (1999) and Jansen and Turrini (1998).

level of integration is reached. Therefore, assuming that in the early Eighties the European regions were in a core-periphery equilibrium, the model implies that regional integration leads to convergence in real per capita income, divergence in regional unemployment rates, and declining migration rates. Hence, the model can help explain the most striking features of the last decades unemployment experience in European regions.

A second important result of the paper is to highlight a sharp contrast between the short run impact of labor mobility and its effects on the long run equilibrium. In particular, during the transitional dynamics migration tends to promote regional unemployment convergence, whereas in the long run it exacerbates the unemployment differential. We also show how a change in a common policy implemented by a central government can affect the two regions in a very different way, both in the short run dynamics and in the long run.

The last contribution of the paper is methodological. The introduction of search frictions in the job market allows us to study the geographical allocation of production in a fully dynamic framework. This enables us to analyze the stability properties of equilibria in a formal way and to study the dynamic adjustment of the economy after a change in the environment. An interesting by-product of our approach is that it allows to address a common methodological problem in the new economic geography literature. In these models recourse is made to the following ad hoc migration rule: in each period, a constant fraction of workers moves toward the region that offers a higher real wage.[5] This assumption, which is deprived of deep justification, is necessary in these models in order to avoid catastrophic agglomeration after trade integration. In our model we do not need this assumption, because we can show that, since the matching process between jobs and workers requires time, it implies a gradual relocation of both firms and workers. Hence, we avoid catastrophic agglomeration without imposing any ad hoc assumptions on sluggish labor mobility.

The paper is organized as follows. Section 2 sets out the formal model. Section 3 analyzes the steady-state properties of the model and illustrates the effects of trade integration on regional variables. Section 4 studies the transitional dynamics of the system after a fall in trade costs. Section 5 analyzes a policy experiment. Section 6 concludes.

[5] See Fujita et al. (1999, page 62).

2 The Model

In this section we describe a core-periphery model along the lines of Krugman (1991). We depart from the literature on economic geography by introducing frictions in the labor market and imperfect labor mobility. We study an economy in which there are two regions, North and South (indexed by $i = N$, S), two sectors, agriculture and manufacturing, and two factors, farmers and workers. The two regions share the same preferences, technology and original endowments. To capture the notion of "distance" between the two regions (to be interpreted in a broad sense), we consider a trade cost on manufactured goods only. The agricultural sector employs farmers to produce an homogeneous good. Firms in manufacturing use workers and intermediates to produce a variety of manufactured goods. We assume that farmers account for a fraction $(1 - 2\alpha)$ of the total population, which is normalized to unity. Farmers are immobile and divided evenly between the two regions.[6] Workers are mobile, but incur a non-monetary migration cost, which is increasing in the share of immigrants over the labor force. To preserve symmetry, we assume that the number of workers born in each region is equal to α and is constant over time. The final distribution of workers among the two regions is determined endogenously. We introduce equilibrium unemployment among manufacturing workers by assuming frictions in the job matching process. Finally, we consider an unemployment benefit, equal in both regions, financed by a lump sum tax levied on the entire population.

2.1 Households

Consumers have identical Cobb-Douglas preferences over an agricultural good, A, and a composite bundle of differentiated manufactured goods, M. Risk-neutral individuals have time separable preferences, discount future utility at the rate $(1 + r)^{-1}$, where r is the interest rate. Time is discrete[7]. In the region of birth, utility is given by:

$$U_i(0) = \sum_{t=0}^{\infty} (1 + r)^{-t} [M_i(t)]^{\mu} [A_i(t)]^{1-\mu}$$

[6] The assumption of immobile farmers, which generate local demand for manufactured goods, ensures that, even in the presence of strong forward and backward linkages in manufacturing, there is still an incentive to keep some manufacturing activity in the peripheral region, consisting in the lower competition for local farmers' demand. See Krugman (1991).

[7] In order to save on notation, in the following we omit the time index from all the static equations.

Utility maximization implies that in each period a fixed share of income, μ, is devoted to manufactured goods.

The composite bundle M is defined as a CES function over a continuum of measure n of varieties produced in the whole economy:

$$M_i = \left[\int_0^n m_i(v)^{\frac{\sigma-1}{\sigma}} dv \right]^{\frac{\sigma}{\sigma-1}} \tag{1}$$

where $\sigma > 1$ is the elasticity of substitution between any two varieties and $m_i(v)$ represents consumption of variety v in region i. By minimizing the cost of obtaining one unit of M_i we find the price index for the composite bundle:

$$q_i = \left[\int_0^n p(v)^{1-\sigma} dv \right]^{1/(1-\sigma)} \tag{2}$$

where $p(v)$ is the final price of variety v. Demand for each variety v is obtained by using Shephard's lemma on the expenditure function $q_i M_i$:

$$m_i(v) = \frac{p(v)^{-\sigma}}{q_i^{1-\sigma}} \mu Y_i$$

where Y_i is total income in region i, and μ is the share of income devoted to the composite bundle implied by Cobb-Douglas preferences, so that $\mu Y_i = q_i M_i$.

Manufacturing workers can migrate, but if they leave the region of birth they incur a non-monetary cost which reduces their instantaneous utility in every period by a factor $1/\lambda \leq 1$. We assume λ to be increasing in the share of the original work force which leaves the region of birth[8]. For analytical convenience, λ is modeled as a CES function:

$$\lambda_i = \max \left\{ \left(\frac{\alpha}{L_i} \right)^{1/\epsilon}, 1 \right\}$$

[8]This assumption can be justified on several grounds. Here, we mention two. The first is racism, which may plausibly increase with the share of immigrants in the total workforce, thus reducing their welfare. The second relates to the housing market (which we do not explicitly model): as the share of migrants rises, house rents rise in the region of immigration and fall in the region of emigration. Hence, if we assume that emigrants own a house (only) in their region of birth, then their welfare is, ceteris paribus, a decreasing function of the share of emigrants. Alternatively, a realistic assumption would have been individual heterogeneity in migration costs. We have not gone along this way since it gives rise to uninteresting complications in the analysis of the dynamics, without affecting the steady-state results. Our assumption captures in a reduced-form fashion this heterogeneity.

where α and L_i are the original and final labor force in region i, respectively. Note that ε can be interpreted as an index of the degree of labor mobility. Given these assumptions, a worker born in region i will migrate to region j if and only if $U_j \geq \lambda_i U_i$. Using the definition of λ, we have that the fraction of the original working population which does not move is:

$$L_i = \min \left\{ \alpha \left(\frac{U_i}{U_j} \right)^{\varepsilon}, \alpha \right\} \tag{3}$$

for $i, j = N, S$ and $i \neq j$[9].

