REGIONAL INCOME DISPARITIES IN EUROPE: WHAT ROLE FOR LOCATION?

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Regional Income Disparities in Europe: What role for location?

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Abstract

This paper uses a New Economic Geography model to test for wage disparities in the European Union. We derive and estimate an econometric specification relating wages to a distance weighted sum of regions' GDP. The empirical estimations of the model were carried out for a sample of 160 NUTS2 regions in the EU15 for the year 2000 showing that geography of access to markets is statistically significant and quantitatively important in explaining cross-region variation in European wages. We also show that incentives for human capital accumulation and innovation activities arising from market access size are also affecting the shaping of regional wages in the European Union.

JEL classification: O1, R1

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1. Introduction

In January 2003 the release of the 2nd intermediate report on the economic and social cohesion showed that regional disparities in the European Union are still very large and there is little improvement since 1990. The figures for the year 2000 reflected that the regions with the highest GDP per head (PPS) accounting for 25% of the total population in the European Union were twice as rich as the regions with the lowest GDP per head (PPS). This ratio was the same in 1990[1]. At the 10% percentile the situation was even worse, the ratio between the regions with the highest GDP per head levels and those with the lowest GDP per head levels was about 2.6 in 2000[2] (2.8 in 1990). Moreover these figures show a strong core-periphery income gradient, i.e. regions with low per capita GDP are predominantly located at the geographical periphery while the richest are at the centre. The persistence of such differences has raised concern on the political and academic arena in light of the successive steps taken by the European Union to even out development levels, being the most important the European Union regional policy[3]. There are a number of reasons which may prevent convergence of income levels such as sluggish technology diffusion, endowment disadvantages[4] and trade costs. At this point New Economic Geography (NEG) has reached a theoretical consolidation as a theory that explains the emergence of a heterogeneous economic space on the bases of

[1]Data refer to EU15 countries

[2]The figures of the 1st intermediate report on the economic and social cohesion comparing the years 1989 and 1999 for the 10% and 25% of population with the highest and lowest levels of GDP per head were the same as in the 2nd intermediate report on the economic and social cohesion.

[3]With respect to the effectiveness of the European Union Regional Policy to boost regions whose development is lagging behind the opinions of the scholars are divergent (see Basile et al. 2001, Boldrin and Canova 2001, Faiña and Lopez-Rodriguez 2004, Rodriguez-Pose and Fratesi 2004).

[4]Studies examining the link between human capital and growth include Benhabib and Spiegel (1994), Bils and Klenow (2000), Eicher and Garcia-Penalosa (2001) Galor and Mountford (2001), and Mankiw et al. (1992)

increasing returns to scale and transport costs (See Krugman, 1991, 1992). Although NEG has experienced rapid theoretical advances[5], authors such as Neary (2001), Ottaviano (2002) and Head and Mayer (2003) pointed out that empirical research on NEG is lagging behind[6]. One of the most successful ways to test the validity of the forces put at work in NEG models has been the analysis of the effects of distance from consumer markets on income levels. These studies can be divided into two strands according to the assumptions made, basically the one referring to the mobility of labour. One strand analyses the effects of economic geography (proximity to consumer markets) on income levels at national level. To this strand belongs the works of Brakman et al. 2004 and Roos 2001 for Germany, Hanson 2004 for US, Mion 2004 for Italy among others. The other strand focuses on the effects of economic geography on income levels at international level being represented by the work of Redding and Venables 2004. In both types of studies, national level and international level, the authors find a significant impact of the geography of access to markets in shaping income levels.

This paper uses the theoretical framework of the New Economic Geography to analyse the effects of proximity to consumer markets on European Union wages for the year 2000. We derive and estimate a New Economic Geography model that captures the role of market access in determining the maximum level of wages a representative firm in each region can afford to pay. The basic idea is that firms in remote locations (low market access) pay greater transport costs on both exports and intermediate inputs,

[5]See Fujita et al. (1999), Fujita and Thisse (2002) for theoretical texts on New Economic Geography. For texts combining theory and empirics see Brakman et al. (2001, 2005)

reducing the amount of value added left to remunerate domestic factors of production, so they can only afford to pay relatively low wages in comparison with central regions (high market access). Therefore, we emphasize the role of remoteness (market access) in avoiding regional wage differences to be bid away and so in acting as a penalty for economic convergence of income levels.

