Universität Hamburg

Faculty Economics
and Social Sciences
Chair for Economic Policy

GABRIEL AHLFELDT / ARNE FEDDERSEN

DETERMINANTS OF SPATIAL WEIGHTS IN SPATIAL WAGE EQUATIONS: A SENSITIVITY ANALYSIS

Urban
Transport
Media
Sports
Socio-
Regional
Real Estate
Architectural

HAMBURG CONTEMPORARY ECONOMIC DISCUSSIONS

No. 22

Hamburg Contemporary Economic Discussions
University of Hamburg
Faculty Economics and Social Science
Chair for Economic Policy
Von-Melle-Park 5
D-20146 Hamburg | Germany
Tel +49 40 42838 - 4622
Fax +49 40 42838 - 6251
http://www.uni-hamburg.de/economicpolicy/

Editor: Wolfgang Maennig

P. Gabriel M. Ahlfeldt
University of Hamburg
Faculty Economics and Social Science
Chair for Economic Policy
Von-Melle-Park 5
D-20146 Hamburg | Germany
Tel +49 40 42838 - 5569
Fax +49 40 42838 - 6251
ahlfeldt@econ.uni-hamburg.de

Arne Feddersen
University of Hamburg
Faculty Economics and Social Science
Chair for Economic Policy
Von-Melle-Park 5
D-20146 Hamburg | Germany
Tel +49 40 42838 - 4628
Fax +49 40 42838 - 6251
feddersen@econ.uni-hamburg.de

ISSN 1865 - 2441 (Print)
ISSN 1865 - 7133 (Online)

ISBN 978 - 3 - 940369 - 64 - 2 (Print)
ISBN 978 - 3 - 940369 - 65 - 9 (Online)

Gabriel M. Ahlfeldt & Arne Feddersen

Determinants of Spatial Weights in Spatial Wage Equations: A Sensitivity Analysis

Abstract: Recent empirical tests for a spatial wage structure have confirmed regional accessibility to be a significant determinant for income, although estimates vary considerably with respect to the geographic scope of estimated demand linkages. Our study is the first to estimate spatial demand linkages for a set of more than 1,300 European NUTS 3 regions (U.S. county equivalent) based on effective road travel times. We conduct a series of more than 200 estimations on the basis of the Harris Market Potential Equation in order to evaluate the estimates' sensitivity to various model alterations in a meta-analysis. In line with the distinct spatial interactions captured at different levels of aggregation, our estimates reveal lower average travel costs when data aggregated to larger geographic units are used. The largest sensitivity, however, is found for sample restrictions to a limited geographic coverage, which is likely to account for the inconsistent results available in the literature.
Keywords: Market Potential, Nominal Wage Equation, New Economic Geography, Sensitivity Analysis
JEL classification: F15, R12

Version: June 2009

1 Introduction

There is a well-developed body of theoretical New Economic Geography (NEG) literature explaining why economic activity tends to concentrate in regional agglomerations.[1] The driving forces of concentration into cities and regions according to most of these theories are scale economies and transport costs (FUJITA, KRUGMAN, & VENABLES, 1999; KRUGMAN, 1991). Stated briefly, agglomerations attract firms by offering access to large local markets at low transport cost.[2] The history of thought of this reasoning dates back to at least HARRIS (1954), who

---

1 See e.g. NEARY (2001), OTTAVIANO (2003) and OTTAVIANO & PUGA (1998) for an introduction into the literature.

2 Similarly, the role of production economies as an explanation for the intra-city firm location has attracted much scholarly attention. Important contributions include LUCAS (2001) and LUCAS & ROSSI-HANSBERG (2002). Models sharing the same spirit have been developed by BORUKHOV & HOCHMAN (1977), FUJITA & OGAWA (1982), and TEN RAA (1984).

defined the demand for goods at a location as the distance weighted purchasing power of neighboring regions, also called "market potential". An increasing number of empirical studies engages with economic geography models in order to identify structural parameters based on cross-sectional specifications using data from very small units, like counties (HANSON, 2005), to very large units, like countries (REDDING & VENABLES, 2004).[3] REDDING & STURM (2008) go one step further by exploiting Germany's division and reunification as a source of exogenous variation in market potential in order to prove a causal impact on economic performance. They show that the adverse economic performance of West-German border regions during the period of division can be entirely explained by an unexpected loss of access to their former hinterlands. While this promising empirical strategy certainly deserves much attention in further research, comparison of market potential before and after exogenous shocks still raises the question of the spatial scope to be considered. REDDING & STURM (2008) use distance weighted population of German municipalities based on inverse distance weights, which they set up in an ad-hoc manner, to generate a rough market potential indicator. Despite constraints in data availability for the historical period, this simple indicator already yields impressive results.