2.2 Production and Labor Market

The agricultural sector employs farmers to produce a homogeneous good under constant returns to scale and perfect competition. The agricultural good is freely traded and is taken as the numeraire. Labor productivity is set to one so that the equilibrium wage for farmers is also one. Agriculture is modeled as a residual sector tied to land, its main role being to sustain the demand for goods from peripheral regions. For this reason we interpret it in a broad sense that includes different traditional activities which cannot be easily relocated. For simplicity, we do not study farmers' unemployment[10].

Manufacturing firms produce a large variety of differentiated goods which are used both for final consumption and as intermediate inputs. Firms are symmetric, each of them needs one worker and a fixed amount $1/a$ of the composite bundle M per unit of time. This intermediates requirement captures in a simplified fashion investment in capital equipment and its maintenance. Firms and workers are matched in the labor market through a process that requires time. This assumption captures the idea that heterogeneities in skills and jobs make it costly for a firm or a worker to find a suitable partner. Once employed, a worker produces one unit of a single variety which coincides with the final output of the firm. Since the price of any variety is decreasing in the quantity supplied, no two firms will find it convenient to produce the same

[9] Following Faini (1996), we assume that the original working population of each region is constant and is not affected by ongoing migrations; in other words, we consider only a guest-worker type of mobility and we implicitly assume that no offspring of the guest-worker are born in the visited region. This assumption is not crucial for our results, but allows us to consider the possibility of return migrations, an interesting feature supported by some empirical evidence.

[10] It would be possible to introduce unemployment in agriculture in a way that parallels the manufacturing sector. Under mild assumptions the unemployment rate in the two sectors will evolve in a similar fashion and none of the qualitative results of the model will be affected.

variety. Furthermore, as differentiated goods can be traded, each region will specialize in a different range of varieties so that $n_N \cup n_S = n$. Given the symmetry in production and demand, every variety from each region will have the same production price p_i. Production prices can differ from final prices because of an "iceberg" trade cost: of $\tau > 1$ units shipped to the other region, only one unit arrives at the destination. This implies that the final price in region i of a variety produced in region j is $p_j\tau$ and the price index (2) reduces to:

$$q_i = \left[n_i p_i^{1-\sigma} + n_j \left(p_j \tau\right)^{1-\sigma}\right]^{1/(1-\sigma)} \tag{4}$$

for $i, j = N, S$ and $i \neq j$.

We now describe the matching process in the regional labor markets, which are assumed to be segmented. As a firm decides to enter the market, it has to post a vacancy and a new job is immediately created. Production will start only once a worker has been found, but in order to keep the job, filled or vacant, a firm must pay the fixed cost q_i/a for intermediates. This assumption reflects the fact that maintaining idle equipment is expensive and makes the search process costly for a firm.[11] Since the price index q_i depends on trade costs, the fixed cost in intermediates creates linkages between firms that make agglomeration of production advantageous. It also provides a parsimonious way to introduce the link between the location of production and the labor market (the search cost now depends on the trade cost), which has been stressed in the early literature on agglomeration economies (see Marshall [1920]). Following Pissarides (1985, 1990), the frictions generated by heterogeneity in the labor market are summarized by a function that gives the measure of successful matches per unit of time. In the simplest approach, this function depends positively on the number of job seekers and the number of vacant jobs. For tractability, we assume that it takes the Cobb-Douglas form $du_i^{\eta} v_i^{1-\eta}$, where u_i represents the unemployment rate, v_i is the number of searching firms as a fraction of the labor force and d is a scaling parameter. Defining $\theta_i = v_i/u_i$ as the "tightness" of the labor market, we can write the probability that an unemployed worker will be matched as $d\theta_i^{1-\eta}$. Similarly, the probability that a firm will fill a vacancy is $d\theta_i^{-\eta}$. Matches are destroyed at the exogenous rate s. Upon separation, both the firm and the worker must reenter the labor market.

The value at time t of a firm with a filled job, $V_{fi}(t)$, can be expressed as the sum of its profits at time t, $p_i(t) - w_i(t) - q_i(t)/a$, plus the expected

[11] Following Pissarides (1985), we assume that equipment can be brought into use, rented and scrapped instantaneously, implying that the number of job vacancies is a perfectly flexible variable.

discounted value of the firm at time $t+1$:

$$V_{fi}(t) = p_i(t) - w_i(t) - q_i(t)/a + (1+r)^{-1}[(1-s)V_{fi}(t+1) + sV_{vi}(t+1)] \tag{5}$$

Note that with probability s the match is destroyed, and hence the value of the firm falls to $V_{vi}(t+1)$, which represents the value at time $t+1$ of a searching firm.

Similarly, the value at time t of a firm posting a vacancy, $V_{vi}(t)$, must be equal to the cost of idle equipment, $-q_i(t)/a$, plus the expected discounted value of the firm in the next period:

$$V_{vi}(t) = -q_i(t)/a + (1+r)^{-1}[(1 - d\theta_i^{-\eta}(t))V_{vi}(t+1) + d\theta_i^{-\eta}(t)V_{fi}(t+1)] \tag{6}$$

Note that the value of the firm rises to $V_{fi}(t+1)$ in case of a successful match, i.e., with probability $d\theta_i^{-\eta}(t)$.

