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Increasing Returns and Spatial Unemployment Disparities

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HWWA Discussion Paper

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Increasing Returns and Spatial Unemployment Disparities

ABSTRACT

Regional unemployment rates in the European Union (EU-15) reveal a core-periphery structure. Large “core” regions in the middle of the continent have low unemployment rates, whereas excessive mass unemployment is predominantly found in the peripheral regions at the outside borders of EU-15. This geographical pattern of unemployment rates follows the pattern of GDP per capita. That is, the regions with low (high) unemployment rates on average have comparatively high (low) real income levels.

In this paper we try to understand this stylised fact with the help of a theoretical model that builds on two strings in the literature: the recent trade and location theories (like the ‘new economic geography’) and the ‘wage curve’. Standard models of the new location theories deal with regional disparities in production and income, but they usually assume full employment and are thus ill-equipped to study spatial unemployment disparities. The wage curve-approach, which explicitly shows how disparities in real wages and unemployment rates are interrelated, can not endogenously explain the origin of these asymmetries.

In this paper, we combine these previously unrelated strings and develop a unified theoretical framework. We show that a core-periphery in real wages is associated and magnified by regional unemployment disparities. This wage curve relation is stable over time with an increasing returns technology. That is, the wage curve does not vanish as workers move from the periphery to the core, but it is rather reinforced by migration. These theoretical predictions of our model are in line with the empirical evidence.

Keywords: Regional Unemployment, Economic Geography, Increasing Returns, Wage Curve, Migration, Labor Mobility

JEL-Classification: F4, J6, R1

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1) Introduction

Unemployment has always been a prominent topic for macroeconomists, who predominantly think in national dimensions. Regional issues traditionally played a secondary role in this debate. Yet, researchers have recently begun to pay much more attention to the regional dimension of the unemployment problem. In the European Union regions with practically full employment and regions with excessive mass unemployment coexist. In many cases they coexist even within the same country. Germany, Italy and Spain are the most prominent examples, where some areas have unemployment rates below 5 per cent, whereas others are stuck with figures well above 20 per cent. Such spatial unemployment disparities within and across countries exist for decades, and they even tended to increase in the last years. Moreover, if one looks at the geographical structure of unemployment in the European Union as a whole, like we will do in section 2 of this paper, one finds a quite striking spatial pattern. Unemployment tends to be organised in trans-national clusters that closely resemble the core-periphery-structure of regional GDP per capita. Regional unemployment rates are low in the rich core regions in the centre of EU-15, where population, production and income are agglomerated. On the contrary, high unemployment rates are found in small and economically peripheral regions.

The main aim of this paper is to study this spatial coincidence of low (high) unemployment and high (low) GDP per capita-levels in regional clusters. Put differently, we study the spatial structure of unemployment rates within an integrated economic area in relation to the overall economic agglomeration. This is a largely unexplored issue in regional research.

One milestone in the literature on regional labour markets is the 'wage curve' pioneered by David Blanchflower and Andrew Oswald (1990, 1996), hereafter labelled simply as B/O. Their *empirical law of economics* according to which "doubling the unemployment rate of some region will drive down the regional wage level by roughly ten per cent" is by now widely known and mostly accepted.¹ The wage curve draws a link between key labour market variables on a regional level, the unemployment rate and the real wage level, and is therefore

¹ There is still an ongoing debate whether or not a wage curve can be detected in the labour market data of various countries (see e.g. Partridge/Rickman, 1997; Buettner, 1999; Blien, 2001; Bell/Nickell/Quintini, 2002), to which this paper will not aim to contribute. There also exist good surveys of the wage curve (e.g. Blien, 2003, 2001; Buettner, 1999; Card, 1995), which by and large seem to accept the implied negative correlation of regional unemployment rates and real wage levels.

useful for our purposes. But we will argue that the existing wage curve models alone are insufficient to fully understand the spatial structure of unemployment in the EU. The existing models, which usually assume perfect competition on product markets and a production function that exhibits constant returns to scale, are useful to study how regional unemployment rates develop if the corresponding levels of wages and output are exogenously given. But they cannot endogenously explain *why* there are so pronounced spatial GDP disparities.

This question is at the root of the recently growing field of new location theories, namely the 'new trade theory (NTT)' and the 'new economic geography (NEG)' (Krugman, 1980, 1991). Especially the latter (NEG) explicitly shows how core-periphery structures of economic activity can endogenously emerge and persist within an integrated area. This regional divergence is due to the presence of localised increasing returns to scale in combination with spatial transaction costs and labour mobility. However, this literature usually has nothing to say about unemployment. The standard models of the NTT and the NEG assume that labour markets always automatically clear.² The phenomenon of regional unemployment disparities can thus not be analysed explicitly with the existing models.

In our view the two literatures are really good complements, since they are both ultimately concerned with the distribution of key economic variables across space. In this paper we will therefore marry a wage curve that represents a labour market equilibrium relation, with a product market that exhibits the essential features of the new location theories. The contribution of our model is thus twofold: Firstly, it can be seen as a general equilibrium wage curve model, where the regional disparities develop endogenously. And secondly, it is a step towards the integration of unemployment into the new economic geography.

In our model the regional asymmetries are entirely driven by localised agglomeration economies, i.e. by purely regional effects. In reality there exist also other factors that are relevant for explaining why some regions are ahead of others economically, e.g. the sectoral structure of a region, or the skill composition of the local workforce (e.g. Esteban, 1999). However, we abstract from these influence factors in order to focus exclusively on the role of agglomeration effects through market linkages. In doing so we stress the analogy with the basic model

² The notable exceptions in this respect are Peeters/Garretsen (2000) and Matusz (1996), whose focus, however, is somehow different, namely on the overall impact of globalisation and trade on unemployment.

of NEG, which both also rest only on one explanation for regional economic differences, not on several parallel mechanisms.

At first we will analyse regional unemployment disparities in the short-run by assuming immobile agents. Our main prediction is that large core regions with high income levels have low unemployment rates, and vice versa, small and poor regions additionally suffer from high unemployment. This spatial coincidence of high GDP per capita and low unemployment rates seems to be reasonably consistent with the evidence from EU-15.

Afterwards we deal with long-run aspects. The short-run economic disparities will spur at least some migration from the backward areas to the prospering regions. Is labour mobility an adjustment force that gradually leads to an erosion of existing disparities? Or do differences even get larger and more pronounced when workers migrate? The conventional viewpoint is that labour mobility will lead to a convergence process and will eliminate spatial disparities to the extent that only compensating differentials between wages and unemployment rates à la Harris/Todaro (1970) and Hall (1970, 1972) can persist. In the seminal B/O-model the wage curve-relation is also put under strain by labour mobility. This erosion tendency stands in some contrast to the view of the wage curve as a long-run equilibrium relation that B/O seem to prefer. An increasing returns technology, however, is a natural way to establish the wage curve as a long-run phenomenon. With our technology labour migration will not eliminate but rather exacerbate existing economic differences. That is, the wage curve does not erode, but is rather strengthened as workers move from the periphery to the core. In a long-run spatial equilibrium, individuals living in the disadvantaged areas must therefore be compensated by other factors (e.g. regional amenities) so that a zero migration condition is satisfied.³ This theoretical result is also broadly consistent with the available empirical evidence, since regional unemployment rates recently underwent a polarisation process where increases in labour supply were by and large associated with declining unemployment rates.