The empirical investigation of smaller shocks rather than the rare occasion of an unexpected political separation or reunification of an entire country, however, may require more precise indicators of regional accessibility. Besides more disaggregated data and distance or travel time measures taking into account transport infrastructure, empirically founded spatial weights would essentially contribute to an increase in precision. At this point, however, the existing literature fails to provide a clear recommendation. Existing estimates on the spatial scope of regional economic integration range from implausibly low to very large distances that go far beyond what would be in line with an interpretation of the core-periphery model as referring to e.g. urban and rural areas. So far, the literature has discussed the reasons behind the incomprehensive pattern of results based

[3] HEAD & MAYER (2004a), OVERMAN, REDDING, & VENABLES (2003), REDDING & VENABLES (2004) and HANSON (2005) provide highly recommendable reviews of the literature.

more on intuition (HEAD & MAYER, 2004a; NIEBUHR, 2006) than on the basis of a considered empirical evaluation. We try to fill this gap by conducting more than 200 estimates in selectively altered specifications whose results are subject to a meta-regression analysis. Our objective is a) to assess estimates' sensitivity to altering model specifications in order b) to explain inconsistencies in the literature and c) to provide recommendations on plausible spatial discount parameters to be used in further research.

A nominal wage equation building on HARRIS (1954) is chosen as the baseline framework. In this specification, nominal wages driven by labor demand are assumed to be a function of consumer income in neighboring regions, discounted by distance or travel time. From the estimated spatial discount the range of demand linkages can easily be inferred. We favor this simple concept against augmented versions that come closer to the theoretical reference models (HELPMAN, 1997; KRUGMAN, 1991) due to constraints in data availability (consumer prices) and the inappropriateness of some of the underlying model assumptions for the European market area (e.g. perfect labor mobility), which potentially account for the poor performance in previous research (NIEBUHR, 2006; ROOS, 2001).[4] The rest of the paper is organized as follows. Section 2 discusses the background of the relevant NEG literature. Section 3 describes the data and empirical strategy. Section 4 shows the baseline empirical results and derives some stylized facts that serve as a guide line for the econometric meta-analysis conducted in Section 5. Section 6 concludes.

2 Background

During the recent decade, empirical economic geography research has made considerable advances in catching up to theory. HANSON (2005) distinguishes between three major strands of research. One focusing on the location of produc-

[4] Even the structural parameters of the HELPMAN (1997) extension of the nominal wage equation estimated by HANSON (2005) for the U.S. show some implausibilities, e.g. increasing transport costs over time.

tion and exports, which according to KRUGMAN (1980) should concentrate close to large markets (DAVIS & WEINSTEIN, 1999, 2003; HANSON & CHONG, 2004; HEAD & RIES, 2001). Technology diffusion and the impact on trade in industry location, accordingly represent the second backbone of empirical geography research (EATON & KORTUM, 1999, 2002). Finally, the role of access to regional markets as a determinant for economic wealth is receiving increasing attention. Important contributions include REDDING & VENABLES (2004), HEAD & MAYER (2004b) and, of course, HANSON (1996, 1997, 2005). This article clearly fits into the last category, sharing much in common with HANSON (2005), who examines the spatial correlation of wages and consumer purchasing power across U.S. counties from 1970 to 1990. Using a HARRIS (1954) type nominal wage equation, as well as an augmented version based on KRUGMAN (1991), he finds strong demand linkages between regions that are, as he notes, relatively localized.

