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MARKET POTENTIAL AND SPATIAL AUTOCORRELATION IN THE EUROPEAN REGIONS

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Abstract

The concept of market potential developed by Harris (1954) has several shortcomings but it is very useful in practical work even in the context of the NEG's wage equation. We stress the theoretical and empirical reasons to be careful about interpreting the results when using market potential as an explanatory variable, but we also underline its utility to summarize the whole picture of regional markets accessibility and their spatial distribution. We specially highlight a very important feature of the market potential/market access concept in its foreign or external form (without computing own region's market potential). Namely, external market potential has the ability to capture and depict the interrelation effects from the spatial structure of economic activities. Our preliminary results point out that this variable collects the spatial lag of the regional internal markets and can help to explain the variation of per capita gross value added across European regions better than a spatial lag model.

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1 Introduction

Since 1954's seminal article of Chauncy Harris the concept and measures of "market potential has been widely used in Regional Economics, especially after the theoretical support given to it in the nineties by the New Economic Geography (NEG).

The nominal wage equation of the NEG uses a concept related with the one developed by Harris, with some differences that will be commented bellow. Empirical specifications close to NEG approaches use gravity equations to estimate market potential, in a way certainly different from Harris's measure. However, when working at regional level there are a number of data restrictions, forcing to work with additional assumptions. For instance, in their estimations for the European regions Breinlich (2006) or Head and Mayer (2006) have to assume that the export behaviour of each region is the same than the export behaviour of its country. Additionally, Breinlich (2005) obtains the same explanatory power using the gravity equation approach than using the simple Harris`s approach.

In spite of its theoretical limitations, Harris's approach continues to be useful and two of the authors of this article have used it widely in previous work[1]. That is the reason why we focus here on its difficulties and oin the need of being careful when interpreting some results. We discuss it in the context of the NEG's wage equation, and with particular attention to empirical applications working with regional data.

But, apart from this, there is an additional aspect in the concept of market potential, which has not been sufficiently highlighted in the literature. When we distinguish internal and external market potential, called foreign market potential by Brakman et al (2009b), there is a close relation between the spatial structure of economic activity and the measure of external market potential. We devote the rest of the paper to discuss it.

[1] See, for instance: Faina and Lopez-Rodriguez (2006 a,b and c; 2008); Lopez-Rodriguez (2007); Lopez-Rodriguez and Faina (2004, 2006, 2007); Lopez-Rodriguez, Faina and Lopez-Rodriguez (2007); Lopez-Rodriguez, Faina and Garcia (2007).

In section 2 we remind the original approach developed by Harris. Section 3 deals with the role of “market potential” in the nominal wage equation of the NEG, and with the differences and empirical problems with respect to Harris’s measure. In section 4 we comment on some contributions of Spatial Econometrics literature. Section 5 starts our exercise providing a big picture of the market potential in European regions at the same time that discussing why external market potential should be considered separately in a regression. In section 6 we show the spatial structure the European Gross Value Added per capita as represented by a global trend. Finally, in section 7 we make a simple econometric exercise comparing the results of an estimation of a spatial lag model including external market potential. Section 8 concludes.

2 Regional Economics: Harris’s Market Potential

The concept of “market potential” (MP), widely used in Regional Economics, was developed by Chauncy Harris (1954). The market potential of a point (region r) is defined as the summation of markets (M) accessible to r divided by their distances from that point r. Considering n possible (regional) markets, Harris’s Market Potential is defined as:

$$HMP_r = \sum_{s=1}^{N} \frac{M_s}{d_{rs}}$$

where the distance to the own regional market (d_{rr}) is measured by within region distances[2]. Harris claims that the term market potential, suggested by Colin Clark, is analogous to that of population potential as proposed by Jonh Q. Stewart (1947). The concept is derived ultimately from physics, as in similar formulas for the strength of a field, whether electrical, magnetic or gravitational. Therefore the indicator is inspired by the gravity equation. In fact, a later paper by Clark has the title “Demographic Gravitation”, but there have been applications of Newton’s theory of gravitation in “social physics” since the nineteenth century, including those in Economics during the first third of twentieth century.

[2] The later literature usually considers an adjustment for the distance to own regional market based in the area of the region.

Harris´s main interest was to develop and map a measure of the market relevant for the location of industries. He collected data on counties to give the value of M in previous equation. His measure of the MP for each city (county) “is an abstract index of the intensity of possible contact with markets” for goods:

> *“Market potential appears to gauge the possible spatial interaction between producers and markets, of the likely flow of goods from a point to accessible regions. A number of studies indicate that freight movement as well as many other types of relationships between any two points varies directly with their size and inversely with their distance apart. Actually there is a complex hierarchy of distribution areas from any given city; some products may have national or international distribution, others regional, and many local only. The aggregation of these various distribution areas results in a large volume of local and nearby movement with amounts decreasing with distance (...)”*

It is convenient to remark two ideas in Harris’s original approach. First, in order to measure the over-all market for goods (the values of M) he used figures for retail sales. His paper has many references to demographic studies, including some about the relationship of population and distance in retail trade. So maybe he could have used population instead of retail trade to measure the size of the markets. However, Harris was interested in a general description of the market potential of each city. He used data on retail sales in a particular year. He did not estimate any equation using time series, so he did not discuss how to deal with changing prices to measure changing market potentials. Given the type of data he used, many year later, the New Economic Geography (NEG) will call Harris’s measure nominal market potential (NMP) to distinguish it from the real market potential (RMP) derived in its wage equation, which includes a price index. We will come back to this below.