Our findings contribute to the empirical literature on New Economic Geography (NEG) providing evidence of the importance of the geography of access to markets in explaining cross-region variation in EU wages. Using regional data on 160 European Union NUTS[7] 2 regions we find that a significant fraction of wage differences can be explained by this variable. We check the robustness of our results including control variables that capture the potential indirect effects of economic geography being able to isolate the direct influence due to market access disadvantages for peripheral regions. The findings of the effects of market access on regional wages proved to be robust to the inclusion of control variables. Our final contribution was to disentangle the main channels through which market access can be affecting regional wages. We have found that the main benefits of market access in shaping the regional wage gradient in the European Union seem to come from increased incentives for innovation activities and human capital accumulation.

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[6]See Overman, Redding and Venables (2003), Head and Mayer (2004) and Combes and Overman (2004) for comprehensive surveys of the existing empirical literature.

[7]Nomenclature of Territorial Units for Statistics (NUTS) is a Eurostat's classification in order to provide a single uniform breakdown of territorial units for the production of regional statistics for the European Union. The present NUTS nomenclature valid from 11 July 2003 onwards and extended to EU-25 on 1 May 2004 subdivides the economic territory of the European Union (EU25) into 89 regions at NUTS 1 level, 254 regions at NUTS 2 level and 1214 regions at NUTS 3 level.

The remaining part of the paper is structured as follows. In section 2 we develop the theoretical model and derive the equation that forms the basis of the econometric estimations. Section 3 discusses the empirical implementation of the model. Section 4 presents the results of the estimations. Finally, section 5 concludes.

2. Theoretical Framework

In NEG models, the interaction of transport costs and increasing returns to scale generates demand linkages and serves as explanation for agglomeration. Agglomeration is caused by a circular relationship in which the spatial concentration of manufacturing both creates and follows market access. In krugman's words, *circular causation a la Myrdal* is present because these two effects reinforce each other: "*manufactures production will tend to concentrate where there is a large market, but the market will be large where manufactures of production is concentrated*" (Krugman, 1991, p.486). These forces that are at work in any multiregional economy can be studied within a relatively simple general equilibrium model of monopolistic competition developed by Krugman (1991b), which has come to be known as the *core-periphery model*[8]. Krugman's theoretical research on NEG has triggered a plethora of contributions[9], which have been surveyed by Ottaviano and Puga (1998). Most recently a synthesis of the existing theoretical research on NEG can be found in Fujita et al. (1999) and Fujita and Thisse (2002).

[8]An earlier analysis that anticipated several aspects of Krugman's work was developed by Faini (1984).
[9]See also Fujita et al. (1999) and Venables (1996), among others

Our theoretical framework is a reduced form of a standard New Economic Geography model based on Redding and Venables (2004)[10]. We consider a world with R regions and we focus on the manufacturing sector, composed of firms that operate under increasing returns to scale and produced differentiated products.

On the demand side, each firm's product is differentiated from that of the other firms and is used for consumption. We also assume that the elasticity of substitution between any two varieties is constant and takes the value σ, $\sigma \succ 1$. So, products enter both utility and manufacturing goods consumption through a constant elasticity of substitution (CES) aggregator with the form.

$$M_j = U_j = \left[\sum_{i=1}^{R} \int_0^{n_i} m_{i,j}(z)^{\sigma-1/\sigma} dz \right]^{\sigma/\sigma-1} \qquad \sigma \succ 1 \qquad (1)$$

Making the assumption that in equilibrium, all products produced in country i are demanded by country j in the same quantity, expression (1) can be rewritten as:

$$\left[\sum_{i}^{R} n_i m_{i,j}^{\sigma-1/\sigma} \right]^{\sigma/\sigma-1} \qquad (2)$$

z stands for manufacturing varieties, n_i is the set of varieties produced in country i, $m_{i,j}(z)$ is country j demand for zth product from this set.

Dual to manufacturing goods consumption index (M_j) is a price index (G_j) defined over the prices of individual varieties produced in i and sold in j (i.e) $P_{i,j}$.

$$G_j = \left[\sum_{i}^{R} \int_0^{n_i} P_{i,j}(z)^{1-\sigma} dz \right]^{1/1-\sigma} = \left[\sum_{i}^{R} n_i (P_{i,j})^{1-\sigma} \right]^{1/1-\sigma} \qquad (3)$$

[10]See also Krugman and Venables (1995), Redding and Schott (2003) and Redding and Venables (2004)

where the second equation makes use of the symmetry in equilibrium prices.