We assume free entry of firms, hence, the value of posting a vacancy must be zero. Imposing $V_{vi} = 0$ in (6) yields:

$$V_{fi}(t+1) = \frac{(1+r)\, q_i(t)/a}{d\theta_i^{-\eta}(t)} \tag{7}$$

Using (7) into (5) and imposing $V_{vi} = 0$, we obtain:

$$V_{fi}(t) = p_i(t) - w_i(t) - (q_i(t)/a)[1 - (1-s)/d\theta_i^{-\eta}(t)] \tag{8}$$

The value at time t for an employed worker, $V_{ei}(t)$, equals the wage rate, plus the expected discounted value of the worker at time $t+1$:

$$V_{ei}(t) = w_i\,(t) + (1+r)^{-1}[(1-s)V_{ei}(t+1) + sV_{ui}(t+1)] \tag{9}$$

Note that, with probability s the match is destroyed and the value for the worker falls to $V_{ui}(t+1)$, which represents the value for an unemployed worker.

Finally, the value for a job seeker equals:

$$V_{ui}(t) = z(t) + (1+r)^{-1}[(1 - d\theta_i(t)^{1-\eta})V_{ui}(t+1) + d\theta_i(t)^{1-\eta}V_{ei}(t+1)] \tag{10}$$

where $z(t)$ is an unemployment benefit, equal in both regions, provided by the central government. We assume that z is financed through a lump sum tax, T, levied on the whole population.

Wages are flexible, i.e., there is renegotiation in each period (see Pissarides [1985]). They are determined as the solution to a Nash bargaining problem, implying that the worker surplus is a constant fraction β of the total surplus generated by the match:

$$V_{ei} - V_{ui} = \beta \left(V_{ei} - V_{ui} + V_{fi} \right) \tag{11}$$

Finally, in each period t, $sn(t)$ jobs are exogenously destroyed, whereas $d\theta_i(t)^{1-\eta} u_i(t) L_i(t)$ new jobs are created. Hence, the number of producing firms, which is identically equal to the number of employed workers, evolves according to the following law of motion:

$$n_i(t+1) = (1-s) n_i(t) + d\theta_i(t)^{1-\eta} u_i(t) L_i(t) \tag{12}$$

2.3 General Equilibrium

In order to close the model we impose the following general equilibrium constraints. First, regional income is given by farmers' income, equal to $(1-2\alpha)/2$, plus manufacturing wages, equal to $n_i w_i$, and net manufacturing profits. The last term comprises profits of firms with a filled job, which sum up to $n_i(p_i - w_i - q_i/a)$, minus the losses incurred by $v_i L_i (= \theta_i u_i)$ firms with a job vacancy. Hence we can write:

$$Y_i = (1-2\alpha)/2 + p_i n_i - (q_i/a)(n_i + \theta_i u_i L_i) \tag{13}$$

Given regional income, market clearing in manufacturing requires the total supply of each variety (one unit) to equal total demand for consumption and intermediate goods from both regions:

$$1 = \frac{p_i^{-\sigma} \mu Y_i}{q_i^{1-\sigma}} + \frac{p_i^{-\sigma} \tau^{1-\sigma} \mu Y_j}{q_j^{1-\sigma}} + \frac{n_i + \theta_i u_i L_i}{a} \left(\frac{p_i}{q_i} \right)^{-\sigma} + \frac{n_j + \theta_j u_j L_j}{a} \left(\frac{p_i}{q_j} \right)^{-\sigma} \tau^{1-\sigma} \tag{14}$$

for $i, j = N, S$ and $i \neq j$.

Since we allow for equilibrium unemployment, the labor market clearing condition is replaced by the requirement that the number of employed workers be equal to the number of active firms:

$$n_i = L_i \left(1 - u_i \right) \tag{15}$$

Finally, balanced government budget requires the subsidy to equal the ratio of government revenues from the lump sum tax, T, over the sum of unemployed workers in the two regions:

$$z = \frac{T}{L_i u_i + L_j u_j} \tag{16}$$

for $i, j = N, S$ and $i \neq j$.

3 Steady-state analysis

In a steady-state all the variables must be constant. Solving equations (9) and (10) for $V_{ei}(t) = V_{ei}(t+1)$ and $V_{ui}(t) = V_{ui}(t+1)$, we obtain:

$$V_{ei} = \left(\frac{r+1}{r}\right) \frac{sz + (r + d\theta_i{}^{1-\eta})w_i}{(r + s + d\theta_i{}^{1-\eta})} \tag{17}$$

$$V_{ui} = \left(\frac{r+1}{r}\right) \frac{(r+s)z + d\theta_i{}^{1-\eta} w_i}{(r + s + d\theta_i{}^{1-\eta})} \tag{18}$$

Similarly, imposing $V_{fi}(t) = V_{fi}(t+1)$ in (8) and (7) gives the following price equation:

$$p_i = w_i + (q_i/a)[1 - (r+s)/d\theta_i^{-\eta}] \tag{19}$$

It can be shown that in steady-state the wage equation is given by the following expression:[12]

$$w_i = (1-\beta)\, z + \beta \left[p_i + (\theta_i - 1)\frac{q_i}{a}\right] \tag{20}$$

In words, the wage rate compensates a fraction $(1-\beta)$ of the lost unemployment benefit and gives the worker a share β of the firm's output in excess of production costs and of the average vacancy cost per unemployed worker.

Using the wage equation (20) into (19), we obtain the equilibrium price of a variety produced in region i:

$$p_i = z + \frac{q_i/a}{1-\beta}\left(\beta\theta_i + (1-\beta) + \frac{r+s}{d\theta_i^{-\eta}}\right) \tag{21}$$

[12] In order to obtain the wage equation (20), set: $V_{fi}(t) = V_{fi}(t+1)$, $V_{ei}(t) = V_{ei}(t+1)$, $V_{ui}(t) = V_{ui}(t+1)$ and $V_{vi} = 0$. Then, use (9) and (5) into (12). This gives:

$$(r+1)\, w_i = rV_{ui} + \beta\, (r+1)\, (p_i - q_i/a - rV_{ui})$$

In order to eliminate rV_{ui} from the RHS, use (7) into (11). This gives:

$$V_{ei} - V_{ui} = (1+r)\, \frac{\beta}{1-\beta} \frac{q_i/a}{d\theta_i^{-\eta}}$$

Now use the expression for $V_{ei} - V_{ui}$ into (10). This gives:

$$rV_{ui} = (1+r)\, z + (1+r)\, \theta(q_i/a)\frac{\beta}{1-\beta}$$

Using the expression for rV_{ui} into the expression for $(1+r)\, w_i$ gives the wage equation (20).