A second remark about HMP is related to the measure of distance. Already in his seminal paper, Harris claims that for this purpose transport cost is superior to sheer miles. He avoids tabulating individual routes assuming that the shortest distances on a map are proportional to actual route miles. But he estimates carefully total transport cost, including railroad terminal costs, truck delivery costs, water transportation terminal costs and running costs per ton-mile. Later literature frequently quotes Harris but uses physical distance to measure MP, forgetting Harris’s effort to avoid using only physical distances. Given data restrictions, proxying with physical distances can be appropriate, particularly in the context of multicountry estimations. This is certainly what we do in this paper. But it seems worthy to remember that this is not what Harris does. And the discussion becomes more relevant when trying to estimate the NEG's wage equation, where transport cost is a specific parameter of NEG's concept of MP, as we will see below. Quoting Harris to proxy NEG's MP with physical distances inverses is misleading or at least, it is not accurate. In these cases, the literature is proxying NEG´s trade costs with physical distances using a Harris measure which was truly developed with trade costs. Even in this case, physical distances can be useful, but it is convenient to explicit the underlying assumption of homogeneous trade cost per unit among observations and distances. For instance, with multi country estimations it is harder to work with good data about trade costs but it is good to remember that the previous assumption of identical trade costs is strong (Anderson and van Wincoop, 2004). Additionally, Bosker and Garretsen (2010) call for a much more careful treatment of trade costs in future empirical NEG studies, because of the specification of trade costs can matter a lot for the conclusions reached, as we will mention later again.

We do not address here the issue of transport costs. But this remainder allows us to introduce the terminological and conceptual dispersion surrounding this topic. We will show later other aspects of this dispersion, sometimes even somewhat confusing.

3 New Economic Geography: wage equation and Real Market Potential

The concept of market potential has been received a strong theoretical foundation within the models developed in the New Economic Geography (NEG) literature (Krugman 1999a; Krugman 1991b; Fujita et al. 1999). The Krugman's general equilibrium setting provides microeconomic foundations to the ad-hoc formulation and physical analogies of Harris's Market Potential function (see Brakman et al. 2009a or Combes et al. 2008).

The most estimated prediction of the NEG is the wage equation. The theoretical framework has been shown many times[3] and here we just write the final equation, following Brakman et al. (2009b) and Combes et al. (2008).

The NEG's wage equation explains the equilibrium industrial nominal wages of each region r (W_r) as a function of the sum, for all the s regions to which industrial goods are exported[4], of the product of two elements. On one hand, their respective volume of demand to region r ($\delta_s E_s$, being E_s the expenditure and δ_s the share of income spent on manufacturing goods in region s), weighed respectively by their prices index (P_s) properly adjusted. On the other hand, it is the transport costs from region r to the destiny s (T_{rs}), to the power of one minus the elasticity of substitution among the varieties of industrial goods (σ) or range of product differentiation:

$$W_r = \left[\sum_{s=1}^{R} \mu_s E_s P_s^{\sigma-1} T_{rs}^{1-\sigma}\right]^{1/\sigma} = [RMP_r]^{1/\sigma}$$

The term RMP stands for the real market potential (RMP) with reference to the pioneering work of Harris. Similarly, the RMP of region r is a measure for the degree of accessibility to the overall set of markets available to firms located in region r. This is why Redding and Venables (2002, 2004) prefer the expression "market access" (MA) instead of RMP. Using the idea of MA these authors distinguish the channel of consumption from the concept of "supply access", which conveys the proximity of a firm to its suppliers of intermediate inputs. This effect is similar to the traditional notion of physical origin, so Head and Mayer (2004) name it effect "supply potential".

Here we are not distinguishing income (Y_s), relevant for consumption goods, from expenditure (E_s), relevant for intermediate goods, so we focus on the main relation between NEG and Harris's formulations. To maintain continuity with prior work (from

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[3] See, for instance: Head and Mayer (2011); Lopez-Rodriguez et al. (2007); Breinlich, (2006); Hanson (2005); Head and Mayer (2004); Redding and Venables (2004); Redding and Schott (2003).

[4] Note that in the nominal wage equation the whole set of regions is named R while in the HMP function we used the notation N. With this we try to differentiate that the equilibrium wage equation is given by trade, but in Harris formulation there are a potential demand affecting the location decision of the firms. So R and N could not be the same. This is related with the sample problems of omitting zero trade relationships when estimating gravity equations (see the recent review of Baldwin and Harrigan, 2011). However, we will not address more the possible differences of R and N.

Harris, 1954, to Fujita et al. 1999), Head and Mayer (2004) employ the term real market potential. The “real" is added in order to contrast it with an alternative formulation that the authors refer to as “nominal market potential” or $NMP_r = \sum_{s=1}^{R} \mu_s E_s T_{rs}^{1-\sigma}$. The “nominal" refers to the absence of an adjustment for variation in the price index term P_s. The authors conclude that under certain assumptions and using aggregate measures of demand such as GDP or retail sales, the NMP is proportional to the original formulation of market potential used by Harris (1954) and in subsequent work of geographers. We comment below on this terminology.

As summarized by Combes et al. (2008, page 305), to derive the expression proposed by Harris from the RMP defined above, we must make three additional assumptions:

1) The term of trade costs becomes $T_{rs}^{1-\sigma} = {d_{rs}}^{-\lambda}$ and $\lambda = 1$. This last assumption can be justified by estimations of gravity equations given values of λ close to 1.

2) The share of income spent on manufacturing goods is the same across regions. Regarding the expenditure on intermediate goods, this implies the strong assumptions that either all sectors use the same amount of each factor, or regional sectorial compositions are the same.

3) The price index (P_s), present in the RMP, disappears in Harris formulation. An increase in the number of competitors located in a given destination fragment demand, which in turns implies a decrease in the corresponding RMP. Harris's market potential does not take into account this effect to explain a particular site's profitability.

This last point, also stressed by Brakman et al. (2009b, page 211), is the reason why Head and Mayer (2004) use the name of nominal market potential (NMP). Below we point out that this terminology can be “potentially” misleading.