The rest of this paper is organised as follows. First we provide an empirical motivation by looking briefly at the structure of regional disparities in the EU. Then we introduce the micro-economic foundations of the wage curve as a labour market equilibrium relation in section 3.

³ Some authors, e.g. Pissarides/McMaster (1990) or Buettner (1999), show that migration is a quite weak equilibrating force in Europe. But still, regional differences in utility levels must disappear in the long run, even if it might be a “very long run”.

In that section we also briefly review the general equilibrium model of B/O. The product market structure with an increasing returns technology is introduced in section 4. Section 5 presents the short-run equilibrium solution of our model. In section 6 we deal with the issue of labour mobility and with the long-run equilibrium. A discussion about the empirical relevance of the model is provided in section 7. Section 8 concludes.

2) Regional economic disparities in the European Union

In almost all EU member countries there exist non-negligible, in some cases even extreme intra-national unemployment disparities, measured on the usual level of regional gradation, NUTS2. Figure 1 shows the area with the lowest and the highest unemployment rate (for 2000) for those 13 EU-countries that consist of more than one NUTS2-region. These intra-national differences are often far more pronounced than the differences between countries, most notably in Italy, Spain and Germany. But also in some smaller countries, e.g. Finland, Belgium and Greece, differences are significant and range around 9-10 percentage points.

Figure 1: EU-15 – Regional Unemployment Disparities, 2000

Country (national unemp. rate)	Min-region	Max-region	Difference
Italy (10,8)	Trentino/Alto Adige (3,1)	Calabria (27,7)	24,6
Spain (14,4)	Navarra (4,9)	Ceuta y Mellila (25,5)	20,6
Germany (8,1) [West Germany]	Oberbayern (3,5)	Halle (19,2) [Bremen (10,5)]	15,7 [7,0]
Finland (11,0)	Aland (1,7)	Ita Suomi (15,5)	13,8
France (9,6)	Alsac (5,3)	Languedoc-Rousillon (16,1) [Réunion (33,1)]	10,8 [27,8]
Belgium (6,7)	Vlaams Brabant (2,9)	Hainaut (13,1)	10,2
Greece (11,1)	Ionia Nisia (5,1)	Dytiki Makedonia (14,7)	9,6
UK (5,6)	Berkshire (1,9)	Merseyside (11,2)	9,3
Sweden (6,2)	Stockholm (3,6)	Norra Mellansverige (8,8)	5,2
Portugal (4,1)	Centro (1,8)	Alentejo (5,7)	3,9
Austria (3,9)	Oberösterreich (2,6)	Wien (5,8)	3,2
Netherlands (2,8)	Utrecht (2,1)	Groningen (4,6)	2,5
Ireland (4,4)	Southern/Eastern (3,9)	Midland/Western (5,8)	1,9

Source: Eurostat. European Commission.

Figures 2 and 3 show maps that depict regional unemployment rates and regional GDP per capita levels for the EU-27. When focussing on the current EU-members (EU-15), the maps reveal a striking spatial pattern. There is an area, geographically located in the middle of the

continent, where unemployment rates tend to be on a very low level. This core area contains Northern Italy, Southern Germany and Austria, the Netherlands and the southern part of Great Britain. Figure 3 shows that the highest levels of regional GDP per capita (measured in purchasing power standards) are found precisely in this area, which is often called the „European banana“, where economic activity is highly agglomerated.⁴

Exactly the opposite characteristics can be found in the geographically remote areas at the outside borders of EU-15. The regions in Southern and Eastern Spain, Southern Italy, Greece and Eastern Germany are faced with high or very high unemployment rates. And they all belong to the group of regions with a GDP per capita level below 75 per cent of the EU-15-average, i.e. to the group of regions that is eligible for “objective 1”-funding from the EU. But not all “objective 1”-regions have to deal with mass unemployment. The notable exception is Portugal. All Portuguese are relatively poor, but unemployment rates are modest. One might put it this way: Being an “objective 1”-region is a necessary, but not a sufficient condition for having extraordinarily high unemployment rates. On average, however, “objective 1”-regions have unemployment rates well above the EU-average (15.8% vs. 9.7% in 1999). In between these two trans-national clusters, there is a group of regions with intermediate income levels and unemployment rates. This group contains most parts of France, Eastern Spain, the middle part of Italy, North-Western Germany, Scandinavia and the Northern part of UK.

Put differently, it seems to be at least somewhat reasonable (in a very aggregate view) to divide the area of EU-15 into three regional clusters: the “European banana”, the “objective 1-regions” and the “intermediate regions”. Note that national borders do not play very prominent roles as division lines between the three clusters, which consequently can be classified as being “trans-national”.

⁴ The regions in this central area reveal also some other favourable economic characteristics like a high participation rate, a high fraction of skilled labour and a high innovative activity (Suedekum, 2003a; EU-Commission, 2001).