As a final requirement, in the steady-state the number of unemployed workers is constant. From (12), this implies that the flow of laid off workers offsets exactly the flow of job seekers who are hired. Hence, from (12) and (15), the steady-state rate of unemployment is given by:

$$u_i = \frac{s}{s + d\theta_i^{1-\eta}} \tag{22}$$

Summarizing, the steady-state of the system is described by equations (3), (4), (13)-(18), (20)-(22), and by the equivalent equations for region j.

We can now explore the steady-state properties of the model. Since the system is highly non linear, it cannot be solved analytically. Therefore, we proceed by numerical simulations. Our main aim is to study the impact of regional integration on regional inequalities, with particular reference to the geographic distribution of unemployment. Hence, in this section we analyze the structure of steady-states as a function of trade costs.

Before turning to numerical examples, we briefly summarize the forces which affect the geographical structure of the economy. Since the two regions are originally identical, the model will always exhibit a symmetric equilibrium in which manufacturing production is evenly distributed. But the presence of labor mobility implies that a geographically differentiated production structure may arise. The specific outcome depends on the migration choice, which is in turn determined by the interaction of two opposing forces, one working toward agglomeration, the other against it. Agglomeration forces consist, *in primis*, of the forward and backward linkages among manufacturing firms and, *in secundis*, of the forward and backward linkages among consumers and producers. These forces attract firms and workers toward the region with the larger market to save on transport costs. Centrifugal forces arise because competition for local farmers' demand is lower in the smaller region and this tends to increase, ceteris paribus, nominal wages and profits in the peripheral region. The existence of increasing migration costs further reduces the incentive for agglomeration. Consistent with a well established result from the new economic geography literature[13], we find that for very high or very low trade costs centrifugal forces prevail, so that the symmetric equilibrium is unique. Conversely, agglomeration forces prevail for intermediate levels of trade costs. In this case, the symmetric equilibrium becomes unstable and a stable core-periphery pattern emerges: workers and firms leave the peripheral region (the South) and manufacturing production becomes partially agglomerated in the core region (the North)[14].

[13] See Ottaviano and Puga (1999) for an analysis of the forces at work in models of the new economic geography.

[14] To analyze local stability properties of equilibria we have linearized the system in a

Figure 1 summarizes the steady-state evolution of regional variables as a function of trade costs (from $\tau = 1$ to $\tau = 2$). The parameter values used in these simulations are reported in the appendix. Most of them are taken from other studies (e.g., Pissarides [1998], Fujita et al. [1999]); the remaining ones are chosen to give realistic values for the variables of interest. For instance, these parameters imply that the average duration of a job is about 5.5 years, whereas the average unemployment spell is around 5-6 months. The unemployment benefit varies between 60% and 70% of nominal wages. In all the graphs displayed in Figure 1, the solid line represent Northern variables whereas the dashed line refers to the South. The fall of trade costs is represented by a movement to the left on the x-axis.

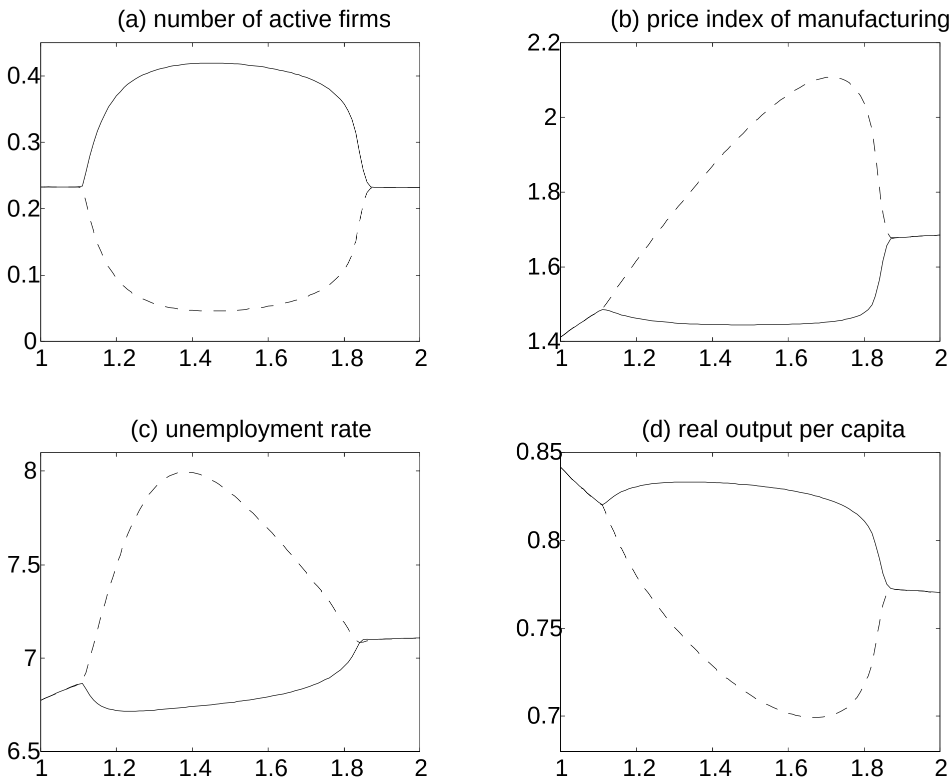

Figure 1. steady-states as functions of trade costs

Panel (a) reports the number of firms in the two regions, which equals

neighborhood of the steady-state. We find that there is always a unique saddle-path stable type of equilibrium (symmetric versus partially agglomerated). Multiple stable equilibria do not arise here because of limited labor mobility. Details on the transitional dynamics are discussed in Section 4.

manufacturing employment. When trade costs are reduced below a threshold level, the symmetric equilibrium breaks down: employment and production agglomerate in the core, although the periphery keeps a small but positive share of manufacturing. The reason for partial agglomeration is that in this model, contrary to Krugman (1991), agglomeration forces are bounded by the increasing costs of migration. Hence, even for intermediate trade costs, i.e., when agglomeration forces are stronger, a positive share of manufacturing workers stays in the periphery. Finally, for low transport costs, the geographical advantage of the core vanishes; the disutility of being an immigrant induces a wave of return migration to the South until the symmetric equilibrium is restored.