In recent studies, a significant correlation between nominal wage levels and market potential is also found for Europe, e.g. ROOS (2001), BRAKMAN, GARRETSEN, & SCHRAMM (2000, 2004) for Germany, MION (2004) for Italy and NIEBUHR (2006) for West Europe. The estimated scope of regional economic integration is also relatively narrow in most of these studies. BRAKMAN, GARRETSEN, & SCHRAMM (2000, 2004) find half-life distances of estimated spatial weight functions ranging between 2 and 8 km. ROOS' (2001) respective estimates range from 5 to 30 km. Wondering about the plausibility of such localized demand linkages HEAD & MAYER (2004a) question the appropriateness of the commonly employed exponential cost function. However, NIEBUHR (2006) also employs an exponential cost function and finds much larger half-life distances ranging from 190 to 270 km (150-200 min travel time) for a sample of West European regions on the basis of the nominal wage equation. While she emphasizes that her estimates are supported by studies from different research areas (BRÖCKER, 2003; FÜRST *et al.*, 1999) it is also evident that her estimates imply a rather continental interpretation of what is core and what's periphery.

As a possible explanation for her relatively large estimates on spatial demand linkages, NIEBUHR (2006) notes that her framework refers to a combination of relatively large NUTS 1 and NUTS 2 regions, while ROOS (2001), BRAKMAN, GARRETSEN, & SCHRAMM (2000, 2004), MION (2004) and HANSON (2005) all use more disaggregated data referring to the European NUTS 3 or U.S. county level. However, such an inference on the basis of cross-comparison of different studies naturally remains vague as the empirical approaches differ considerably. Notably, existing studies use either relatively small country samples at a high level of disaggregation (BRAKMAN, GARRETSEN, & SCHRAMM, 2000, 2004; MION, 2004; ROOS, 2001) or large samples at a low level of disaggregation (NIEBUHR, 2006). While indeed HANSON (2005) uses a highly disaggregated dependent variable, the "right-hand side" regions are grouped to 16 distance rings and, hence, are quite aggregated. Every researcher experienced with this type of analyses will understand the researchers' motivation to avoid summation expressions with thousands of exponential terms. Data management and computation requirements are further increased when travel times are used instead of straight-line distances. However, we believe that in light of the fundamental character of the economic phenomenon under investigation and the relevance of reliable estimates for further applied research, it is worth the effort to engage with these technical limitations. Therefore we provide estimates for the European market area, including central and south east European countries at NUTS 3, NUTS 2, NUTS 1 and NUTS 0 levels in order to investigate the inconsistencies observed in the literature. At the same time, we go beyond the current discussion by considering a number of further specification details that have so far remained unconsidered, despite their potential influence. They will be introduced in the section below.

3 Empirical Strategy and Data

The starting point of our analysis is the so-called wage equation (FUJITA, KRUGMAN, & VENABLES, 1999, p. 53) which can be derived from structural relationships of general-equilibrium spatial models:[5]

$$w_i = \left[\sum_{j=1}^{J} Y_j \, e^{-\tau(\sigma-1)d_{ij}} T_j^{\sigma-1}\right]^{1/\sigma} \tag{1}$$

where w_i is the nominal wage in region i and Y_j the income in location j . τ is the unit transport cost and d_{ij} the distance between region i and j. The elasticity of substitution between any pair of varieties is σ and T_j is the CES price index for manufacturing goods available in region j. The general mechanism of this equation is that wages at a location are increasing in the income of surrounding regions and decreasing in transport costs to and from these locations. In turn, a higher wage at location i increases prices for traded goods at location j.

Equation (1) can be translated into a regression equation by taking logarithms:

$$\log(w_i) = \sigma^{-1}\log\left(T_j^{\sigma-1}\right) + \sigma^{-1}\log\left(\sum_{j=1}^{J} Y_j \, e^{-\tau(\sigma-1)d_{ij}}\right) + \varepsilon_i \tag{2}$$

The strength of an equation like this is the microeconomic foundation derived from a general-equilibrium model (KRUGMAN, 1992, p. 7). Another valuable feature of this equation is that, in principle, it can be estimated empirically in order to test the validity of the NEG framework. Unfortunately, data for the price index T_j is not available at a disaggregated geographic level for Europe. Hence, equation (2) cannot be estimated directly. The simplest way to deal with this empirical data problem is to assume that the price index is equal in all regions.[6] Thus, the expression containing the price index T_j is moved into a single constant (α_0) and the elasticity σ^{-1} is transferred into a coefficient (α_1). Furthermore, consistent with

---

[5] For an analytical derivation of the wage equation from HELPMAN's (1998) extension of the KRUGMAN (1991) model see e.g. HANSON (2005, pp. 3-6).