If we denote by E_j total consumer expenditure on manufacturing goods in country j, its demand for each product is (Applying Shephard's lema on the price index[11])

$$x_{i,j} = P_{ij}^{-\sigma} E_j G_j^{\sigma-1} \tag{4}$$

Turning to supply, a representative country i firm maximizes the following profit function

$$\prod_i = \sum_{j=1}^{R} \frac{P_{i,j} X_{i,j}}{T_{i,j}} - w_i^{\alpha} \upsilon_i^{1-\alpha} c_i (F + x_i) \tag{5}$$

where the total output of the firm is $x_i \equiv \sum_j x_{i,j}$. Technology has increasing returns to scale and its represented by a fixed output requirement $c_i F$ and a marginal input requirement c_i, parameters that can vary across regions. For our purpose, we suppose that we only need primary factors in the production of manufacturing goods, entering in the production function as a Cobb-Douglas form. Basically, we assume that we need labour (with price w_i and input share α) and "other primary factors" (with price υ_i and input share $1-\alpha$).

$T_{i,j}$ stands for iceberg transport cost, so $T_{i,j} = 1$ the trade is costless, while $T_{i,j} - 1$ measures the proportion of output lost in shipping from i to j.

The first order conditions for profit maximization yield the standard result that equilibrium prices are a constant mar-up over marginal costs.

$$P_i = \frac{\sigma}{\sigma - 1} w_i^{\alpha} \upsilon_i^{1-\alpha} c_i \tag{6}$$

[11]See also Dixit and Stiglitz (1977)

Substituting this pricing rule into equation (5) we obtain the following expression for the equilibrium profit function,

$$\prod_i = \left(\frac{P_i}{\sigma}\right)\left[x_i - (\sigma - 1)F\right] \tag{7}$$

In order to break the firm's output must equal a constant $\bar{X} = \frac{\sigma - 1}{F}$. The price needed to sell this many units satisfies[12] (using demand function (4))

$$P_i^{\sigma} = \frac{1}{\bar{x}} \sum_{j=1}^{R} E_j G_j^{\sigma-1} T_{i,j}^{1-\sigma} \tag{8}$$

Combining the expression in equation (8) with the fact that, in equilibrium prices are a constant mark-up over marginal costs we obtain the following zero-profit condition

$$\left[\left(\frac{\sigma}{\sigma - 1}\right) w_i^{\alpha} \upsilon_i^{1-\alpha} c_i\right]^{\sigma} = \sum_{j=1}^{R} E_j G_j^{\sigma-1} T_{i,j}^{1-\sigma} \tag{9}$$

This is the so-called nominal *wage equation* which is point of departure of our investigation. According to equation (9), the nominal wage level in region i depends on a weighted sum of purchasing power in all accessible regions j, whereby the weighting scheme is a function declining with increasing distance between locations i and j.

This sum we will refer to as the "*market access*" of country i (MA_i). As Hanson (2000) notes, equation (9) can be thought of as a spatial labour demand function.

[12]The transport cost term ($T_{i,j}$) enters with the exponent ($1-\sigma$) and not σ because total shipments to market j are $T_{i,j}$ times quantities consumed.

Labour demand and wages increase with income of neighbouring regions and decline with rising transport costs to these locations.

The nominal wage equation can be rewritten as:

$$w_i = A(MA_i)^{\frac{1}{\alpha\sigma}} \upsilon_i^{\frac{-\beta}{\alpha}} c_i^{\frac{-1}{\alpha}} \qquad (10)$$

Where $A = \left(\frac{\sigma}{\sigma - 1} \right)^{\frac{-1}{\alpha}}$ combines constants from the equation (9) and $MA_i = \sum_{j=1}^{R} E_j G_j^{\sigma-1} T_{i,j}^{1-\sigma}$.

Left hand side of equation (10) contains the wage, w_i , while right hand side contains market access, prices of others factors of production, υ_i, and a measure of technology differences, c_i . The meaning of this equation is that access advantages raise local factor prices. More precisely, production sites with good access to major markets because of relatively low trade costs tend to reward their production factors with higher wages.

3. Econometric specification and Regional System

1. Econometric specification

The nominal wage equation (10) cannot be estimated directly since data on regional price indices are not available. The strategy followed to eliminate G_j and arrived at an estimable specification was to consider that the price index is equal in all regions ($G_j = G$) . Taking into account this assumption the theoretical predictions of the model can be tested by using the following specification (taking logs in equation (10):

$$\ln w_i = \alpha_0 + \alpha_1 \ln MA_i + u_i \quad (11)$$

Where the error term captures both the price of other factors of production, υ_i, as well as differences in technology across regions, c_i. To begin with, we consign these to the error term and examine how much of the variation in cross regional wages can be explained when only including information on market access. This provides the basis for our baseline estimation where we assume that the error term is uncorrelated with the explanatory variables[13]. Considering that this assumption can be violated and therefore the coefficient estimates be biased and inconsistent we also presents estimates using instrumental variables regression.