Panel (b) reports the price index of manufacturing. When symmetry breaks down, a large mass of workers and firms leave the South, and hence most manufacturing goods must be imported to this region. Consequently, trade costs become a relevant component of the price index. This explains why the South experiences a dramatic increase in the price index of manufacturing. The converse is true in the North, where agglomeration implies a fall in the volume of imports and a consequent fall in the price index of manufacturing.[15] Note, also, that further falls in trade costs imply a different response by the two regions' price indices. Since Northern imports of manufactured goods from the South are very small, the price index is fairly stable in the core region. Conversely, since the South imports most of the manufacturing goods, the fall of its price index closely mirrors the fall of trade costs.

Panel (c) illustrates the evolution of regional unemployment rates (percentages). When the symmetric equilibrium breaks down, the sharp fall of the price index in the North lowers substantially the cost of intermediates and therefore also the search cost, which in turn induces the opening of new vacancies and a rise in the labor market tightness. The opposite happens in the South, where the increase in the price index deteriorates the labor market conditions. This translates into a core-periphery unemployment gap. An interesting feature of this model is that, contrary to conventional wisdom, the unemployment gap is first generated and then exacerbated by migrations. As it will become apparent in the next section, this result holds only in the long run; in fact, during the short run adjustment, migration flows tend to reduce the unemployment gap.

[15] Note that the price index q_i is not to be confused with empirical price indices, such as the CPI. The reason is that q_i is a perfect price index which fully reflects the regional availability of consumption and intermediate goods. Given the assumption of love for variety embedded both in the preferences and the production functions, it follows that the price of utility is higher in the peripheral regions.

To understand the evolution of the unemployment gap as trade costs are reduced, it is important to study the role played by the subsidy. As symmetry is broken, the higher search cost in the South is partially mitigated by a sharp fall in the real value of the subsidy (the price index for manufacturing increases in the periphery). However, as trade costs fall, the real value of the subsidy grows, and this deteriorates the labor market. Unemployment in the South reaches a peak for intermediate values of transport costs. Thereafter, the negative effect of the growing real subsidy is offset by the fall in the cost of intermediates induced by regional integration, and the Southern unemployment rate starts to decline. Note that, as the geographical advantage of the core vanishes, the periphery experiences a wave of return migrations which reduces the steady-state peripheral unemployment rate (partly at the expense of the North), because it reduces the share of manufacturing goods subject to trade costs. Hence, as migration generated the emergence of regional disparities, return migrations speed up the process of convergence. Finally, note that once the symmetric equilibrium is restored, further falls in trade costs reduce unemployment because they lower the cost of intermediates.

Panel (d) shows the evolution of regional real per capita income. Note that, in the symmetric equilibrium, a fall in trade costs raises per capita income because it reduces unemployment and increases real wages. However, once symmetry is broken, per capita income rises in the North and falls in the South, mainly because of the divergent behavior of the price indexes in the two regions. Further falls in trade costs have little impact on Northern income, since most manufacturing production is concentrated in that region. Conversely, per capita income grows fast in the South, because of the higher real value of wages and subsidies induced by the fall in trade costs.

3.1 Sensitivity analysis

The choice of parameter values does not generally affect the qualitative results illustrated so far. In particular, with regard to "geographic" parameters, a higher share of manufactured goods in consumption, μ, a lower share of farmers in total population (i.e., a higher α), a lower elasticity of substitution, σ, or a higher intensity of intermediates, $1/a$, imply higher North-South unemployment differentials. As it is well known from the new economic geography literature, these parameters imply stronger agglomeration forces and hence wider disparities once the symmetric equilibrium is broken. A higher ε implies lower migration costs and hence higher mobility. For very high values of ε, migration costs are not high enough to impede (almost) complete agglomeration of manufacturing firms when the symmetric equilibrium becomes unstable. We are not interested in this possibility, because it implies that the problem of peripheral unemployment disappears, since almost no manufacturing workers would be left in the periphery.[16]

The labor market parameters are s, the rate of job destruction, β, the share of the match surplus that goes to workers and η, the elasticity of the matching function to the unemployment rate. Both s and β imply higher regional unemployment rates, but have a small impact on regional disparities. On the other hand, a higher elasticity η induces higher unemployment, but lower regional disparities, since it deteriorates the labor market conditions less than proportionately in the region with a higher unemployment rate.

Finally, a higher lump sum tax T allows the government to finance higher unemployment benefits. This deteriorates the regional labor markets and induces higher unemployment rates in both regions. Since the subsidy is in nominal terms and geographically undifferentiated, it generates a stronger distortion where prices are lower (because of its higher real value)[17]. Therefore, a higher subsidy improves the relative performance of the Southern labor market as symmetry is broken. This effect vanishes as trade integration generates price converge.

3.2 Empirical implications

Figure 2 summarizes the main implications of the model. The horizontal axis reports the level of trade costs. The dashed line represents the North-South unemployment gap (in percentage) as a function of regional integration. The dotted line represents the North-South gap (in percentage) in terms of real per capita income. Finally, the solid line represents the percentage of immigrants in Northern population. The figure tells the following story. Starting from a symmetric equilibrium, a gradual regional integration (a move from the right to the left) triggers migrations to the core and this leads to the emergence of strong regional disparities, both in terms of per capita income

[16] Note that, in Figure 1, when the symmetric equilibrium loses stability, it gives rise to two stable steady states in its neighborhood. This kind of bifurcation is called "supercritical pitchfork" (see Ottaviano [2000] for an illustration of nonlinearities arising in new economic geography models, and Puga [1999]). For a sufficiently high ϵ, the number and stability of steady states changes. In this latter case, for trade costs in the neighorhood of the level at which the symmetric equilibrium becomes unstable, two unstable interior equilibria appear around the symmetric equilibrium. When these equilibria disappear, they give the symmetric equilibrium their instability. This alternative bifurcation is called "subcritical pitchfork". Further, in the former case the evolution of steady-states as trade costs are reduced is gradual, whereas in the latter there is a discontinuous change.