[6] See ROOS (2001). For different approaches to overcoming these shortcomings by means of substituting the price index by other equilibrium conditions see, e.g., HANSON (2005, p. 6) or NIEBUHR (2006, p. 317).

HANSON (2005, p. 13), we merge the expression $-\tau(\sigma-1)$ into a single coefficient (α_2) which we refer to as distance decay parameter or spatial weight in the remainder of the article. Equation (2) can be written in a reduced form:

$$\log(w_i) = \alpha_0 + \alpha_1 \log\left(\sum_{j=1}^{J} Y_j e^{-\alpha_2 d_{ij}}\right) + \varepsilon_i \quad (3)$$

where w_i, Y_j, and d_{ij} are defined as in equation (1). α_0, α_1, and α_2 are parameters to be estimated and ε_i is the disturbance term. The reduced form of equation (2) can be called the nominal wage equation because regional price variations are excluded.

The assumption of regionally equal price levels is obviously a bit problematic because differentials in real wages feature among the crucial mechanisms that cause agglomeration in the core-periphery models. Within the NEG framework, a low price index in a certain region is indicative of many varieties being produced in nearby locations and of a relative intense competition among neighboring manufacturing firms. The resulting relatively good supply with inputs and consumer goods is one of the key forces driving agglomeration, the so-called forward linkages (FUJITA, KRUGMAN, & VENABLES, 1999, p. 4 and 149; NIEBUHR, 2006, p. 317). Due to the fixed price index we cannot infer on forward linkages from equation (2). However, our specification accounts for the second centripetal force, the backward linkages, which drive firms to concentrate where market access, e.g. purchasing power, is high. Thus, estimating equation (3) still represents a fundamental test of the NEG framework. If this relationship does not hold, the agglomeration patterns observed in reality are due rather to other factors than those stressed in the theoretical models (ROOS, 2001).

Besides the missing regional price indices, at least two additional particularities complicate the estimation of an augmented wage equation for Europe (ROOS, 2001). First, the processes of wage setting differ considerably between the USA and Europe, where in most countries unions exhibit a large influence and wage setting occurs, to some degree, harmonized on a national scale (LAYARD, NICKELL, & JACKMAN, 2005, p. 87). Second, the Krugman-Helpman model assumes perfect labor mobility, which theoretically leads to equalized real wages in all regions.

However, labor mobility in Europe is relatively low, particularly in comparison to the USA (LAYARD, NICKELL, & JACKMAN, 2005; NICKELL, 1997). These particularities might explain why empirical strategies based on the Krugman-Helpman model performed inferiorly compared to reduced market potential equations in terms of plausibility of estimation results for European study areas (NIEBUHR, 2006; ROOS, 2001). Given the constraints in data availability and the less encouraging results of previous estimations of the augmented spatial wage equation for Europe, we stick to the well-established nominal-wage equation in our empirical analyses. In principle, equations (2) and (3) may be extended by control variables that capture regional geographic, industrial, cultural, etc. particularities. The focus of our analysis, however, is to investigate the sensitivity of decay parameter estimates. Since HANSON (2005) shows that even large sets of control variables hardly affect the magnitude and precision of the respective estimates, we abstract from such controls in order to keep the models as compact as possible.

For the estimation of the European spatial wage-income relationship based on equation (2), we use the GDP or GVA of the year 2005 as a proxy of regional income, i.e. purchasing power. Nominal wages are not available for the whole study area at all considered levels of disaggregation, especially for the NUTS 3 level. Thus, the dependent variable w_i will be approximated by per capita income, i.e. GDP per capita or GVA per capita. These data are provided by EUROSTAT (Statistical Office of the European Communities) for almost all NUTS area at all levels.[7] Our study area comprises the whole area for which data is available at EUROSTAT: all member countries of the European Union (EU 27) and, in addition, Norway, Switzerland, Liechtenstein, and Croatia. All oversea regions were excluded.[8]

---

[7] For some NUTS 3 regions, especially in Poland, the eastern part of Germany, Sweden, and the Italian island Sardinia, EUROSTAT does not provide any data on income for the year 2005. In these cases, the NUTS 3 regions received an income share of their respective NUTS 2 region (the next higher level) that corresponds to the respective shares of the 2002 figures provided by the EU through its ESPON project (http://www.espon.eu).