Figure 2: Unemployment rate in the NUTS2-regions of the EU-15, 2000

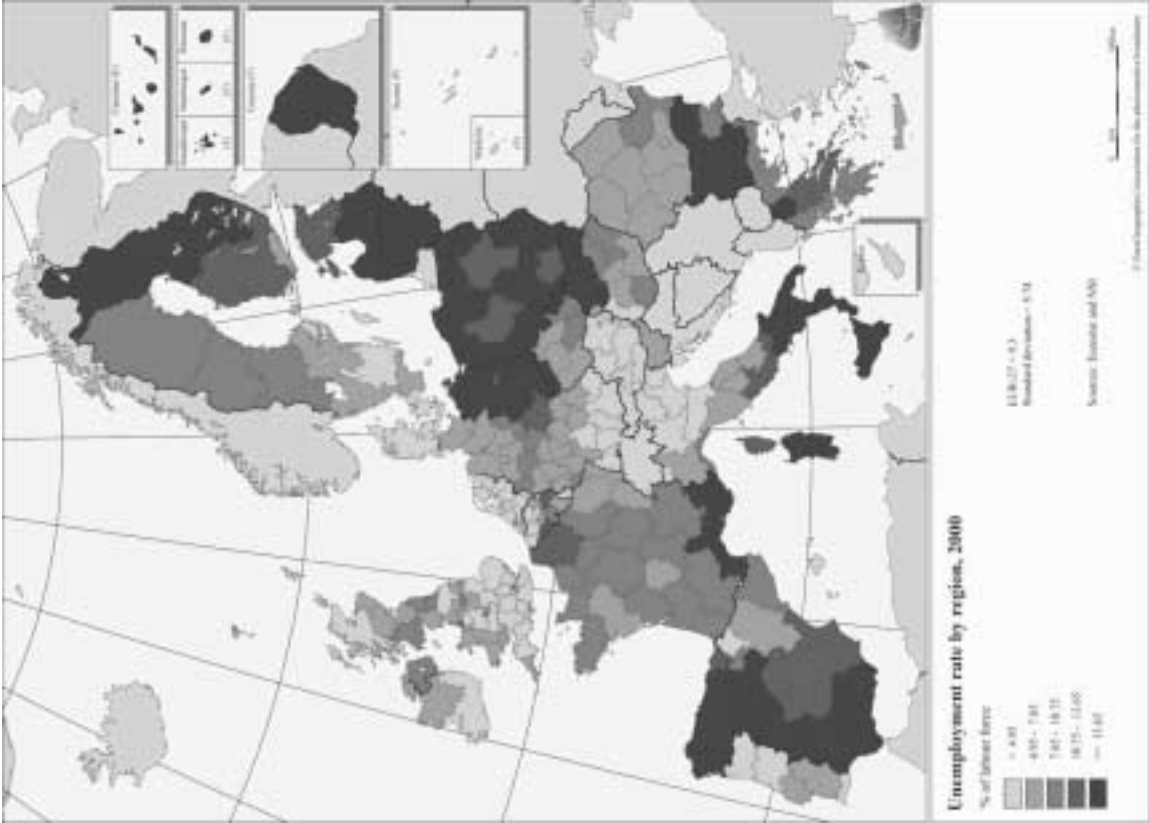
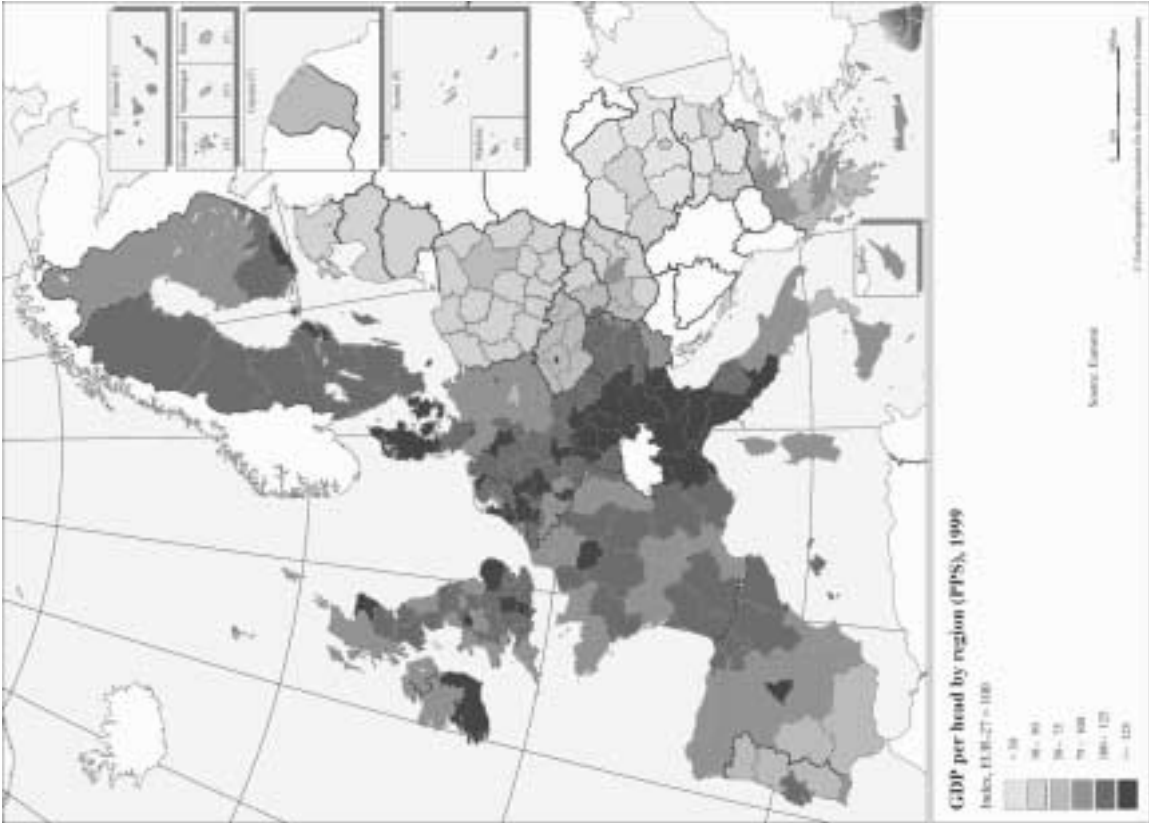


Figure 3: GDP per capita (purchasing power standards), 1999



More compelling evidence on this trans-national clustering phenomenon was recently provided by Overman/Puga (2002). Using stochastic kernel mapping methods, the authors document that regional unemployment rates in Europe underwent a polarisation process between 1986 and 1996. That is, regions with intermediate unemployment rates in the mid 1980s tended to move to one of the extremes (high or low rates) in the subsequent 11 years. The authors show that this unemployment polarisation was driven by the location of labour demand, with labour supply changes (i.e. migration) even mitigating the process. In other words, regions with declining unemployment rates in fact experienced labour force growth, but this was outpaced by employment growth.⁵ This polarisation led to a situation where the unemployment rates of neighbouring regions (that may or may not belong to the same country) are much more similar to each other than the unemployment rate of some particular region with the respective national average rate. Niebuhr (2003) uses parametric spatial econometrics techniques and also finds evidence for regional unemployment clusters in the EU.

In view of this spatial pattern one can doubt whether it is really useful to predominantly think about unemployment along national borders. The structure of regional unemployment rates in the EU-15 apparently does not obey too strongly to national borders. The membership of a specific region to one of the three income clusters seems to be a much more reliable indicator for the regional unemployment rate than the assignment to a nation. The fact that we like to stress is that these trans-national unemployment clusters correspond with the respective income clusters.⁶

3) The theory of the wage curve

As mentioned above, one useful approach for the analysis of regional labour markets is the 'wage curve' literature pioneered by B/O. From a theoretical point of view the wage curve

⁵ An unemployment rate by definition changes either because of changes in labour demand (employment) or labour supply (labour force growth). As Overman/Puga (2002) show, it is "employment changes that have driven high unemployment regions to their high rates and low unemployment regions to their low rates." Consistent empirical evidence is provided by Martin/Tyler (2000).

⁶ One has to keep in mind, however, that this relation does not hold for level of spatial dis-aggregation. For example, it is known that many metropolitan areas are characterised by comparatively high unemployment rates (Brueckner/Zenou, 2003), although real wage levels also tend to be high. The opposite is true for more rural districts in close distance to the economic centres. However, we are concerned here with a much broader geographical scale and do not address local phenomena like suburbanization or urban unemployment.

builds directly on standard wage setting equations known from the imperfect competition approach in macroeconomics (e.g. Layard/Nickell/Jackman, 1991; Carlin/Soschice, 1990; Lindbeck, 1992; Blanchard/Katz, 1997). The central idea of the wage (setting) curve is that poorer conditions in local labour markets, i.e. a higher unemployment rate, will reduce regional wage pressure and real wage levels. From an aggregate perspective the wage curve implies that at any point in time there exist regions with both high real wages and low unemployment rates, and regions with low wages and high unemployment rates. B/O think of this wage curve as a long-run equilibrium relation, not as a representation of permanent disequilibrium or sluggish adjustment. The typical microeconomic foundation for the wage curve is either a collective bargaining model, or an efficiency wage model. Recently, Sato (2000) has shown that a wage curve also arises in a search model of the labour market. In this paper, we will use a simple efficiency wage model close to Shapiro/Stiglitz (1984), because of its analytical simplicity and because it is supposedly most appropriate for the case of continental European labour markets.⁷ One should keep in mind, however, that there is more than one convincing story to justify the existence of a wage curve.

A wage curve based on efficiency wages

Consider an economy in continuous time consisting of two regions $r=\{1,2\}$, each populated with risk-neutral workers who gain utility from wage income w_r , but disutility from work-effort e_r . Effort at work is a technologically fixed number $e_r > 0$. Individuals can choose to “shirk” at work and spend zero effort $e_r=0$. Utility V_r is assumed to be linear, $V_r = w_r - e_r$. Shirking individuals run the risk of being detected and then fired. The detection and firing probability $(1-\gamma_r) < 1$ is less than perfect. Once fired, an individual enters the pool of the unemployed. But there is also some exogenous destruction rate of firms $R_r > 0$ that likewise leads to an inflow from employment to unemployment. For simplicity, we assume that unemployed persons have no source of income.