However, equation (11) is a restricted specification for analysing the effects of market access on wages. We cannot tell if the relationship founded in the bivariate regression is causality or it might simple capture correlations with omitted variables like access to technological innovation, educational levels and so. In order to deal with these issues and to control for the potential existence of other shocks to the dependent variable that are correlated with measures of economic geography, we also estimate this alternative specification that explicitly allows for these possibilities:

$$Lnw_i = \alpha_0 + \alpha_1 \ln MA_i + \sum_{n=1}^{N} \gamma_n X_{i,n} + \varepsilon_i \quad (12)$$

[13]Factor mobility should equalize υ_i across locations and hence it will be captured by the term α_0 of the regression. However this is not the case for the parameter c_i and the variables affecting it. These variables can be correlated with market access generating endogeneity problems.

Where X_{in} is a control variable and γ_{in} is the correspondent coefficient.

2. Data and Regional System

The dependent variable in the regression analysis is the log compensation per employee defined as the total remuneration in wages and salaries payable by an employer to an employee in return for work done by the latter during the accounting period. Eurostat does not have this variable as such, instead it has data on the total amount of wages and salaries pay at regional level, labelled "compensation of employees" (Eurostat table code e2rem95). To get the compensation of employees "per capita", we use the regional employment figures from the European Union Labour Force Survey (Eurostat table code lf2emp) and we labell this new variable in our analysis as "compensation per employee". The advantages of this variable as a proxy for regional wages against per capita GDP is that using the latter what we are doing is to divide the GDP produced by production units in region X by the resident population of the same region X. This leads to an overestimation of the figures in regions where you have a net inward commuting, circumstance common to several EU regions (London, Paris, etc.). On the other hand, if you divide compensation of employees by the number of employees, then you get the compensation "per employee" of all the production units in region X. Therefore compensation per employee is a better indicator for regional wages. The definition of this variable is a broad definition of wages that does not correspond exactly with the one derived from the theoretical model, which refers only to the remuneration in the manufacturing sector. However taking into account the way we built the market access

variable this is the best proxy we found for regional wages. Moreover, a narrower definition of regional wages, would not change the main result carried out in this paper.

The dependent variable is given for 160 NUTS2 regions[14] for the year 2000.

The variables in the right-hand side of the equation are the following ones:

Market access (MA), which is a proxy for access to sources of expenditure. We compute market access as a distance weighted sum of regional GDPs. Technically speaking the expression we use to compute market access is:

$$MA_i = \sum_{j=1}^{n} \frac{M_j}{T_{i,j}}$$

Mj is a measure of the volume of economic activity of region j, Tij is a measure of the distance between i and j and n is the number of regions considered. For the market access computations, taking into account that we are measuring access to sources of expenditure and to avoid underestimation of market access of more peripheral EU regions, we build up our measure for all EU27 NUTS2 regions with the exceptions of French Dominions (Guadeloupe, Martinique, Reunion and Guyane), Portuguese Islands (Azores and Madeira) and Spanish Island of Canarias. A total of 259 EU27 NUTS2 regions were included. As a measure of economic activity (Mj), we took Regional Gross Domestic Product and with respect to distance between regions (Tij), they are great circle distances in Km between the main cities of the regions. The distance from a region i to itself, T_{ii} is modeled as proportional to the square root of the region's area. The expression we use to compute it is $0.66\sqrt{\frac{Area}{\pi}}$ in which "Area" is the size of

[14] See appendix for the list of NUTS2 regions.

region i in km2. This formula gives the average distance between two points in a circular location, (see Crozet 2004 for a discussion of this measure for internal distance). Market access computations were carried out using a geographic information system (arc info and arc map 8.2 softwares)

Our baseline regression was the bivariate regression *log compensation per employee-log market access* represented by equation #11. However we carried out a number of alternative specifications (equation #12) to check for the robustness of market access in explaining the wage estructure in the European Union. We introduce variables thought to be important in explaining average regional wages and whose influence may be picked up by the market access measure such as educational levels and patents per capita as a measure of innovation activity.