Anyway, Harris’s market potential is at best a rough approximation of the NEG´s RMP. Given that we and other authors use this approximation for practical reasons, it is worthy to extend the discussion about these three assumptions to go from RMP to Harris’s market potential (HMP):

1) It is said that when using HMP instead of RMP we are assuming $T_{rs}^{1-\sigma} = d_{rs}^{-\lambda} = d_{rs}^{-1}$. This could be translated as trade costs as a constant proportion of physical distance for all regions and a elasticity of substitution among varieties $\sigma = 2$. However, as we discussed in section 1, Harris (1954) did not use physical distances. Therefore, we should not appeal to Harris in order to use inverse physical distances. There is a long tradition in several fields using the inverse of physical distances, and Harris himself analyses this argument for his topic, but he chooses to estimate trade costs (of course, with data on distances too). Physical distances still can be useful but we have to be careful about putting this in Harris's words. The measures of HMP should be improved in the original spirit of Harris.

Second, it is no clear that a distance decay parameter $\lambda = 1$ should be a good approximation. The argument in Combes et al. (2008), or Head and Mayer (2004) about findings in the literature of gravity equations of a value of $\lambda = 1$ is under debate. As already noted, the work of Bosker and Garretsen (2010) emphasizes how the specification of trade costs changes the results. For instance, an exponential specification such as $eMP_r = \sum_{s=1}^{R} M_s e^{-\lambda d_{rs}}$ produces a strong distance decay (see for instance, Hanson 2005 or Brakman et al. 2009b, page 212), as discussed by Bosker and Garretsen (2010). This has been criticized on the basis of argument raised in the transport economics literature. But comparing cross sections analysed in different studies Niebuhr (2006) provides an alternative explanation to the one about functional form. The pronounced differences in the geographic extent of demand linkages could be a consequence of the regional system under consideration, in particular of the average size of the observational units. The size of the estimated distance decay seems to increase with the declining size of regions. This might imply that the nature of spatial effects detected in studies working at different NUTS level with EU regional samples would not be the same.

Again, this is a fresh field of study which is not an obstacle for assuming $\lambda = 1$ to get a broad initial picture.

2) To go from the direct demand effect of exports on the wages of regions r to the Harris's function of market potential we need the strong assumption of equal share of

income spent on manufacturing across regions. Normalizing $\mu_s = \mu = 1$, we have: $RMP_r = \sum_{s=1}^{R} E_s P_s^{\sigma-1} T_{rs}^{1-\sigma}$. Therefore, in the NEG's wage equation, nominal wages of region r become a function of its "potential" (total) demand (expenditure) from all regions.

We have here the issue of the sectorial composition of each region and its relation with what it was called above "supply market potential". Besides, we have the familiar issue in trade literature with non-tradable goods, and its effects on the purchasing power parity of each currency. Again, the use of a Harris's type market potential can provide useful insights, but we have to be very careful in order to interpret them in terms of NEG's nominal wage equation.

3) The absence of prices in Harris's formulation has been considered as its main difference with the "real" market potential in the New Economic Geography. But the term "nominal market potential" (NMP) to describe Harris's formulation is potentially misleading and has already confused some researchers.

As we emphasized in section 1, Harris used a nominal variable, retail sizes, to measure the potential size of the each regional market. But he used data on just one year, he did not work on how changes of prices would affect the locational decisions of the firms. But when using regional data, price indices are typically not available. For instance, when working with Cambridge Econometrics data, as we do, there data on regional real GDP or regional Gross Value Added. Some researches use this data and still claim to be calculating "nominal" real potential Harris's style. This is clearly wrong.

Therefore, we distinguish Harris's market potential as:

$$HMP_r = \sum_{s=1}^{R} \frac{M_s}{d_{rs}} = \sum_{s=1}^{R} \frac{E_s/P_s}{d_{rs}} = \sum_{s=1}^{R} E_s\, P_s^{-1} d_{rs}^{-1}$$

where the price index makes a clear difference from the nominal market potential (with $\mu_s = 1$):

$$NMP_r = \sum_{s=1}^{R} E_s T_{rs}^{1-\sigma}$$

When estimating for a single year, as Harris does, all price indexes would refer to that year so HMP_r becomes exactly the same than the one proposed by Harris, deflating does not alter nominal values in the base year. But when using time series with regional data on real income or value added (at the base year prices), we are working with HMP_r, not with NMP_r. Comparing HMP_r with its equivalent in the NEG:

$$RMP_r = \sum_{s=1}^{R} E_s P_s^{\sigma-1} T_{rs}^{1-\sigma}$$

in HMP_r we are making the assumption $P_s^{\sigma-1} = P_s^{-1}$ so the constant elasticity of substitution among industrial goods is $\sigma = 2$. With this last assumption, we are assuming $T_{rs}^{-1} = d_{rs}^{-1}$. With a version of HMP_r we can estimate non-linearly the distance decay parameter, as Niebuhr (2006). Forgetting now the issue of the functional form, we can write HMP_r as $\sum_{s=1}^{R} E_s \, P_s^{-1} d_{rs}^{-\lambda}$ and estimate it with regional real income or gross value added. In this case, we are assuming $P_s^{\sigma-1} = P_s^{-1}$ $(\sigma = 2)$ but the assumption about trade costs is slightly different: $T_{rs}^{1-\sigma} = T_{rs}^{-1} = d_{rs}^{-\lambda}$. Data availability about transport cost can justify this general approach, but there are a research agenda to improve it, even with gross adjustments for each type of region.