The unemployed have a chance α_r of re-entering into a job. This endogenous variable depicts the flow from unemployment back into the pool of the employed. In the steady state equilib-

⁷ One could have expected collective bargaining models to be more appropriate in the European context. However, recall that we are concerned with the *regional* dimension of an economy. It is true that continental labour markets are highly unionised. But at the same time, they are also characterised by a very low degree of regional differentiation of union wages (Faini, 1999). If at all, regional differentiation occurs through differences in *effective earnings*, when employers from different areas consciously pay above the uniform union wage (Suedekum, 2003; Schnabel, 1995), which might e.g. be motivated by efficiency wage considerations.

rium, these two labour market flows must be equal: $R_r N_r = \alpha_r (L_r - E_r)$, where L_r is the labour force and E_r is employment. The definition of the unemployment rate is $U_r = 1 - E_r/L_r$, hence the function α_r is given by $\alpha_r = (R_r / U_r) - R_r$, with $\partial \alpha_r / \partial U_r < 0$.

The only decision an individual needs to make is whether to shirk or not. The utility of an unemployed individual (V_{ur}) is given by

$$V_{ur} = \alpha_r (w_r - e_r). \quad (1)$$

Non-shirking employed workers and shirkers have utility levels V_{enr} and V_{esr} respectively

$$V_{enr} = w_r - e_r \quad (2)$$

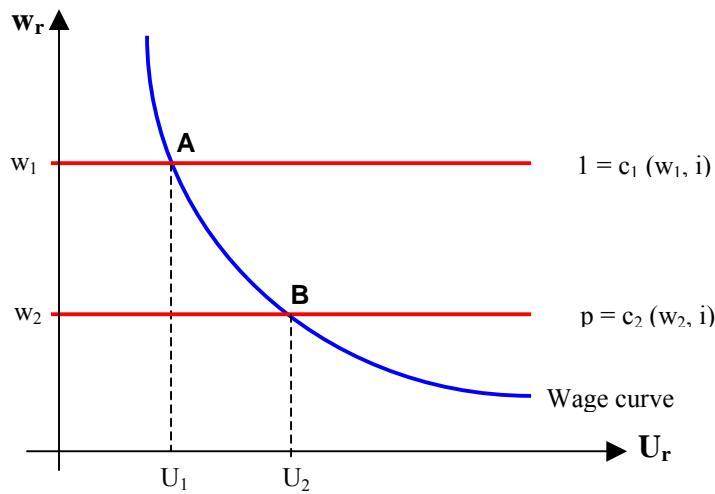
$$V_{esr} = \gamma_r w_r + (1 - \gamma_r)(\alpha_r(w_r - e_r)). \quad (3)$$

Firms can prevent shirking by paying efficiency wages that are just sufficient to ensure equal utility for shirkers and non-shirkers, i.e. $V_{esr} = V_{enr}$. Equating (2) and (3) yields

$$w_r = e_r + \frac{\gamma_r e_r}{(1 - \gamma_r)(1 - \alpha_r(U_r))} \quad (4)$$

Equation (4) is the regional wage curve and can be interpreted as the aggregate non-shirking condition in region r . This relation represents the locus of all possible combinations of U_r and w_r where the labour market in region r is in equilibrium. Analogously to the standard approach in macroeconomics (Layard/Nickell/Jackman, 1991 etc.), equilibrium here simply means that for any given regional unemployment rate firms will set their (efficiency) wages in an optimal fashion such that shirking of the incumbent workforce is just ruled out. Graphically, equation (4) can be represented like in fig. 4 as a downward-sloping and non-linear curve in the real wage/unemployment rate-space.

Figure 4: The wage curve model of Blanchflower/Oswald



The wage curve shifts away from the origin if e_r or γ_r increase. If we think of more than one region, potential differences in these parameters across regions would lead to different labour market equilibrium curves (wage curves). One could easily think of model extensions where the parameters e_r and γ_r reflect structural characteristics of the respective labour market. The firing probability γ_r might e.g. be influenced by employment protection laws, or the work effort parameter e_r might represent a reservation wage contingent on welfare state arrangements. The position of the wage curve would then depend on labour market institutions. If we assume that there are no regional differences in institutions, which seems reasonable in the EU at least for regions from the same country, the same wage curve holds in all regions. We come back to this issue in section 7.

We can now move from partial to general equilibrium by adding the product markets, i.e. the labour demand side, to this model. Before doing so in the next section, we first want to briefly outline the way B/O (1996:77 ff.) have dealt with this issue.⁸

They consider a two-region version of the wage curve model and assume that each region produces a distinct tradable commodity under perfect competition and a constant returns production function that requires fixed input proportions. In this scenario, the prices of the region-specific goods are simply given by world markets and factor prices (real wages) must adjust such that zero long-run profits are warranted. General equilibrium in either region is

⁸ The general equilibrium model of B/O is introduced and discussed at length in Suedekum (2003), chapter C.

reached when product and labour market are jointly in equilibrium. If both regions face the same wage curve locus the general equilibrium is reached at points A and B respectively in figure 4. The region 1 happens to manufacture a “better” product with a higher price on world markets and is thus advantaged over the other region in two respects: the regional unemployment rate is lower, and the real wage level is higher.

In this product market specification of B/O, the substantial origin of regional disparities remains an open issue. Regional fortunes are tied one-by-one to the product market conditions of a specific good and it is unspecified *why* regions are specialised precisely in those commodities. There are good reasons to believe that the sectoral structure plays a role for explaining regional disparities (see Blien, 2001). But, as several authors have pointed out, regional disparities also have a genuinely *spatial* dimension, which is missing in this specification.⁹

Labour mobility is another important issue. The situation that is depicted in figure 4 clearly would spur migration from region 2 to region 1. With a neoclassical production function exhibiting constant returns to scale and diminishing marginal returns to labour, migration leads to an erosion of regional factor price differentials and would continue up to the point where all disparities in wages and unemployment rates have vanished.¹⁰ In other words, the wage curve is put under strain by labour mobility. B/O (1996: 81f.) introduce a utility supplement ξ_r and assume that it is negatively proportional to the population density of region r . As workers keep on moving to region 1, the place gradually becomes crowded and unattractive. With this element of congestion, it is possible to construct a configuration where the two regions are located along a wage curve locus, but with no further migration incentives. The variable ξ_r compensates the individuals from region 2 for the worse “economic” variables w_r and U_r . It must be stressed, however, that the long-run survival of the wage curve relation crucially hinges on this assumption of imperfect labour mobility. With perfectly mobile labour, the wage curve disappears over time, which stands in contrast to the view of B/O that the wage curve represents a long-run equilibrium relation in regional labour markets.

⁹ See e.g. OECD (2000), R.Martin (1997), Taylor/Bradley (1983), or Elhorst (2000) (and the references therein), who concludes that “most empirical applications have indicated that spatial differences in industry mix account for little, if any, of the variation in unemployment rates between regions. The same industry seems to experience different unemployment rates in different regions.”

¹⁰ Graphically, this migration would imply that the two horizontal product market equilibrium curves in fig. 4 would shift closer together until they ultimately collapse into one line.