[8] The excluded NUTS 1 regions are: Départements d'Outre-Mer (FR9, Oversea Departments), Ísland (IS0, Iceland), Comunidad Autónoma de Canarias (ES7, Canary Islands), Região Autónoma dos Açores (PT2, Azores Autonomous Region), Região Autónoma da Madeira (PT3, Madeira Autonomous Region).

Distance is measured by travel time in minutes. In the literature two different ways of measuring travel time can be observed: travel time based on straight line distances (SL) and travel time evaluated using effective road distances (RT). Probably due the ease of their generation, straight lines are used more frequently in the literature. However, if there are effective geographic barriers like mountains, rivers or oceanic areas, which cannot be so lightly overcome, application of straight line distances may lead to a biased travel time matrix. Imagine two regions with a large lake or an ocean in between. Any straight line measure will necessarily underestimate the "true" travel time as people or goods must be transported via the longer land bypass or via slower ferry connections.[9] Hence, relatively remote areas may appear more central than they are. South Italy and countries east of the Adriatic Sea, like Slovenia and Croatia, as well as Italy and Spain on the other side of the Tyrrhenian Sea are good examples.

Both travel time measures based on road and straight line distances will be used in the empirical analyses. In the first case, effective road travel time between the centroids of the respective regions was generated by the use of the route planner from Microsoft "MapPoint Europe 2006".[10] This program ascertains the exact road distance between two points on the basis of the existing infrastructure (road and ferries) of the year 2005. Furthermore, the quality of road infrastructure in the sense of travel speed is considered as MapPoint distinguishes between five different road types: (1) limited-access highways, (2) main highways, (3) other highways, (4) arterial roads, (5) streets. For every road type a representative average speed is assumed.[11] Ferry connections are considered with an average speed of approximately 25 km/h. The decision of whether to take a longer land route or a ferry connection is based on travel time minimization. In the second case, the

9 Even ferry connections might not be established as linear distance between two regions. Moreover, the speed of seafaring vessels is much lower than the speed of landfaring vehicles.

10 Exactly 450 (NUTS 0), 4,418 (NUTS 1), 38.088 (NUTS 2), and 891,112 (NUTS 3) effective road distances and travel times were calculated during this procedure.

11 The overall average speed between the centroids of the regarded regions as calculated by MapPoint lies within a range of 90-94 km/h.

travel time matrix was calculated by multiplying the linear distances between the centriods of two regions by an average speed of 90km/h.

There are – besides some sparsely used alternatives[12] – two major concepts of internal distance measures that help to account for within region transport costs while considering that NUTS regions vary considerably in size.[13] The first concept, which will be referred to as CKOT, was adopted by CRAFTS (2005) and KEEBLE, OWENS, & THOMPSON (1982):

$$d_{ii} = \frac{1}{3}\sqrt{\frac{Area_i}{\pi}}, \quad (4)$$

where d_{ii} is region i's internal distance which is equal to a distance value of one-third of the radius of a circle of the same enclosed area as region i. The second concept follows NIEBUHR (2006) and BRÖCKER (2001) and is referred to as NB below:

$$d_{ii} = \frac{3}{4}\sqrt{Area_i} \quad (5)$$

Assuming that the internal distance d_{ii} represents the average distance between evenly across space distributed consumers and centrally concentrated producers in a region, internal distance can be estimated as a function of the square root of a region's area.

Based on the data described above, the nominal wage equation can be estimated on the basis of NUTS 0/NUTS 1/NUTS 2/NUTS 3 data, straight lines/road times, CKOT/NB internal distance measures, GDP/GVA data and varying (sub-)samples of European regions. In the remainder of the analysis we will refer to the full European sample, the NB internal distance, the road-distance-based travel time ma-

12 See e.g. CLARK, WILSON, & BRADLEY (1969).

13 See for a survey on the treatment of regions' self-potential in the literature KEEBLE, OWENS, & THOMPSON (1982, p. 425).

trix and GDP as the "standard" setup when evaluating estimates' sensitivity to model specifications.[14]

4 Baseline Empirical Results

Table 1 presents non-linear least squares (NLS) results corresponding to equation (3) and the "standard" setup described in the section above at varying levels of data-aggregation (column 1-4). The coefficient of interests α_1 and α_2 are positive and statistically significant in all models, indicating that wage is positively correlated with market access across European regions. Note that these estimates do not suffer from sensitivity to initial values, which has been reported in previous attempts to estimate a European spatial wage-income relationship (NIEBUHR, 2006).