There are three additional points to comment:

4) The strength of NEG is that it is a general equilibrium setting. So the price indexes in the nominal wage equation are endogenous. In fact, location is endogenous, as Harris intuited, ruled by increasing returns in what it is called “the home market effect” (see the estimation of Davis and Weinstein 2003 or Head and Mayer 2006). The literature shows how a region's RMP depends on the location choices of agents (migration, FDI...). We do not address here the issue of the endogeneity of RMP but focus on the preeminent role that literature gives to market potential as an explanatory variable. But it is worthy to note that taking as given the regional potential real expenditure is a poor test of the NEG, particularly when working with long time series.

5) Another issue is the election of the endogenous variable to estimate the wage equation. A number of articles use real GDP per capita instead of compensation per employee or a similar variable closer to the concept of nominal wage. Again, data availability can recommend this use but the underlying assumption must be made explicit, particularly in the light of the previous discussion about real, nominal, and Harris's market potential. Additionally, some kind of empirical evidence about the general relation between real GDP per capita and nominal wages should be provided.

6) A final point is about the explanatory variables in an equation of nominal wages in terms of the NEG´s RMP or in terms of HMP. On one hand, there are other possible determinants of wages. For instance, human capital density (Breinlich 2006). Again the problem of endogeneity appears (Hering and Poncet 2009; Lopez-Rodriguez et al 2007). Apart from fixed time and country effects, a number of other issues related with the own definition of market potential has been addressed, as differentiate between own demand and foreign demand or to estimate border effects. We do not address here this research agenda to focus on the most general approach to the NEG equation.

After the discussion of previous issues, we still defend that Harris's market potential can provide useful insights, even in a wage equation, but been very careful with its interpretation in terms of the NEG. So taking natural logarithms in the NEG's wage equation:

$$\ln W_r = \frac{1}{\sigma} \ln RMP_r$$

And considering the omission of other possible determinants of the nominal wages, and the assumptions needed to proxy RMP_r by HMP_r we can estimate (see a full derivation in Brakman et al. 2009b, including a theoretical justification for the constant parameter β_0):

$$\ln W_r = \beta_0 + \ \beta_0 \ln HMP_r + \epsilon_r$$

However, in the rest of the paper we show how this measure has another aspect. The concept of market potential is related with the spatial structure of the economic activity and, therefore, with spatial autocorrelation in regression models.

4 Spatial Econometrics and Spatial Autocorrelation

The spatial structure of the economic space, as studied in the Harris-NEG tradition is closed linked to the concept of spatial autocorrelation studied by Spatial Econometrics. Durbin (2008) claims that while autocorrelation in a time series context is well understood, and researchers routinely test and correct for this problem, the same cannot be said of autocorrelation in a cross-sectional context. The consequences of spatial autocorrelation are the same as those of time series autocorrelation: the OLS estimators are unbiased but inefficient, and the estimates of the variance of the estimators are biased. Thus, the precision of the estimates as well as the reliability of hypotheses testing can be improved by making a correction for autocorrelation. As Getis (2007) says, the special effort to discern spatial autocorrelation makes identifying temporal autocorrelation a relatively simple job compared to the same task for spatial autocorrelation. The multidimensional nature of spatial autocorrelation, i.e., the need to search in all directions as opposed to the one-way temporal direction, is one complicating factor.

Spatial Econometrics uses a spatial weight matrix W to capture the spatial links, and it is the use this particular matrix what links directly Spatial Econometrics with the concept of market potential and its matrix of (adjusted) inverse distances. This is more generally related with de estimation of externalities (Anselin, 2004). There is a number of estimations using these techniques in the context that we are discussing.
Kosfeld and Eckey (2010) study autocorrelation in the NEG equation applied to the German regions. Fingleton (2009) compares the predictions of the NEG equation using panel data, for UK regions, with the results provided by an Urban Economics approach. Ertur and Koch (2007) build and estimate a neoclassical growth model with human and physical capital externalities and technological interdependence among countries. Certainly, these estimations may be reflecting the spatial structure and interactions among regions, making difficult to interpret conventionally their impact of variables proposed by the theoretical models (Tappeiner et al. 2008).

We do not discuss here the alternative models proposed by Spatial Econometrics. But in spatial lag models ($Y = \alpha I + \rho WY + \varepsilon$) there are similarities with the Harris concept of Market Potential. When the variable Y represents a regional macro-magnitude (GVA, GDP, aggregate demand and the like) the spatially lagged variable, WY, becomes similar to Harris' MP and measures the same concept if the weights matrix W is formed by the reciprocals of regional distances.

Global tests for spatial autocorrelation assume that the spatial process is the same everywhere. The most common test for spatial autocorrelation is the Moran's I. Following Bivand et al (2008), Moran´s I is calculated as a ratio of the product of the variable of interest and its spatial lag, with the cross-product of the variable of interest, and adjusted for the spatial weights used:

$$I = \frac{n}{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} \, (y_i - \bar{y})\,(y_i - \bar{y})}{\sum_{i=1}^{n} \left(y_i - \bar{y}\right)^2}$$

where y_i is the ith observation, $\bar{y}$ is the mean of the variable of interest, and w_{ij} is the spatial weight of the link between i and j. Centering on the mean is equivalent to asserting that the correct model has a constant mean, and that any remaining patterning after centering is caused by the spatial relationships encoded in the spatial weights. The authors show that even a gentle global regional trend induces apparent spatial autocorrelation in the Moran's indicator, unmasked when a correct model is fitted.

With this discussion we try to show that a measure of market potential, by its own construction, might be collecting a spatial structure of the data induced by multiple generating processes. This would mean that more care would be necessary when interpreting the results of estimation in terms of the NEG's core model.