4) A product market with endogenous agglomeration economies

We will now introduce our alternative product market specification that is close in spirit to the NEG, i.e. build around the central ideas of localised increasing returns to scale and spatial transaction costs. Our product market specification is actually not a full-fledged NEG-model with centripetal and centrifugal technological forces, since this class of models is difficult or even non-tractable analytically even with perfect labour markets.¹¹ What distinguishes our approach from a typical NEG-model is that we do not assume a second, competitive sector in the economy, where a basic good (“agriculture”) is produced by immobile agents whose demand for commodities from the (mobile) industrial sector acts as a centrifugal force.¹² In other words, we look at a technology that is characterised by agglomeration effects alone. But we will consider a dispersion force below in section 6 when we deal with the issue of labour mobility.

We consider a two-region, two-sector model where both regions $r = \{1,2\}$ produce a final consumption good Y_r by assembling a variety of intermediate inputs X , which are produced and traded in both regions. The Y -producers in both regions use all available intermediates symmetrically, i.e. the production of Y in region 1 requires both local inputs (X_{11}) and imported inputs (X_{21}). Increasing returns are present in the model, because the production costs in the Y -sector are a decreasing function of the number of available industrial intermediates from either region (N_r). This argument for increasing returns, the expansion in the variety of intermediate inputs, dates back to the seminal paper of Ethier (1982). Matusz (1996) has introduced unemployment to this standard model of NTT. Our own product market specification has some similarities with that approach. Yet, contrary to Matusz (1996), we work with an explicitly spatial framework by assuming that transportation of intermediate inputs across space imposes ‘iceberg’ transportation costs $\tau > 1$. For each unit X_{sr} dispatched, only $1/\tau$ units arrive. The final consumption good Y on the other hand can be traded freely across space. The

¹¹ The seminal core-periphery model of Krugman (1991), as well as the NEG-models of Venables (1996) and Puga (1999) can only be solved numerically. By now, a class of NEG-models has emerged that allow for analytical solutions (see e.g. Forslid, 1999; Ludeman/Wooton, 2000; Ottaviano/Tabuchi/Thisse, 2002; Pflueger, 2003). These models, however, remain quite complicated even when assuming full employment.

¹² Introducing such a force would generate a range of transportation costs for which a symmetrical distribution of all economic activity across the two regions and without regional disparities is the only stable equilibrium. The centripetal forces that prevail for all levels of transportation costs in our model would only dominate below a certain threshold level. Compared to our relatively simple product market structure, this extension would greatly complicate the analysis without adding significant new insights. A more detailed comparison of this product market structure with a “typical” NEG-model can be found in Suedekum (2003), chapter E.

production function for the consumption good Y in region $r = \{1,2\}$, which also represents a quasi-utility function, is given by a symmetric CES form

$$Y_r = \left(N_r X_{rr}^\theta + N_s \left[\frac{X_{sr}}{\tau} \right]^\theta \right)^{1/\theta} \quad \text{with } 0 < \theta < 1 \quad (5)$$

where $s = \{1,2\} \neq r$ denotes the other region. By solving a cost minimization problem subject to the output level (5) we can derive the demand functions for intermediates X_{rr} and X_{sr}

$$X_{rr} = p_r^{\frac{1}{\theta-1}} G_r^{\frac{\theta}{1-\theta}} Y_r \quad X_{sr} = (\tau p_s)^{\frac{1}{\theta-1}} G_r^{\frac{\theta}{1-\theta}} Y_r, \quad (6)$$

where p_r is the mill price of a symmetrical intermediate from region r . G_r is the regional price index and at the same time the minimum cost function for producing one unit of Y_r . This function G_r is given by

$$G_r = \left(N_r (p_r)^{\frac{\theta}{\theta-1}} + N_s (\tau p_s)^{\frac{\theta}{\theta-1}} \right)^{\frac{\theta-1}{\theta}} \quad (7)$$

The unit costs G_r are decreasing in the number of available intermediates N_r and N_s . Due to the transportation costs in the X -sector the decline is stronger in N_r than in N_s . We assume that the Y -sector is perfectly competitive. This together with the assumption of costless transportation of Y implies that there is price equalisation on the market for the final consumption good. Without loss of generality we can use p^Y as the numeraire and set it equal to one. The equilibrium condition in the perfectly competitive Y -sector with zero profits and efficient production is thus

$$1 = N_r (p_r)^{\frac{\theta}{\theta-1}} + N_s (\tau p_s)^{\frac{\theta}{\theta-1}} \quad (8)$$

Production of intermediates

In both regions, each of the differentiated, symmetrical intermediates j is produced by using labour only. We assume that production incurs a fixed requirement of α effort units (i.e. non-

shirking workers), and exhibits constant marginal costs equal to $w_r e_r$.¹³ Due to the fixed costs, each differentiated intermediate will be produced by only one firm. The assumption of symmetry implies that there are N_r identical firms operating in region r . Each produces one differentiated intermediate input and charges a mill price p_r . Since individual performance can only imperfectly be monitored, it is in principle possible that shirkers (who produce no output) are under contract at a 'typical' firm and receive the same wage w_r as non-shirkers ℓ_r . Let s_r denote the number of employed shirkers, who simply add to the fixed costs and hence reduce profits π_r , which are given by

$$\pi_r = p_r \cdot X_r(p_r) - w_r(e_r \alpha + e_r X_r + s_r) \quad (9)$$

Following Dixit/Stiglitz (1977) we say that each single producer is small relative to the market and can neglect its influence on G_r . Maximizing (9) with respect to X_r then leads to the familiar pricing rule according to which prices are a constant mark-up over marginal costs.

$$p_r \left(1 - \frac{1}{\eta_{p,X}}\right) = e_r w_r \Leftrightarrow p_r = \frac{e_r}{\theta} w_r \quad (10)$$

Furthermore, again following the Dixit-Stiglitz-model, we assume that profits (9) for every firm are driven down to zero by the entry of potential outside competitors. Using (9) and (10), the output level of the representative firm in region r is thus

$$X_r = (\theta/(1-\theta))(\alpha + s_r/e_r). \quad (11)$$

A firm must theoretically be larger the more shirkers are among its workforce, since it must cover the higher fixed costs with its variable profits in order to make zero total profits. If there is no demand for this "extra output" on the market, shirking will lead to negative profits for the firm.

¹³ Put differently, the labour requirement ℓ_r to produce the quantity X_r is $\ell_r = \alpha + X_r$ workers or $e_r(\alpha + X_r)$ effort units.

Product market equilibrium

In equilibrium each of the symmetrical firms in region r will pay the same efficiency wage w_r that rules out shirking and endogenously creates unemployment. When shirking is ruled out ($s_r=0$), each firm regardless of its location is operating at the same scale of output $\bar{X} = \alpha(\theta/(1-\theta))$ and employs $\ell = \alpha/(1-\theta)$ workers, which yields a profit level of zero. The equilibrium number of firms and intermediate products in region r is by definition

$$N_r = (1-U_r) \frac{\bar{L}_r}{\ell} \quad (12)$$

where \bar{L}_r denotes regional labour supply. By plugging (10) and (12) in (8) we obtain the following expression for the product market equilibrium in region $r=1$

$$w_1 = \left(\frac{(1-U_1) \frac{\bar{L}_1}{\ell}}{1 - (1-U_2) \frac{\bar{L}_2}{\ell} (\tau w_2)^{\frac{\theta}{\theta-1}}} \right)^{\frac{1-\theta}{\theta}} \quad (13)$$

This wage is increasing in employment in both regions, but decreases with higher wages in region 2 and the transportation cost τ . An analogous equation applies to the other region. When solving for w_1 and w_2 , we can obtain closed-form solutions for w_1 and w_2

$$w_1 = \left(T (1-U_1) \frac{\bar{L}_1}{\ell} \right)^{\frac{1-\theta}{\theta}}, \quad w_2 = \left(T (1-U_2) \frac{\bar{L}_2}{\ell} \right)^{\frac{1-\theta}{\theta}} \quad (14)$$

where $T = \frac{1 - \tau^{\frac{2\theta}{\theta-1}}}{1 - \tau^{\frac{\theta}{\theta-1}}}$

At these wage levels, the zero profit condition holds in both sectors and regions and there is no shirking. Moreover, the wage levels in (14) also imply clearing of all markets in this economy. This proposition is proved in appendix 1.