Tab. 1 Empirical Results for the Standard Setup

	(1) (NLS) (NUTS 3)	(2) (NLS) (NUTS 2)	(3) (NLS) (NUTS 1)	(4) (NLS) (NUTS 0)	(5) (SAR) (NUTS 3)
α_0	2.975*** (0.213)	3.329** (0.571)	1.647 (1.046)	-1.243 (2.066)	5.603*** (0.294)
α_1	0.285*** (0.008)	0.267** (0.021)	0.321** (0.038)	0.460** (0.086)	0.193*** (0.013)
α_2	0.023*** (0.002)	0.018** (0.004)	0.010** (0.003)	0.013** (0.004)	
λ					0.908
Obs.	1,335	276	94	30	1,335
adj. R²	0.475	0.375	0.456	0.479	0.820

Notes: Endogenous variable is log of wage in all models. Model (6) includes country fixed effects. Standard errors are in parenthesis. * denote significance at the 1% level. ** denotes significance at the 5% level. *** denotes significance at the 1% level.

Due to the spatial nature of the data, problems of spatial dependency are likely to arise from error terms not normally distributed across space. The LM-tests for spatial autocorrelation detect spatial dependency in the data and rejecting a spatial lag in favor of an error correction model (ANSELIN, 2003; ANSELIN & BERA,

[14] Taking reality as a benchmark, this arbitrary choice is based on plausibility considerations, e.g. road times and NUTS 3 data are more precise than straight lines and NUTS 0 data, etc.

1996; ANSELIN & FLORAX, 1996).[15] At NUTS 3 level, we choose a second order contiguity weights matrix (*W*) which minimizes the Akaike and Schwarz criteria. The application of alternative weights matrices, including first-order contiguity, did not change results considerably. Formally, the spatial autoregressive (SAR) model that we estimate employing a maximum likelihood estimator can be written as follows:

$$\log(w_i) = \alpha_0 + \alpha_1 MP_j + \varepsilon_i, \text{ where} \quad (6)$$

$$\varepsilon_i = \lambda W \varepsilon_i + \mu_i,$$

Parameter λ corrects for the spatial correlation in the error term (ε_i), and μ_i is an independent and identically distributed vector of error terms. Market potential (*MP*) is generated on the basis of the α_2 coefficient values from columns (1)-(4). Due to the nature of the employed SAR-model, which requires a linearized equation, we cannot estimate the coefficient on travel time.[16] Nevertheless, the SAR estimation results presented in column (5) demonstrate that market potential is still highly statistically significant when spatial dependency is addressed, although the impact of market potential on regional wage levels is slightly weaker than suggested by the NLS results.[17] For a 1% increase in market potential there is an increase in wages ranging from 0.29% (NUTS 3) to 0.32% (NUTS 1) in the NLS and 0.19% to 0.26% in the SAR models.[18]

The spatial distribution of market potential is depicted in Figure 1 based on the estimated parameter α_2 from column (1) and the underlying matrix of effective road travel times for 1,335 NUTS 3 regions. The typical European core regions ranging from South England over Isle-de-France, Benelux and West Germany to

---

15 Methodological aspects of spatial error and spatial lag models are covered by ANSELIN (1988) and ANSELIN & BERA (1998).