5 Market Potential in the European Regions

One additional problem of measuring market potentials is that their size is relative to the regions included in the sample. The estimations of market potential in the border regions might be biased because of the omission of their out of sample neighbors. For instance, when the set of regions under study is EU-27, the calculation of market potential does not treat equally the case of Galicia, in the north-west coast of Spain, than the case of Western Slovenia, which is close to the out of sample Croatia and not far from the out of sample Switzerland. This sample border effect, sometimes called edge effect, could be an advantage in policy oriented analysis about the EU internal market but sample selection can produce a false picture of the accessibility of some region to world markets. A common compromise solution is to remove from the sample the Outermost Regions, which are far from everywhere else. These regions are listed in Article 349 of the Treaty on the Functioning of the EU: the French Overseas Departments (Guadeloupe, French Guiana, Martinique, Réunion, Saint-Barthélemy, Saint-Martin), the Azores and Madeira (Portugal) and the Canary Islands (Spain). We could add some other special cases, as Cyprus, in the extreme East of the UE, but part of the referred sample border effect is going to remain in the calculations of market potential.

With this reflection we try to remind that when “market potential” is included in a regression as an explanatory variable, we are estimating average effects of a particular potential market size, the internal market of the regional sample. This seems obvious but has relevant implications. For instance, the most general regressions in the literature, searching for specific causal relationships of any variable with market potential, treat all regions in the same way. Given that regions tend to trade more with other regions in the same country, there is a more specific literature trying to estimate this trade border effects: Head and Mayer (2011); Huber et al. (2011); Niebuhr (2006) or a number of national level studies. But even in this literature when focusing on particular samples, as the European Union, it can be relevant the fact than some regions can trade relatively more with close non EU regions than with further apart (outermost) UE regions.

In order to reduce this effect we work here with a sample of EU-27 countries plus Norway and Switzerland. We use Cambridge Econometrics data at NUTS 2 level and we have eliminated Cyprus, the Outermost regions and the Spanish Ceuta and Melilla, in the African Coast. Our sample is composed by 275 regions and we reduced the time series to the period from 1991 to 2008, to keep the homogeneity of the sample.

We are going to show some estimations of total market potential in Europe, using real Gross Value Added (GVA, millions of 2000 euros) as the measure of the size of the market. Therefore, this measure is the sum of the internal (IMP_r) and the external market potential (EMP_r):

$$HMP_r = \sum_{s=1}^{R} \frac{GVA_s}{d_{rs}} = \frac{GVA_r}{d_{rr}} + \sum_{(s \neq r)=1}^{R} \frac{GVA_s}{d_{rs}} = IMP_r + EMP_r$$

To estimate the total Market Potential of each region, we have used here the matrix of distances calculated by Cambridge Econometrics[5]. The internal economic potential of region r is added to the external economic potential to obtain the total economic potential of region r. This requires a measure of distance from region r to "itself", in the same way that external economic potential requires the distance between regions r and s. As usual in the literature, the internal economic potential at the centre of a uniform circular disc is assumed to be equal to the Gross Value Added of the disc divided by half the radius. The internal distance is therefore a fraction of the radius of a circle of the same area as the NUTS-2 region. Instead of 0.5, Cambridge Econometrics takes a smaller proportion of the radius, 0.4. Economic activity that is more concentrated than a uniform distribution increases economic potential, and the likely peaking of activity is allowed by taking a proportion of the radius smaller than 0.5.

Therefore, the distance from a region to itself is modelled as being proportional to the square-root of the regional area. It is worthy to retain this calculation (here using 0.4 as Cambridge Econometrics)

$$d_{rr} = 0.4\sqrt{\frac{area_r}{\pi}}$$

Now, see the differential role of distances in the internal (IMP_r) and external market potential EMP_r:

$$IMP_r = 2.5\sqrt{\pi}\frac{GVA_r}{\sqrt{area_r}} \approx 4.43\frac{GVA_r}{\sqrt{area_r}}$$

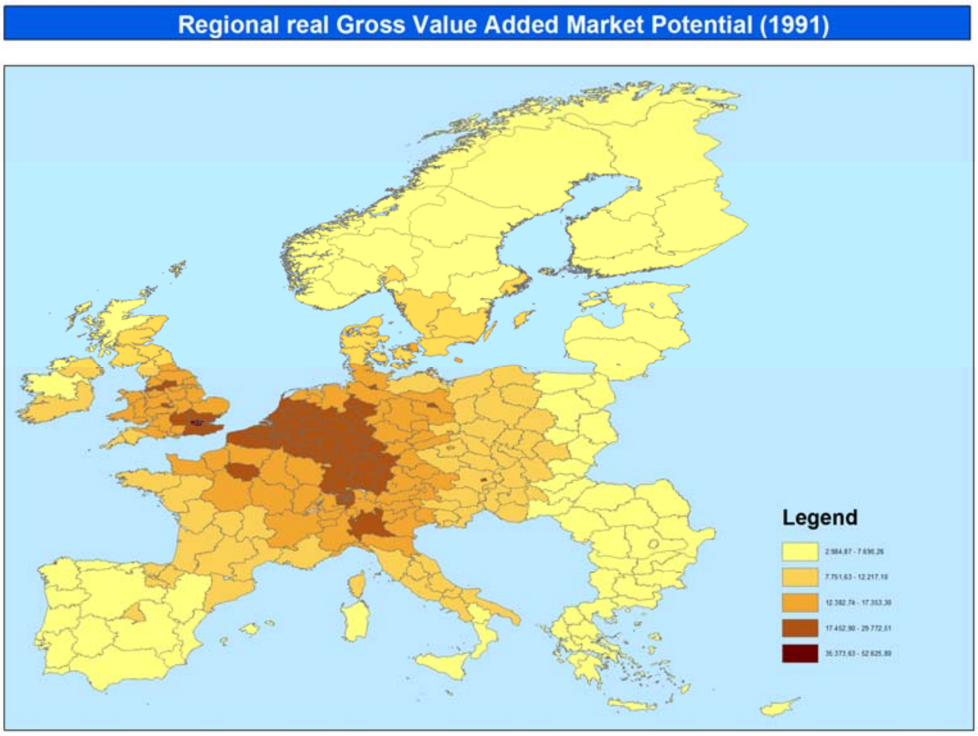
This measure of internal market potential is related with the idea of GVA density $\frac{GVA_r}{area_r}$. The multiplicative term would be 3.55 instead of 4.43 using 0.5 in the definition