We call these wages the *product market equilibrium levels* of w_1 and w_2 . As can be seen, they only depend (positively) on employment in the respective region itself, despite the openness to trade. This is due to the symmetrical use of all intermediates in both regions. An increase in L_2 at first instance also has positive spill-over effects on w_1 . But once the endogenous effect on w_2 is taken into account, the impact will cancel out. The purely regional scale effect can be explained by the better exploitation of the localised increasing returns. With costless trade ($\tau=1$), it would not matter where intermediates are produced. Regional wages and unemployment rates would be equalised (Matusz, 1996). With transportation costs $\tau>1$, however, the larger region has an advantage over the smaller one. Suppose the unemployment rates U_1 and U_2 were identical. The region with the larger labour force could then produce more intermediates locally. It saves on transportation costs and consequently must pay higher wages for the zero profit conditions in the Y- and the X-sector to hold. The influence of transportation costs is also noteworthy. The variable T can be understood as an inverse measure of the resource waste from shipping. It ranges between $T = 1$ (if $\tau \rightarrow \infty$) and $T=2$ (if $\tau \rightarrow 1$).

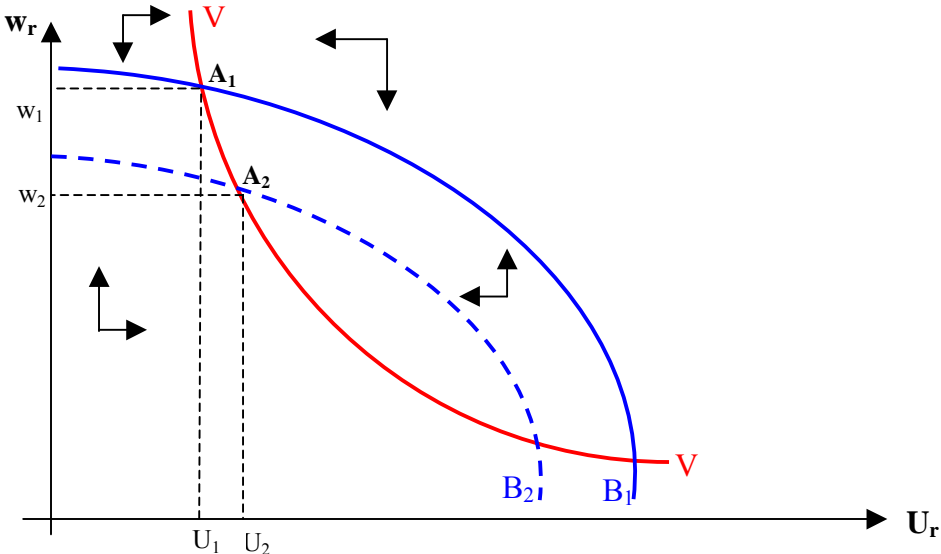
5.) General equilibrium in the short-run

We have derived the labour market equilibrium condition in (4) and the product market equilibrium condition in (14). Both are functions of the regional real wage level w_r that endogenously depends on the regional unemployment rate U_r . Having done this, we can move forward and determine the general equilibrium in both regions, i.e. we can pin down the regional levels of w_r and U_r . At first this will be done for the short-run by assuming immobile agents. For expositional purposes, we will adopt a graphical solution method.¹⁴ The product market equilibrium relations for the two regions are represented by the curves B_1B_1 and B_2B_2 in fig. 5. Contrary to the B/O-model (fig. 4), the curves are now downward sloping and non-linear. The higher is the regional unemployment rate, the lower is the number of active firms in region r and the lower is the regional wage level that is consistent with product market equilibrium. The vertical phase arrows can be understood in the following way: For all points below (above) the BB-schedule, wages are too low (high) for any given unemployment rate. Producers in the Y-sector make positive (negative) profits that induce others to enter (exit) the mar-

¹⁴ The analytical solution approach shall be sketched here. One has to set (4) equal to (14) in order to obtain a non-linear expression for either region that in principle can be solved for U_r . This expression will in general exhibit multiple equilibria. When plugging the equilibrium unemployment rate back into (4) and (14), one obtains the equilibrium real wage levels for both regions.

ket. This expansion or contraction of the Y-sector translates into rising (falling) prices for intermediate products (p_r), which subsequently must be absorbed by higher (lower) real wages for the manufacturing workers in the X-sector. The greater is the difference between \bar{L}_1 and \bar{L}_2 , the further apart are B_1B_1 and B_2B_2 due to different exploitation of the localised scale effect. An increase in τ shifts both curves downwards and to the left, because more resources are wasted in transportation. The same shift occurs as α or θ increases.

Figure 5: Equilibrium in the two-region economy with immobile agents



The labour market equilibrium relation is represented by the wage curve VV in fig.5. It is identical in both regions since we have abstracted from parameter differences in γ_r and e_r across the two locations. For all points to the right (left) of VV , unemployment is too high (low) for any given real wage level. In the former case, firms could hire new workers at the going wage and trust that they do not shirk, in which case equilibrium unemployment must fall. In the latter case, there would be shirking in the economy and firms would make negative profits (see section 3). This dis-equilibrium situation, the violation of the no-shirking condition, is adjusted by an exit of firms and shrinking firm sizes (see equation (11)) until the unemployment rate has sufficiently decreased. These considerations explain the directions of the horizontal phase arrows.¹⁵

¹⁵ The idea that changes in the unemployment rate are an adjustment mechanism that restores an equilibrium situation in the economy is explained more intensively in the macroeconomics literature, e.g. in Layard/Nickell/Jackmann, 1991: ch. 1).

General equilibrium in region r is reached when the product market and the labour market are jointly in equilibrium. The phase arrows indicate that there is only one stable equilibrium for either region, the points at A_1 and A_2 respectively. In figure 5 we have depicted a constellation where region 1 is larger than region 2. The labour demand that is consistent with product market equilibrium is higher in region 1 for any given wage rate. This drives down unemployment at first instance, and simultaneously increases the necessity to pay efficiency wages.¹⁶ In equilibrium, the larger region (“the core”) is advantaged over the smaller one along two dimensions: the real wage level is higher and the unemployment rate is lower. The existence of unemployment exacerbates the agglomeration wage premium. It is not only because of technological factors and the better exploitation of scale economies that large regions pay higher wages. Our model suggests that there is an additional efficiency wage premium.

6.) General equilibrium in the long-run: The impact of labour mobility

The depicted spatial differences will of course spur migration from region 2 to region 1, at least in the long-run. With the increasing returns in production, labour migration is *not* an equilibrating force as in the B/O-model with a neoclassical production technology. Migration rather perpetuates regional disparities.¹⁷ In fact, if workers were *perfectly* mobile across regions, there would always be full concentration of all economic activity in one region, regardless of the level of transportation costs. This implication is unsatisfactory, both from an empirical and from a theoretical point of view, since we hardly observe a complete depopulation of whole regions. We will therefore – in analogy with the B/O-model – consider the case of *imperfect* labour mobility.