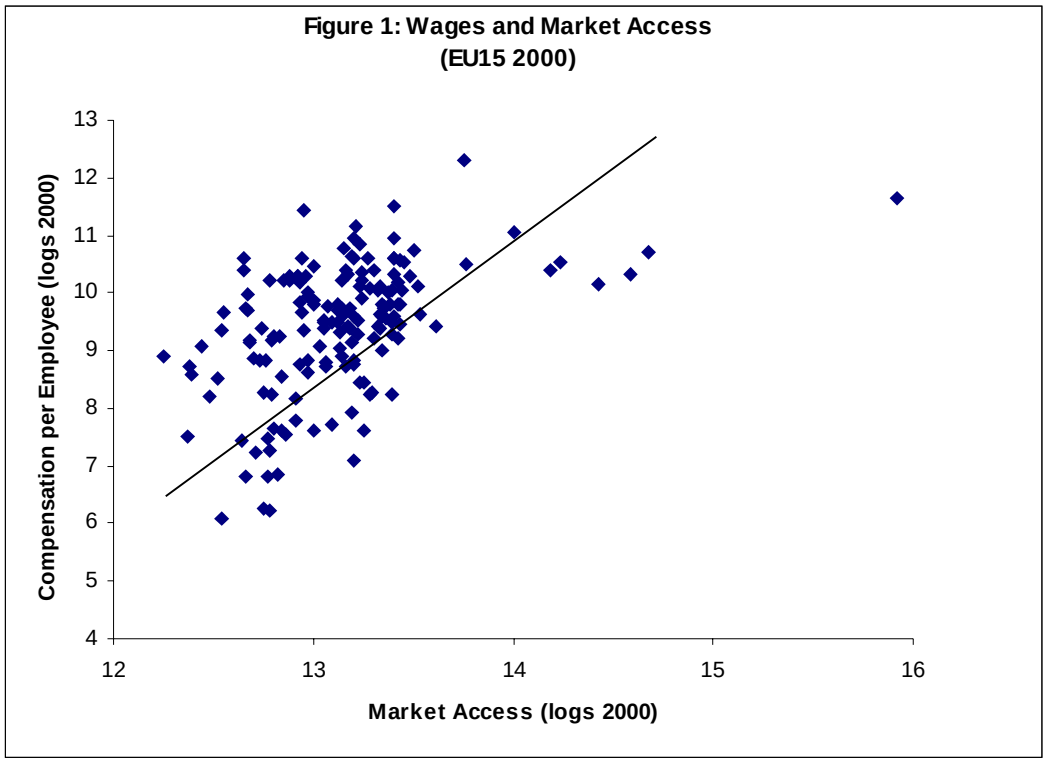
Educational levels are defined as the % of persons age 25-64 with low, medium or high levels of education. Data on educational attainment come from the European Union Labour Force Survey (LFS). The classification is based on the highest level of education attained (educational attainment) as well as on recent or current participation of the population in education and training. Data on education collected through the LFS includes three levels of educational attainment, Low level: at best lower secondary education level (ISCED97= Levels 0-2), Medium level: upper secondary education level (ISCED97 = levels 3-4) and High level: higher education qualification (ISCED97 = levels 5-6). In our analysis data on regional educational attainment refers to the year 2000 for a sample of NUTS 2 EU15 regions chosen.

Patens per capita are defined as number of patent applications to the European Patent Office (EPO) per million inhabitants. These data come from EUROSTAT.

4. Empirical results

In this section we test econometric specifications #(11) and (12) for the year 2000. Our main goal is testing for a spatial wage structure in the European Union according to the predictions of the model in section II.

Figure 1 plots log compensation per employee against log market access for the year 2000 illustrating the key relationship we want to test. This preliminary approach shows a positive effect of market access shaping regional wages.



Columns 1-8 of table 1 summarize the results of our econometric estimations for the year 2000 for the sample of 160 NUTS2 regions. First column is our baseline estimation. We regress log compensation per employee on log of market access using OLS. The coefficients on market access are significant and the signs correspond with theoretical expectations. On average, a 10% increase in market access will increase wages by 5%. Market access explains around 29% of the spatial variation in cross-regional wages for the year 2000. In the light of these results the geography of access to markets is an important factor in explaining the spatial wage structure in the European Union.

However, the use of market access as the only regressor brings the problem of reverse causality in the sense that in its computation we include GDP which in turn is increasing in per capita income as captured by the dependent variable, compensation per employee. This endogeneity problem can cause inconsistent and biased estimates.

In order to address this issue, we use instrumental variables to estimate the effect of market access on wage levels.

The instruments

Determining a causal effect of market access on wage levels depends on the availability of instruments. These need to be variables that are determinants of market access but exogenous with respect to wage levels. Furthermore, they should also be variables that are not driven by an unobservable third variable the authors suspect might be jointly affecting market access and wages. Taking into account these premises, these paper uses as instruments geographical variables which are the most suitable candidates for such estimation and are exogenous determinants of market access. Therefore, we instrument

market access with distance from Luxembourg and with the size of a region's home country. The first instrument captures the market access advantages of locations close to the geographic centre of EU, while the second instrument captures the advantage of large national markets in the composition of domestic market access.