[17] The qualitative result, although weakened, holds also when the subsidy is proportional to the regional wage and therefore is geographically differentiated.

and unemployment. Thereafter, further falls in trade costs bring about convergence in per capita income. The reason for this result is that the volume of imports is relatively higher in the periphery, and hence it gains relatively more than the core in terms of real income.

Note that, during the phase of convergence in per capita income, the core-periphery unemployment gap grows larger until a higher level of integration is reached. This happens because the sharp price fall in the periphery raises the real value of unemployment subsidies, and further deteriorates the labor market conditions in that region.

Finally, in this economy migrations happen in waves. The model predicts large migrations when symmetry is broken and similarly large return migrations shortly before complete convergence, but very little migrations in between. Therefore, the percentage of immigrants in the North goes up sharply when agglomeration starts, stays almost constant for a substantial range of trade costs and then declines when symmetry is gradually restored.

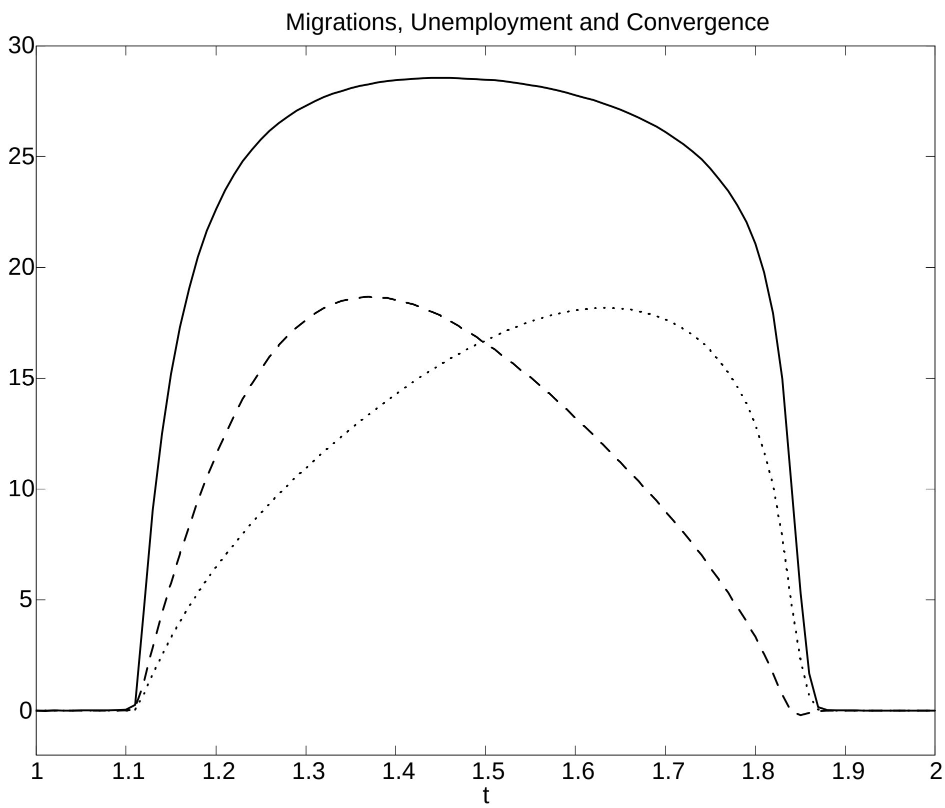

Figure 2. market integration and regional disparities

The model provides a stylized conceptual framework which can help explain the empirical puzzles mentioned in the introduction. In fact, if we assume that in the early Eighties European regions were already in a core-periphery equilibrium, then the model predicts convergence in real per capita income, divergence in regional unemployment rates, and declining migration rates after regional integration, i.e., it can explain the most striking features of the last decades evolutions of the European regions.

4 Transitional dynamics

In this section we explore the adjustment path which leads the system from one steady-state to another after a fall in trade costs. In particular, we analyze the transitional dynamics of the system after a once and for all unanticipated fall in transport costs. In order to accomplish this we have linearized around the steady-state the system described by equations (3), (4), (7)-(16), and by the equivalent equations for region j[18]. As a point of departure for our analysis, we have chosen an equilibrium in which manufacturing is already partially agglomerated in the North. The reason is that our purpose is to explain some stylized facts concerning the regional evolution of unemployment in Europe during the last decades, when regional disparities were already pronounced. The results are shown in Figure 3. The graphs plot the adjustment path after a 10% fall in trade costs, from $\tau = 1.5$ to $\tau = 1.45$. The model is calibrated for quarterly data, therefore each period corresponds to three months.

Note that the dynamic system which governs the short run adjustment only has two state variables, namely the employment levels in the two regions. As the matching process between jobs and workers requires time, the response of employment levels to a change in the environment is gradual. No other variable is assumed to be sluggish.

Panel (a) plots the time path of the total manufacturing work force and the employment level in the South. In this exercise, the reduction of trade costs reinforces the geographical advantage of the North, which makes the core region more attractive for locating manufacturing firms and workers. The result is a wave of migration from the periphery and a discrete jump in regional labor force. As already noted, the reaction of employment is gradual: it falls smoothly in the South, because the rate of job destruction is

[18] The choice of a local solution method is dictated by computational tractability. Even though the original system is non linear, our approximation can be considered reliable because we only study the dynamic adjustment between steady-states which are fairly close to each other. Further, our main interest is on the qualitative behavior of the model rather than on quantitative predictions.

not compensated any more by new matches. Symmetrically, it rises gradually in the North, where the higher number of job seekers increases the likelihood of a match. The eventual increase in employment in the North and the fall in the South strengthens even more the agglomeration forces in the core region. This implies further migration flows from the periphery (although at a slower pace), and further agglomeration of production in the core, until the new steady state is reached.