In a long-run spatial equilibrium, individuals must be unable to increase their level of utility by migrating from one location to another. Our model predicts that there are regional differences in the observable economic variables w_r and U_r such that the two regions are located along the same wage curve. Hence, if some individuals remain in region 2 on the lower right

¹⁶ Since the labour market situation is better in region 1, shirking is at first instance a more viable option for the workers. Put differently, higher efficiency wages are required in region 1 in order to deter workers from shirking.

¹⁷ There is a substantial literature that aims to assess whether the neoclassical predictions about the macroeconomic effects of labour migration hold in reality (see e.g. Walz, 1995; Reichlin/Rusticini, 1998). There it is generally inferred that the evidence for the neoclassical convergence hypothesis is “mixed at best”.

tail of the VV-schedule in fig. 5, they must be compensated for the worse economic situation in their region of residence by other factors that affect their location decision.

There are several conceivable mechanisms. One would be congestion. When individuals dislike urban crowding and prefer to avoid intra-urban commuting, they might accept lower wages and a higher unemployment exposure in the periphery. A different approach is to introduce housing costs, which naturally are lower in peripheral areas. In the remainder we will pursue a slightly different approach, however. We assume that an intrinsic regional preference, or more precisely a *home bias*, acts as the compensating mechanism that can prevent individuals from leaving the periphery. There is no particularly strong reason why choosing this “dispersion force” instead of another, except maybe for the fact that congestion and housing price differentials might have the flavour of typical *urban* costs, i.e. they might be less suited for the more broad geographical scale that we are concerned with.

For notational convenience, let us normalize the size of the total national labour force as $\bar{L} = \bar{L}_1 + \bar{L}_2$ and assume that a fraction $\lambda\bar{L}$ lives in region 1, $(1-\lambda)\bar{L}$ in region 2. From (14) we know that the relative regional wage $\hat{w} = w_1/w_2$ is given by

$$\hat{w} = \frac{w_1}{w_2} = \left(\frac{(1-U_1)\lambda}{(1-U_2)(1-\lambda)} \right)^{\frac{1-\theta}{\theta}} \quad (15)$$

The relative wage \hat{w} is increasing in λ and is larger than one if $\lambda > 1/2$, firstly because of the better exploitation of the increasing returns and secondly because of the additional efficiency wage premium (since U_1 must be smaller than U_2). Now let us assume that we are initially in a symmetrical situation with $\lambda=1/2$, i.e. with no regional disparities ex-ante. Under perfect mobility this symmetrical equilibrium is unstable and workers will migrate from region 2 to region 1 up to the point of full concentration ($\lambda=1$).¹⁸

We now add an individual-specific discount factor $\kappa_i > 0$ that captures the relative attractiveness of region 1 perceived by individual i . Let the value κ_i be equal to one if an individual has

¹⁸ Note that it is indeterminate in which region the concentration occurs. It is also possible that the final equilibrium is $\lambda=0$, but we will not consider this analogous case.

no intrinsic preference for either region. Values $\kappa_i > 1$ represent a preference for region 1, whereas $\kappa_i < 1$ indicates a discount for living in this area. More precisely, consider all \bar{L} workers rowed up in a line from $i=0$ up to $i=\bar{L}$. The distribution of the individual preference parameter κ_i over the whole population is assumed to be described by the following function

$$\kappa_i = \left(\frac{\bar{L} - i}{i} \right)^{1/d} \quad \text{with } d \geq 0. \quad (16)$$

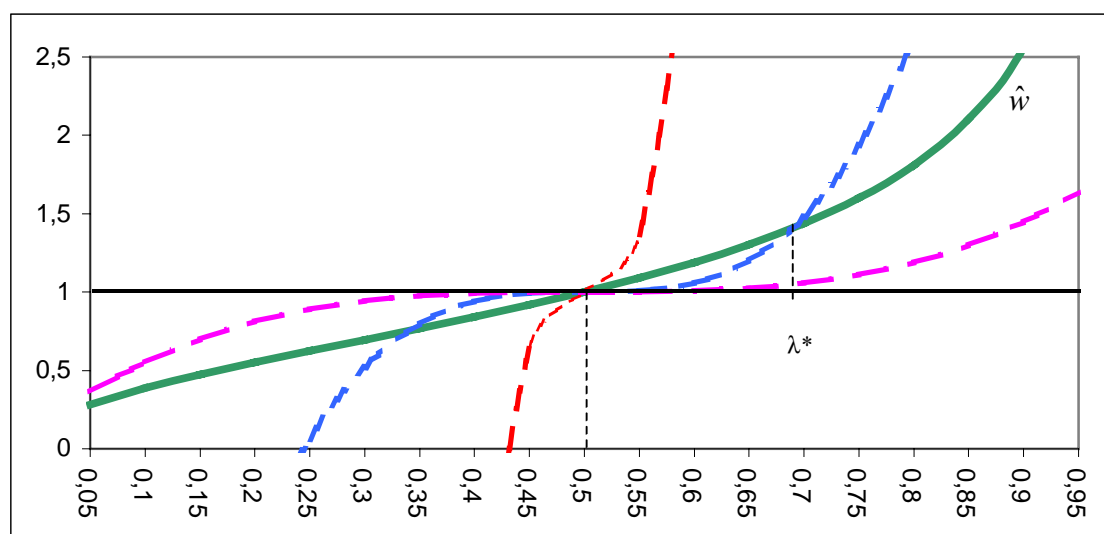
All workers in the range from $\lambda=0$ to $\lambda=1/2$, those who are originally located in region 1, have values $\kappa_i > 1$. Workers indexed in the range $i \in [\tilde{L}/2; \tilde{L}]$ have values $\kappa_i < 1$. In other words, we have assumed with (16) that all individuals are intrinsically attached to the region where they are initially located. The individuals at the extremes, $i=0$ and $i=\tilde{L}$, have values $\kappa_i = \infty$ and $\kappa_i = 0$ respectively and are inevitably tied to one specific region. The parameter d is a measure of the overall home bias in the population. The lower is d , the stronger are the preferences for one specific region. In the extreme case with $d=0$, all individuals are completely tied to their region of birth. For $d \rightarrow \infty$, all individuals are intrinsically indifferent between locations.

Workers living in region 2 face the following trade-off: given the technology alone, they would all want to move to region 1. However, they are intrinsically attached to their home location 2 and must receive an additional wage premium. They move if and only if the relative wage of region 1 is greater than the individual dislike of that location, i.e. if

$$\hat{w} > \frac{1}{\kappa_i}. \quad (17)$$

This trade-off is graphically illustrated in figure 6. The thick solid line represents the relative regional wage \hat{w} from (15). The dotted lines represent three different examples of the regional preferences $1/\kappa_i$ from (16). The steeper is the $1/\kappa_i$ -curve, the more biased are individuals towards their home region, i.e. the lower is the parameter d .

Figure 6: Distribution of the labour force with intrinsic regional preferences



People move only if the curve \hat{w} lies above the curve $1/\kappa_i$. For the case with strong regional preferences (the steepest curve), the final equilibrium will be the symmetrical initial situation, because the higher relative wage can never compensate for the individuals' dislike of region 1. The opposite happens with a low home bias, the flattest dotted line. In this case, there will be complete agglomeration. With intermediate regional preferences the equilibrium distribution of the workforce λ^* is given by the intersection point of the two curves.