In the second column of table 1, the effect of market access in wage levels is estimated using cross-sectional data on market access, compensation per employee and the set of instruments.

The instruments are highly statistically significant and have the expected signs. The p-value for an F-test of the null hypothesis that the coefficients on the excluded instruments are equal to zero is 0.00. Distance to Luxemboug and size of a region's home country explains about 57% of regional market access. Since the instruments represent quite distinct source of information and are uncorrelated, we can trust them to be reliable instruments. However, we examine the validity of the instruments using a Hansen J test of the model overidentifying restrictions. For our market access measure we are unable to reject the validity of the instruments.

In the second-stage compensation per employee equation we again find positive and highly statistically significant effects of market access. The instrumental variables estimation even increases slightly the effects of market access on compensation per employee changing its coefficient from 0.50 to 0.57.

The bivariate regression, Log Compensation per employee-log market access in table 1, columns 1 and 2 does not allow us to know whether the positive correlation found is indeed a causality or might simply capture correlations with omitted variables. In order to deal with this issue and hence to test for the robustness of market access and for

possible changes in its coefficient, control variables were added to our baseline specification.

Although there are a large number of alternative determinants of regional wage levels[15] we choose as control variables those whose influence might potentially be picked up by market access measures. Thus, I include the number of patents per capita as a proxy for innovative activities[16] and the share of economically active population with medium and high educational levels.

Indeed, stocks of medium and high educational levels and the number of patents per capita are highly correlated with market access. The theoretical foundations for the relationship between market access and educational levels have been put forward by Redding and Schott (2003). They proved that high market access provides log-run incentives for human capital accumulation by increasing the premium of skilled labour. Empirical works carried out at international and European level have confirmed this relationship (Redding and Schott, 2003 and López-Rodríguez et. al., 2005). Innovative activity is also affected by spatial proximity and geography. Moreover, at European level the regional dimension is very relevant due to the presence of border effects. The interaction of high market access in dense and central European regions (see figure 2 for the relationship between market access and centrality), which makes them large and profitable markets for innovation, together with increasing returns to innovation and localization of the knowledge spillovers, seem to explain the pattern of high

[15]Porter 2003 provides a comprehensive analysis of US regions performance analysing in detail determinants of wage levels.

[16]Patenting is the best available and comparable measure of innovative activity across regions even though it does not capture all innovative activity. For more details about the relative merits of using patents as a proxy of innovative activity see Griliches, 1984, 1990, Jaffe, 1986, Dosi et al. 1990.

concentration[16] of innovative activities in the centre of Europe. This is confirmed in the regression results reported in table 2. Although testing for the determinants of educational levels and patents in Europe is beyond the scope of this paper, these findings support a potential impact of market access in shaping the distribution of human capital and patents across European Union regions.

In order to disentangle the above mentioned possible channels through which market access may influence wage levels, a straightforward way of checking it is by including educational levels and patens as additional regressors in the baseline specification estimated in columns 1 and 2. The results including these variables are reported in columns 3, 5 and 7. They show that the direct influence of market access on wages is smaller than indicated by the baseline regression. In these alternative estimations market access retains a positive relationship with regional wages, at the usual critical levels, however coefficients on market access drop from values of 0.50 to values between 0.23-0.43 while the R2 of the regression rises to values between 38-61%. Still these estimations show that doubling a region market access increases compensation per employee between 23-43%.

In columns 4, 6 and 8 we investigate the potential existence of other shocks to the dependent variable that may be correlated with our control variables. Our instruments are again distance to Luxembourg and size of region's home country. In the second stage we again find positive and statistically significant effects with the IV estimate.

[16]For comprehensive analysis of innovation activity in Europe see Benat-Osorio and Rodriguez-Pose (2004) Bottazzi and Peri (1999, 2003), Moreno et al. (2005), and Rodriguez-Pose (1999, 2001).

Again, the effect of market access on regional wages is reinforced when IV estimation is carried out.