5 http://www.camecon.com/Europe/Regional_Local_Cities/KnowledgeBase/Appendices/EuropeanEconomicModel/ModelOverview.aspx

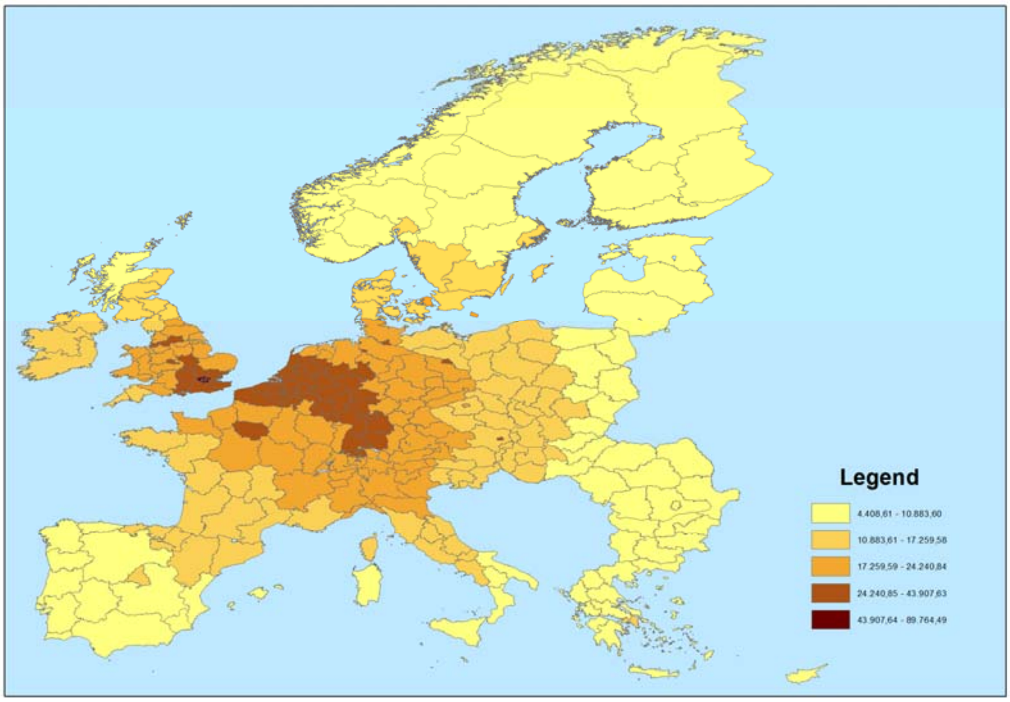
of the regional own distance. In any case, we are making strong assumptions to sum up internal and external market potential.

For empirical estimations it seems more appropriate to allow separate estimation of the parameters of internal and external market potential, as it is done below. However, putting together both measures under a same variable it is convenient to map regional market potential in a simple way. This is one of the reasons why Harris's market potential is an attractive measure to identify the big picture.

We measure HMP with real GVA in a sample period 1991-2008 for 275 European regions NUTS 2 level. On one hand this was a period of EU enlargement which would increase the integration of regional markets. On the other hand, it is a period of increasing integration of the EU members and reduction of transport costs and trade barriers. In spite of all that, our measures of HMP for the initial and final periods do not show increasing regional concentration, as the NEG would predict.

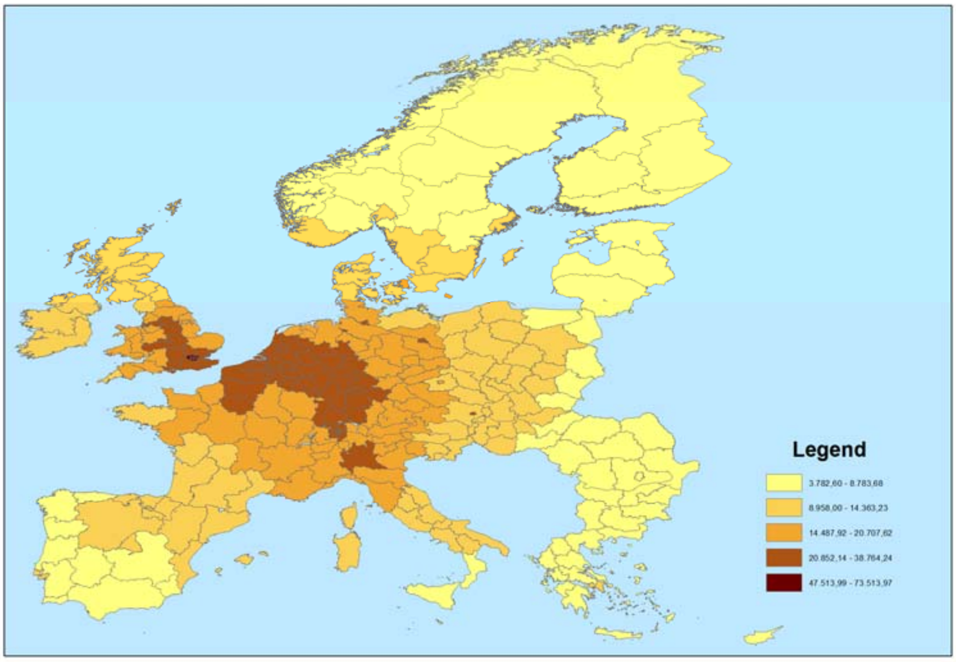


Regional real Gross Value Added Market Potential (2008)