The introduction of regional preferences does not affect the fundamental result that the larger region is better off than the periphery with respect to both w_r and U_r . But imperfect mobility due to regional preferences allows for less-than-full agglomeration. There are interior equilibria $\frac{1}{2} < \lambda^* < 1$, where regional preferences just compensate for the worse “economic” situation in region 2. The more migration occurs, i.e. the larger is λ^* , the further apart are the curves B_1B_1 and B_2B_2 in figure 5 and the greater are the regional differences in w_r and U_r . These disparities can prevail in the long-run since individuals have no further incentive to relocate.

It is important to note that the regional preferences in our model are not responsible to prevent the erosion of the wage curve as in the B/O-model. Quite contrarily, they prevent further disparities. This implies that the wage curve can be a stable interregional relation in the long-run that is even strengthened through labour mobility. In this respect, our paper confirms the finding of Sato (2000), who provides a search theoretical micro-foundation of the wage curve and shows how it can be stable even with mobile agents if regional congestion plays a role.

Our argument that rests on increasing returns and imperfect labour mobility complements this insight that the wage curve must not erode through labour migration.

7) Empirical relevance and further issues

In this section we want to put our theoretical results in perspective with the descriptive empirical evidence. The main implication of our paper is that large core regions, where workers and production are agglomerated, will exhibit lower unemployment rates than sparsely populated peripheral regions, and the core(s) will pay a real wage premium. These theoretical results are broadly consistent with the stylised facts about the geographical structure of economic activity in the EU-15.

In section 2 we have shown that regional unemployment rates follow a trans-national core-periphery-structure that resembles the spatial configuration of GDP per capita. Low unemployment is centred in the agglomeration area (the “European Banana”), whereas the poor “objective 1”-regions mostly have very high unemployment rates. Overman/Puga (2002) have shown that this spatial structure of joblessness is the result of a polarisation process of regional unemployment rates that was driven by the labour demand side. On average, densely populated and rich regions received immigrants, but experienced falling unemployment rates. The opposite happened in the already poor and sparsely populated sending regions.

Our theoretical model might offer a theoretical explanation for this phenomenon. The immigration of additional workers to the core regions firstly causes an increase of competition on the labour supply side, which per se works against unemployment polarisation. But if immigration also causes a shift of the labour demand schedules, due to the better exploitation of scale economies, then migration will lead to a stronger regional polarisation.

What is then the role of labour market institutions for determining regional unemployment rates? Recall that we have assumed in section 3 that the parameters e_r and γ_r in the partial model of the labour market are identical in both regions. The interpretation of this assumption, which warrants that both regions face the same wage curve locus, can be that there is no regional variation in labour market institutions.

This assumption is surely relevant for the case of intra-national unemployment disparities. Within the same country, there is typically very little institutional variation across regions. E.g., labour laws, welfare state arrangements, the tax regime etc. are typically valid nationwide. Still, the same set of (national) labour market institutions can bring about utterly different unemployment rates on the regional level. Our model helps to understand this observation, since it suggests that unemployment disparities can be driven by the regional agglomeration of labour demand. In other words, regions from the same country with identical labour market institutions can evolve very differently, depending on whether they belong to the cluster of central, intermediate or peripheral regions.

The assumption of one “European” wage curve seems quite unrealistic, however. Across the single EU-member countries, there is still a notable degree of variation in labour market institutions. French regions might face a different wage curve locus than German or Spanish regions. The observed pattern of regional differences is then the result of a combination of institutional differences (VV-curves) and the degree of agglomeration (BB-curves).¹⁹ Since the national borders are not very visible as division lines between the clusters of low- and high-unemployment regions (Overman/Puga, 2002), one is tempted to conclude that the influence of the latter seems to be greater. On a regional level, high unemployment seems to result primarily because of economic peripherality and a low degree of agglomeration. Unfavourable labour market institutions play a role for determining unemployment rates, but they cannot explain alone why some regions have high and others have low unemployment rates.

8.) Concluding remarks

In this paper we have combined a wage curve with a technology that incorporates a scale effect. Contrary to the standard approach of Blanchflower and Oswald, we thus present a general equilibrium wage curve model with an *endogenous* mechanism for the emergence of regional disparities. Sectoral specialization patterns play no crucial role in our approach. Moreover, we have shown that the wage curve is not put under strain by labour mobility as in the B/O-model, but is rather strengthened by it. Hence, if one works with an increasing re-

¹⁹ The Portuguese regions are a good example for this. They all belong to the “objective 1”-cluster, but still unemployment rates are relatively low. This is supposedly so, because Portugal has at least in some respects a set of favourable institutions, i.e. a wage curve VV that is located closer to the origin as in other nations. For a more

turns technology, the theoretical case for the long-run stability of the wage curve is reinforced.

The contribution of our paper, however, can also be interpreted differently, namely as an attempt to integrate the element of unemployment in the new regional agglomeration theories. We have argued that NEG and NTT have little to say about unemployment disparities. Our model is an attempt to partly close this gap and shows that core-periphery structures of production and income are probably even exacerbated by unemployment disparities.

The main empirical prediction of our paper is that large core regions, where workers and production are agglomerated, will exhibit lower unemployment rates compared to sparsely populated, peripheral regions, and the core will pay a real wage premium. Migration will not cure but rather reinforce these regional gaps. These implications seem to be roughly consistent with the stylised facts about the geographical structure of economic activity in the EU-15.

detailed discussion about the particularities of the Portuguese labour market, see Addison/Teixeira (2001) or Bover/Garcia-Perea/Portugal (2000).

Appendix 1:

Proof that the product market equilibrium wages (14) imply market clearing

Each firm in the intermediates sector, regardless in which region it is located, supplies the quantity $X=\alpha/(1-\theta)$. Equilibrium requires that X equals total sales to both regions $X_{rr} + \tau X_{rs}$. Using (6) together with the equilibrium condition $G_r=1$ we can write

$$X = (w_r)^{\frac{1}{\theta-1}} \left(Y_r + \tau^{\frac{\theta}{\theta-1}} Y_s \right) \quad (\text{A1})$$

Using (14) and solving for Y_r , this can be written as

$$Y_r = \frac{X}{1 - \tau^{\frac{\theta}{\theta-1}}} \left((TN_r)^{\frac{1}{\theta}} - \tau^{\frac{\theta}{\theta-1}} (TN_s)^{\frac{1}{\theta}} \right) \quad (\text{A2})$$

Equation (A2) determines the regional production level Y_r at which markets for intermediates clear. The total national production of Y is

$$Y_r + Y_s = \frac{X}{T} \left((TN_r)^{\frac{1}{\theta}} + (TN_s)^{\frac{1}{\theta}} \right) \quad (\text{A3})$$

Since Y is freely tradable at $p^Y=1$, (A3) needs to equal total national income and consumption expenditure, which is given by

$$w_r(1-U_r)L_r + w_s(1-U_s)L_s \quad (\text{A4})$$

By using (14) in (A3) and rewriting (A4), one can show that both expressions are equivalent to

$$\left(\frac{T}{X} \right)^{\frac{1-\theta}{\theta}} \left[((1-U_r)L_r)^{\frac{1}{\theta}} + ((1-U_s)L_s)^{\frac{1}{\theta}} \right], \quad (\text{A5})$$

which proves the proposition that the wage levels (14) imply not only efficient production, but also market clearing.

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