Table 1: Market access and Compensation per employee (2000)
Analysing channels of influence

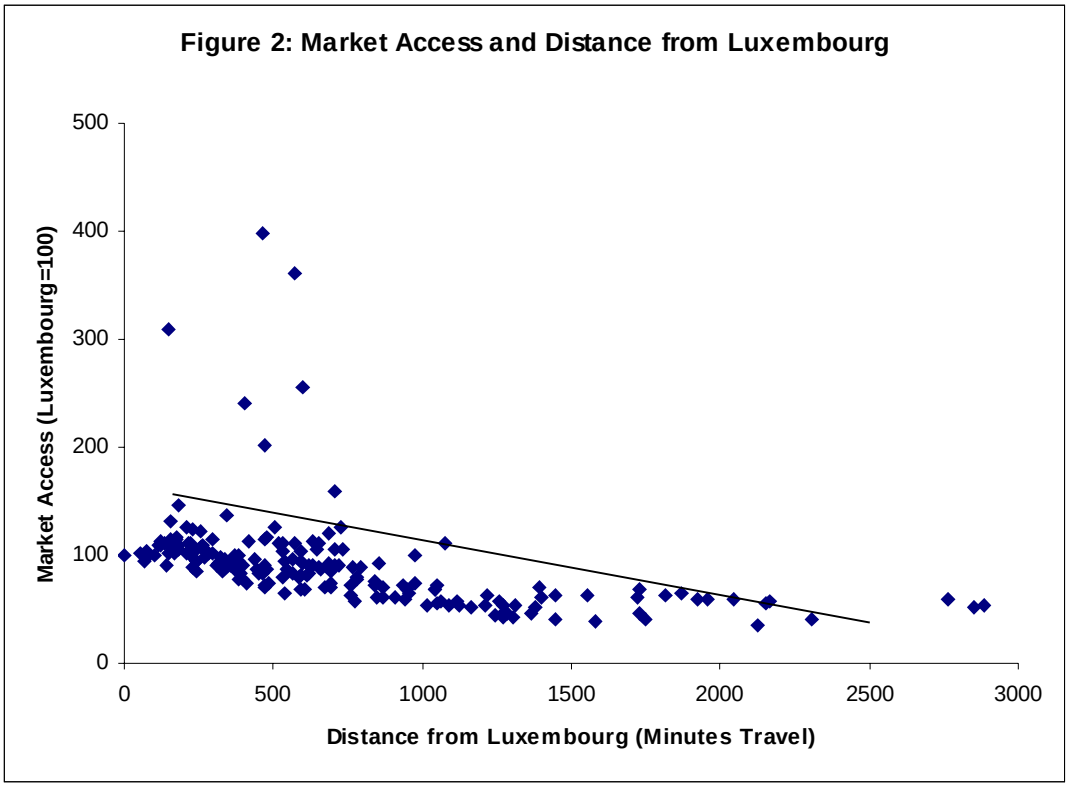
Dependent Variable: Log (Compensation per employee) Coefficients								
Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	3,54**	2,45*	6,33**	6,39**	5,72**	4,65**	6,39**	5,31**
	(0,89)	(1,30)	(0,92)	(0,92)	(0,8)	(1,18)	(0,89)	(1,15)
Market Access	0,50**	0,57**	0,23**	0,23**	0,35**	0,43**	0,32**	0,39**
	(0,06)	(0,09)	(0.07)	(0,07)	(0,06)	(0,08)	(0,06)	(0,08)
Patents per capita			0,17**	0,18**				
			(0,02)	(0,02)				
Medium-High Ed. Level					0,58**	0,54**		
					(0,07)	(0,07)		
High Ed. Level							0,33**	0,30**
							(0,04)	(0,04)
Estimation	OLS	IV (a)	OLS	IV (a)	OLS	IV (a)	OLS	IV (a)
Instrumental variables								
First Stage R2		0,57		0,57		0,57		0,57
R2	0,29	0,30	0,61	0,63	0,46	0,47	0,38	0,39
Prob (F-statistic)	0.000		0.000	0.000	0.000	0.000	0.000	0.000
Number observations	160	160	160	160	160	160	160	160
(a) Distance to Luxembourg and size region's home country								

Notes: Table displays coefficients and Huber-White heterocedasticity robust standard errors in parenthesis.
** indicates coefficient significant at 0.01 level * significant 0.05 level
"First stage" R2 is the R2 from regressing market access on the instruments set.

Table 2: Market Access, Educational Levels and Patents, (EU15 2000)

Dependent Variable:	Log (Low Ed. Level)	Log (Med Ed. Level)	Log (High Ed. Level)	Log (Patents)
Regressors				
Market Access	-0,32**	0,99**	0,90**	1, 35**
	(0,05)	(0.14)	(0,14)	(0,36)
Estimation	OLS	OLS	OLS	OLS
R2	0,18	0,19	0,16	0,19
Number observations	160	160	160	160

Notes: Table displays coefficients and Huber-White heterocedasticity robust standard errors in parenthesis
** indicates coefficient significant at 0.01 level * significant 0.05 level



The results reported in tables 2 and 3 also allow us to shed new light about the way in which market access might be affecting the shape of regional wages in Europe. Possible channels of influence are in the form of increased incentives for human capital accumulation and innovation activities.