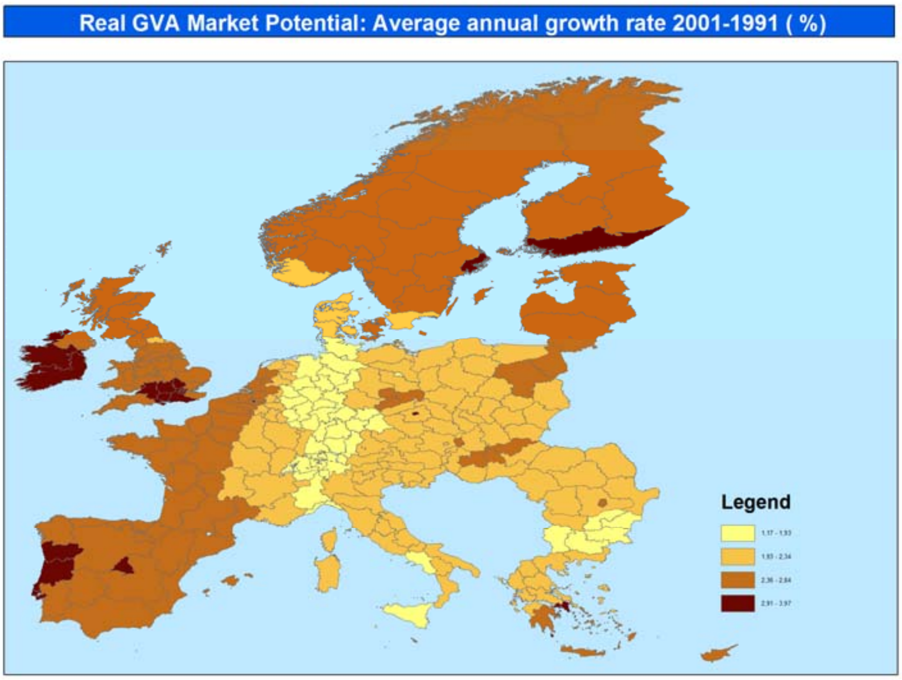


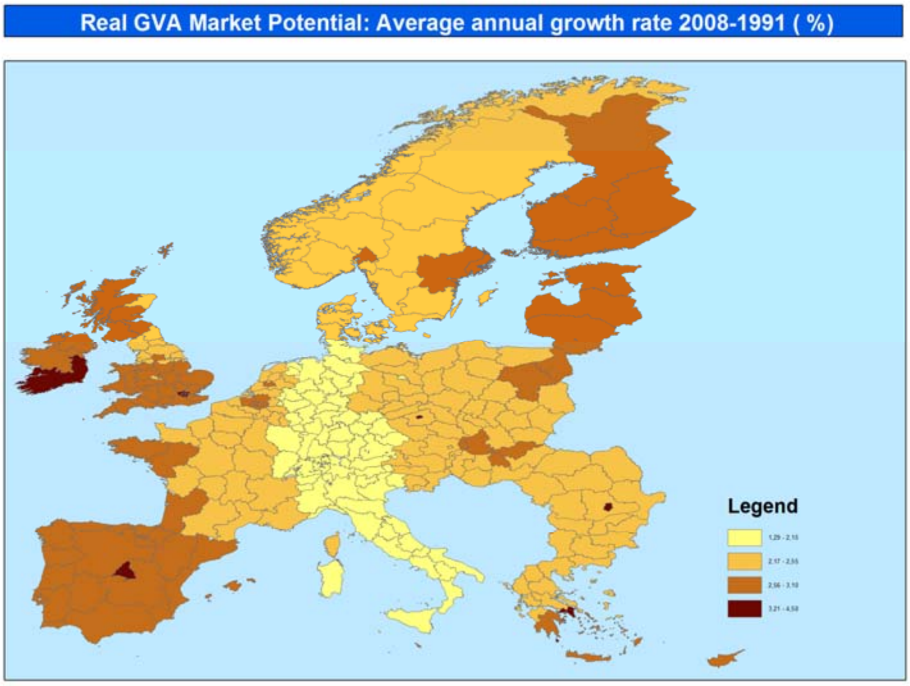
In the intermediate periods, some changes were relevant, as shown by the 2001 figure of real GVA market potential.

Regional real Gross Value Added Market Potential (2001)



The period from the year 1991 to the 2001 seems to be a period of higher reduction of the European concentration, compared with the following years until 2008.





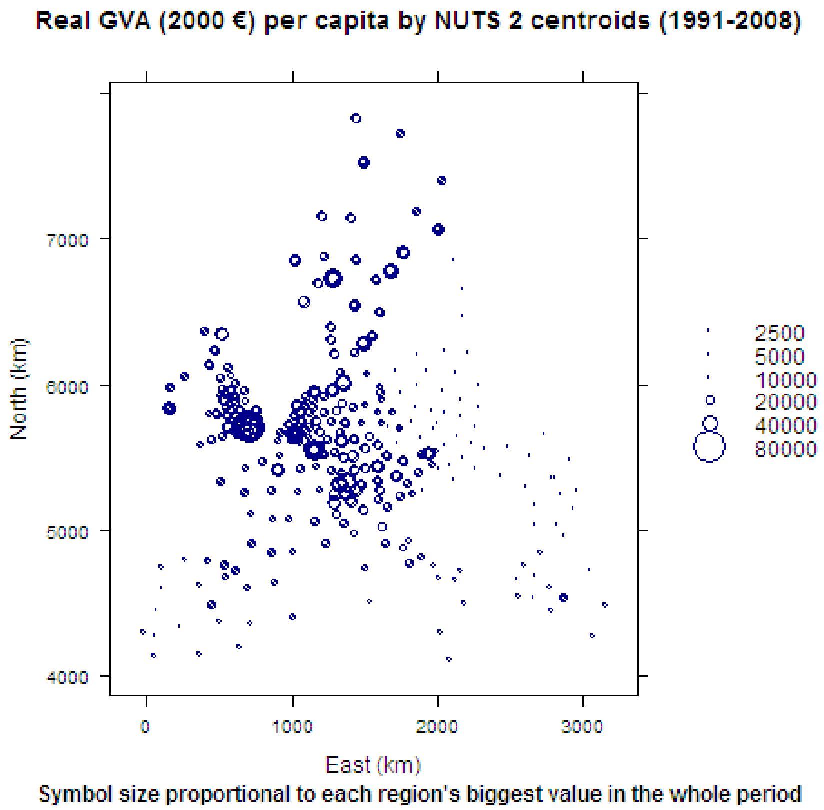
This gives us a fast overview of this measure of the regional market potential in Europe during the sample period, in order to continue with our exercise.