Panel (b) shows the evolution of regional unemployment rates. As unemployed workers move from the South to the North, the impact effect of a fall in trade costs is a temporary discrete fall in the unemployment rate of the South and a rise in the North. As manufacturing production agglomerates in the core, the unemployed workers are gradually absorbed; moreover, the consequent fall in the price of intermediates reduces the search cost for Northern firms and this improves the labor market conditions. The opposite happens in the South. Therefore, after the first jump, the unemployment rates in the two regions diverge.

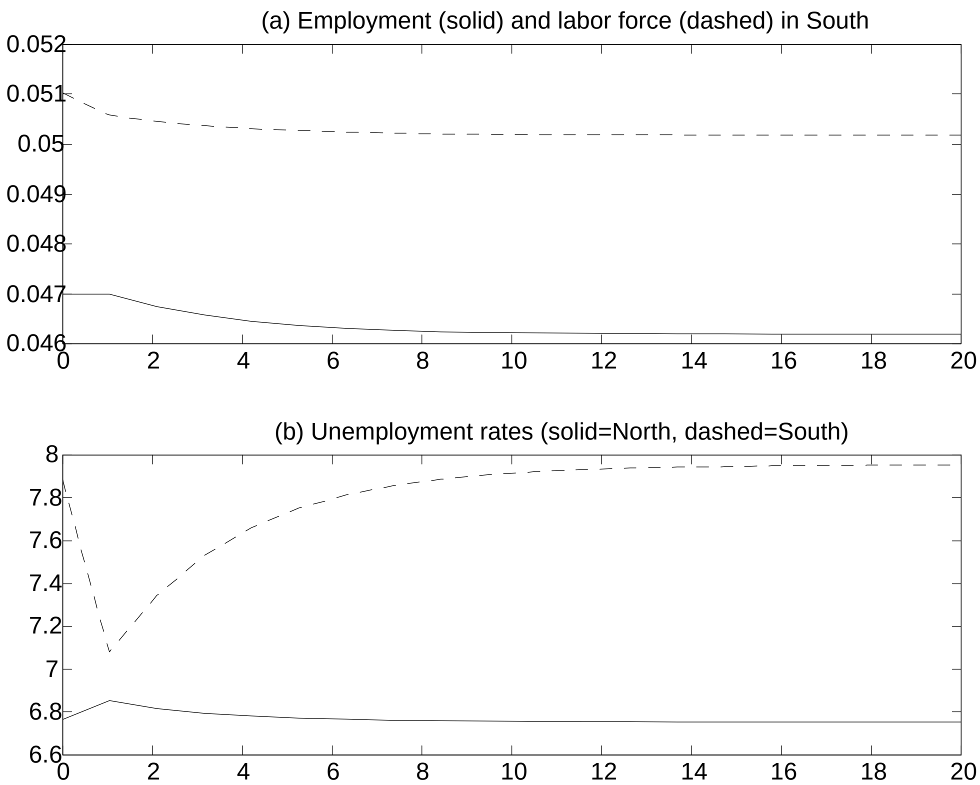

Figure 3. dynamic adjustment after a trade shock

Two points are worth noting. First, during the transition migration is gradual. We obtain this result without imposing any ad hoc sluggishness on labor mobility. The reason for our result is that as incoming migrants are gradually employed, the geographical advantage of the North is reinforced and this attracts more workers from the South.

Second, and more importantly, the transitional dynamics highlight a trade-off between the short run and long run effects of migration flows on the core-periphery unemployment gap: in the presence of strong agglomeration forces and inefficiencies in the job matching process, the migration flows induced by regional integration cause a temporary convergence in the regional rates of unemployment. This happens because migrations reduce the pool of unemployed workers in the South and expand it in the North. However, this induces a positive externality on searching firms in the North and a negative externality on Southern firms. The result is an increase in employment in the North and a fall in the South which strengthens agglomeration forces in the North and reduces them in the South. Hence, in the new steady-state, when Southern immigrants are absorbed by the Northern labor market, the North-South unemployment gap is permanently higher than before the trade shock.

How long does it take for the system to adjust after a trade shock? Simulations reported in Figure 3 are drawn for the same parameter values used in Figures 1-2, and are calibrated for a time unit of one quarter. The time path of the variables shows that the adjustment is fairly fast, as the transition after a large trade shock is almost complete in less then three years. An interesting implication of a fast transition is that it allows us to give a broader interpretation of the simulation results reported in the preceding section. Although the graphs in Figures 1-2 are simply a collection of steady-states as a function of trade costs, we can interpret them as an approximation of the evolution of regional variables after a sequence of steps along a process of regional integration. Further, with reference to the evolution of regional unemployment, the analysis of the transition suggests a picture even more extreme than the one reported in panel (c) of Figure 1. As long as migration rates to the North remain positive, the short run dynamics will tend to reduce the unemployment gap, so that large unemployment differentials will become evident when migration rates are almost nil.

5 A policy experiment

The simple model developed so far does not provide a suitable framework for policy evaluations; the presence of various dimensions of heterogeneity (workers differ according to geographical location, employment status and sector of production) leads to difficulties in defining an aggregate welfare function. However, the model, as simple as it is, includes a policy variable, the level of the subsidy, which captures an important feature of the European welfare system. A large body of literature has blamed the excessive level of subsidization of European countries for the high rates of unemployment experienced in the past decades and a growing number of studies have used similar arguments to question the sustainability of the welfare state (see, among others, Ljungqvist and Sargent [1998]). It is therefore natural to ask what is the effect of a reduction in the generosity of the common unemployment policy on a geographically differentiated economy.