5. Conclusions

In this paper we test for a spatial wage structure in the European Union. The results suggest the importance of the geography of access to markets in determining the spatial distribution of wages across European Union regions. 29% of cross-regional variation in wages is explained by region's distance to consumer markets. Alternative estimations to our baseline specification adding control variables whose influence may be picked up by market access measures show that two important channels through which market access affects wage levels are educational levels and the size of the innovation activities. In these alternative specifications the effects of market access remained highly statistically significant although quantitatively less important.

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Appendix:

List of NUTS2 regions included in the analysis.

Belgium (10): Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest, Prov. Antwerpen, Prov. Limburg (B), Prov. Oost-Vlaanderen, Prov. Vlaams Brabant, Prov. West-Vlaanderen, Prov. Brabant Wallon, Prov. Hainaut, Prov. Liège, Prov. Luxembourg (B), Prov. Namur

Denmark (1): Denmark

Germany (7): Berlin, Bremen, Hamburg, Mecklenburg-Vorpommern, Saarland, Schleswig-Holstein, Thüringen

Greece (13): Sterea Ellada, Peloponnisos, Thessalia, Dytiki Makedonia, KentrikiMakedonia, Anatoliki Makedonia, Ipeiros, Kriti, Attiki, Dytiki Ellada, Voreio Aigaio, Notio Aigaio, Peloponnisos

Spain (17): Galicia, Principado de Asturias, Cantabria, Pais Vasco, La Rioja, Comunidad Foral de Navarra, Castilla y León, Comunidad de Madrid, Castilla-la Mancha, Extremadura, Aragón, Cataluña, Islas Baleares, Comunidad Valenciana, Región, de Murcia, Andalucia, Canarias.

Finland (2): Itä-Suomi, Aland

France (26): Rhône-Alpes, Picardie, Auvergne, Provence-Alpes-Côte d'Azur, Champagne-Ardenne, Midi-Pyrénées, Languedoc-Roussillon, Basse-Normandie, Poitou- Charentes, Centre, Limousin, Bourgogne, Bretagne, Aquitaine, Franche-Comté, Haute-Normandie, Pays de la Loire, Lorraine, Nord - Pas-de-Calais, Alsace, Île de France, Corse Ireland (2): Border, Midland and Western, Southern and Eastern, Guadaloupe, Martinique, Reunion, Guyane

Ireland (2): Border, Midlands and Western, Southern and Eastern

Italy (19): Valle d'Aosta, Piemonte, Liguria, Lombardia, Emilia-Romagna, Veneto, Friuli-Venezia Giulia, Toscana, Marche, Umbria, Lazio, Abruzzo, Molise, Puglia, Campania, Basilicata, Calabria, Sicilia, Sardegna

Luxembourg (1)

Netherlands (12): Groningen, Friesland, Drenthe, Overijssel, Gelderland, Flevoland, Utrecht, Noord-Holland, Zuid-Holland, Zeeland, Noord-Brabant, Limburg

Austria (9): Burgenland, Niederösterreich, Wien, Kärnten, Steiermark, Oberösterreich, Salzburg, Tirol, Vorarlberg

Portugal (4): Norte, Algarve, Azores, Madeira

Sweden (8): Stockholm, Östra Mellansverige, Sydsverige, Norra Mellansverige, Mellersta Norrland, Övre Norrland, Småland med öarna, Västsverige

United Kingdom (36): Tees Valley and Durham, Cumbria, Northumberland and Tyne and Wear, East Riding and North Lincolnshire, North Yorkshire, South Yorkshire,West Yorkshire, Derbyshire and Nottinghamshire, Leicestershire, Rutland and Northamptonshire, Lincolnshire, East Anglia, Bedfordshire and Herefordshire, Berkshire, Buckinghamshire and Oxfordshire,

Surrey, East and West Sussex, Essex, Inner London, Outer London, Hampshire and Isle of Wight, Kent, Gloucestershire, Wiltshire, and North Somerset, Cornwall and Isles of Scilly, Devon, Dorset and Somerset, Herefordshire, Worcestershire and Warwickshire, Shropshire and Staffordshire, West Midlands, Cheshire, Greater Manchester, Lancashire, Merseyside, East Wales, West Wales and The Valleys, Eastern Scotland, South Western Scotland, North Eastern Scotland, Highlands and Islands

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