6 Spatial dependence in the European GVA per capita

To explain uneven spatial distribution of economic activity, urban economics stresses regional specific agglomeration economies, while the NEG stresses the role of spatial linkages. The empirical application of Brakman et al. (2009b) tests what channel is more important in a European sample at regional and country levels.

Their endogenous variable is GDP per capita. This is due to data limitations, and is common in the literature (see Redding and Venables, 2004). In order to compare the procedure we use a similar variable, real GVA per capita. Additionally, in spite of what we have said about using real income or value added per capita to estimate the NEG's wage equation, data on regional real GVA per capita is more robust than data on nominal compensation per employee and do not want to introduce unnecessary noise in order to make a few simple points. On the other hand, though this exercise is an indirect test of the NEG's wage equation, more than testing this equation right now we are more interested in the spatial structure of the main indicator in Economics, real income (or here GVA) per capita.

The estimation of Moran's I for this variable shows that the data exhibits spatial autocorrelation. The following plot of the regional centroids shows the distribution of regional real GVA per capita in the sample period through the size of the symbol in each region. We can see some bigger symbols in the same areas where market potential was high though there are differences, especially for northern countries. The figure shows a possible global regional trend in the regional European map of GVA per capita.



As we said in section 4, the analysis of spatial local autocorrelation is sensitive to the existence of a regional global trend. He have estimated a global second order trend surface of natural logarithm of per capita GVA en our sample. All parameters are meaningful. The residuals of the estimation of the global European second-order regional trend are normally distributed. But, the distribution of under-estimations or over-estimations has spatial pattern.

7 An econometric exercise

Now we undertake an econometric exercise estimating a spatial lag model of the regional log of per capita GVA for a single year, 2005. The idea is to check if the variable of external market potential captures the spatial links of the internal market.

In this exercise we have used a distance-based binary weights matrix W to estimate a spatial lag model. To control for endogeneity, the spatial lag of the endogenous variable is estimated by instrumental variables (spatial lag IV regression). The spatial lag of the log of per capita GVA does not result statistically meaningful. The table compares this estimation with one OLS estimation without spatial lag (OLS regression).

Cross-region regression, year 2005
Dependent variable: ln (GVA per capita)

	Spatial lag IV regression		OLS regression	
	Coefficients (St. errors)	p-values	Coefficients (St. errors)	p-values
W*ln (GVA per capita)	0. 011 (0. 100)	0.910		
ln (EMP)	0. 208 (0. 100)	0.038	0.203 (0.099)	0.042
ln (GVA density)	0. 279 (0. 029)	0.000	0.282 (0.029)	0.000
Constant	7. 328 (1. 224)	0.000	7.493 (0.922)	0.000
$\bar{R}^2$	0.465		0.458	
Observations	270		275	
Instrumented:	W*ln (GVA per capita)			
Instruments:	ln (EMP), ln (GVA density), W*ln (EMP), W*ln(GVA density)			

The external market potential seems to collect the spatial structure of per capita GVA more than the spatial lag of per capita GVA. The argument is as follows. The external market potential is built using inverse distances, so for each region it collects the GVA of its neighbours in a similar way as a spatial lag of internal markets would do. In our estimation, the internal markets are proxied by GVA density, which represents the intrinsic regional factors affecting regional per capita GVA and it has the virtue of having less endogeneity problems. So, when considering both density and external market potential, the spatial lag of per capita GVA is not significant.

In the first stage of the IV estimation (not reported here), the spatially lagged density of GVA is the only significant variable in estimating the spatially lagged per capital GVA. Spatially lagged GVA density is very close to external market potential (EMP), in fact if all regions had the same area it would proportional to EMP when computed with an inverse distance matrix. To a great extent EMP captures the effect of the spatially lagged regional GVA density that’s the reason why OLS regression provides similar results as the more sophisticated spatial lag model.

In any case this estimation does not totally eliminate the spatial structure of the dependent variable, as measured by the Moran's I of the residuals.

This preliminary result calls for more research and attention to the ability of external market potential to explain the spatial structure of economic activities.

8 Conclusions

The concept of market potential developed by Harris (1954) has several shortcomings. We reviewed them and presented different lines of the research agenda. In the context of the NEG`s core model and its nominal wage equation, jumping from real market approach to Harris's approach requires several assumptions but Harris's market potential has several strengths too. In this article we adopt the regional perspective to review the Harris's concept of market potential and recommend being careful when using market potential as an explanatory variable. We also discuss how this concept, in its version of external market potential, is related with the spatial structure of economic activity. Our preliminary estimation uses a spatial lag model with external market potential to explain the spatial structure of the per capita real gross value added in the European regions. The spatially lagged endogenous variable does not result meaningful when external market potential is included because this variable collects the spatial lag of the regional internal markets. More work is needed to clarify the role of the external market potential in explaining the spatial structure of economic activity.

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