Figure 4 shows the dynamic adjustment after a once and for all unanticipated reduction in the lump sum tax, from $T = 0.024$ to $T = 0.02$. This implies a 9% decrease of the nominal subsidy. Trade costs are set at the intermediate level $\tau = 1.5$, which corresponds to an asymmetric equilibrium.

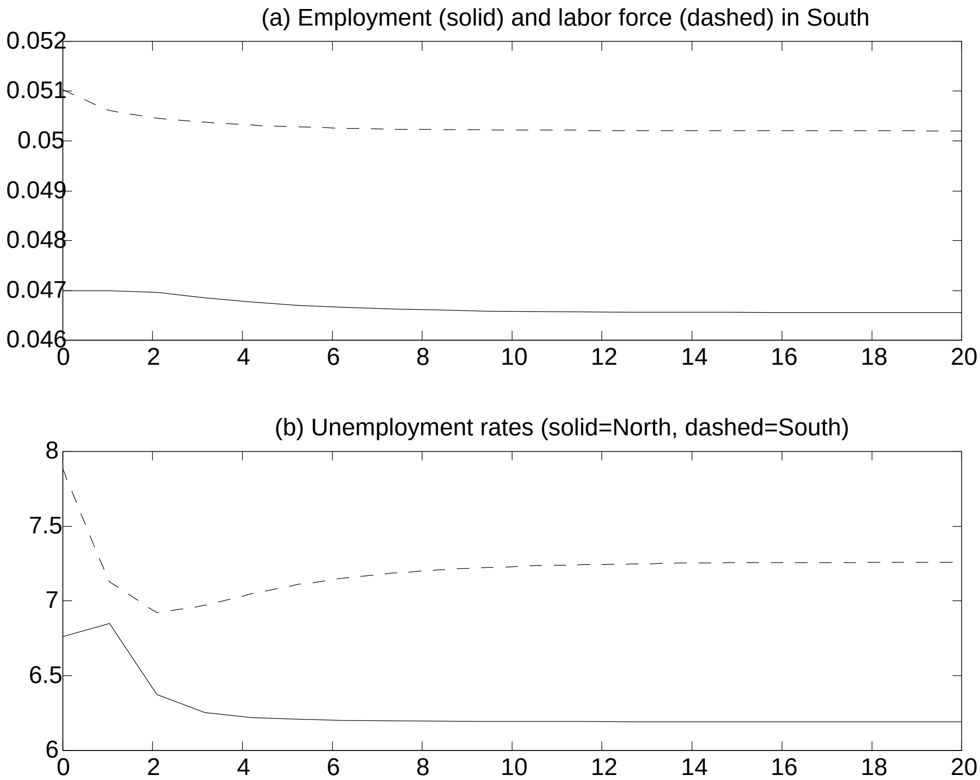

Figure 4. dynamic adjustment after a policy shock

It is apparent that the long run effect is a reduction of the unemployment rates, both in the core and in the periphery. But the effect is generally uneven among the two regions.

Panel (a) shows that a cut in the subsidy strengthens the geographical advantage of the North and therefore induces migrations from the periphery. This happens because the subsidy, set in nominal terms, generates a higher distortion in the region with a lower price index (the core), hence the North benefits relatively more from the cut.

Panel (b) illustrates again a tension between the short run and long run adjustment: as job seekers leave the South, the unemployment gap is initially reduced, but the gradual strengthening of agglomeration economies in the North leads to an improvement in the relative performance of the Northern labor market. However, the picture suggests that the costs of the transition will be borne more than proportionally by the core region.

6 Final remarks

In the last decades Western Europe has undergone a process of deep economic integration. Recent developments in the field of the new economic geography have shown that such a process may trigger the spatial agglomeration of economic activity. However, this literature neglects any imperfections in the labor market and hence it cannot explain the geography of unemployment. Yet, the evidence concerning European regions shows a strong tendency toward polarization and divergence of regional unemployment rates, together with a slight tendency toward convergence in per capita income. As a consequence, the uneven spatial distribution of unemployment is nowadays the main cause of policy concern in Europe.

In this paper, we have formulated a core-periphery model with frictions in the job matching process, in order to study the coevolution of income, migrations and unemployment rates at the regional level. We have shown how market integration can be a driving force behind a recently documented empirical puzzle: the divergence of unemployment rates, together with low mobility and modest income convergence experienced by European regions over the last twenty years.

By explicitly studying the transitional dynamics of the model we have also highlighted a contrast between short run and long run effects of a shock on a geographically differentiated economy. In particular, our model illustrates how labor mobility can temporarily alleviate regional disparities but it exacerbates them in the final adjustment. This tension between short run and long run responses may shed some light on the mixed evidence concerning the labor market effects of immigration (see, for instance, Borjas [1999] and Borjas et al.[1997]).

Since the main focus of this paper was on the qualitative behavior of regional macro variables, we adopted a very stylized framework which enabled us to keep a high level of generality. To address quantitative questions and to match more closely empirical data, the structure of the model could be made more realistic by introducing asymmetries in the underlying economic structure of the regions.

Our model is too simple to lend itself to any robust policy prescription. However, if we take seriously some of its logical implications, it would suggest the policy maker to make any effort to further reduce the core-periphery transportation costs, since unemployment differentials tend to disappear when these costs become negligible. Practically, this may require a strengthening of communication networks (e.g., road and telecommunication infrastructure) in order to facilitate access to larger markets for peripheral regions. In this respect, Viesti (2000) reports some supportive empirical evidence: he shows that 25 industrial clusters in Southern Italy have almost nothing in common, but the proximity to highways.

However, we have also shown that such a process of falling distance costs may further increase the core-periphery unemployment gap before the process of convergence definitely sets in. Hence, we may still observe for some time a further deterioration of labor market conditions in European peripheral regions.

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7 Appendix

Unless otherwise stated in the text, all the graphs are drawn using the following parameter values: $\sigma = 5$, $\mu = 0.5$, $\alpha = 0.25$, $\beta = 0.5$, $r = 0.02$, $\eta = 0.4$, $s = 0.18$, $a = 20$, $\epsilon = 11$, $T = 0.024$, $d = 0.025$.