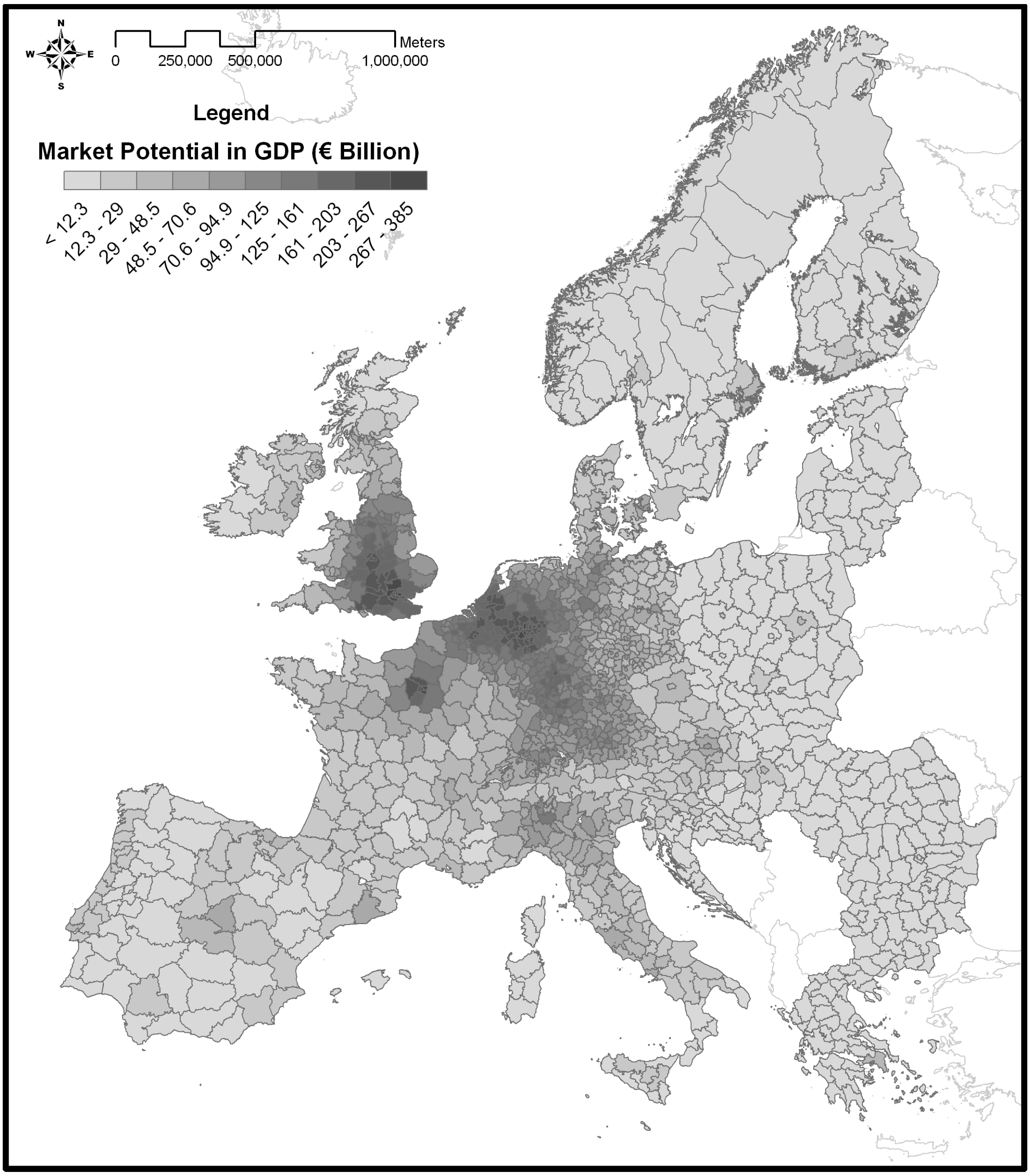
16 See NIEBUHR (2006, p. 325) for a comparable approach.

17 We also tested similar models for NUTS 0-NUTS 2 level. Market potential was statistically significant in all models. A first-order contiguity weights matrix provided the best fit in these models.

18 At country level (NUTS 0) there are correspondingly increases of up to 0.45%. However, these estimates should be interpreted carefully due to the very rough nature of the underlying data.

North Italy are clearly recognizable. The estimated parameter value for α_2 of 0.023 implies the strength of the estimated demand linkages halves every 30 km and is reduced to 1% roughly after 200 km. This estimate seems to be plausible as we interpret the spatial weight to be somewhat between iceberg transports costs (broader range) and costumer/employee linkages (narrow range).

Fig. 1 Market Potential in European Regions



Notes: Own illustration.

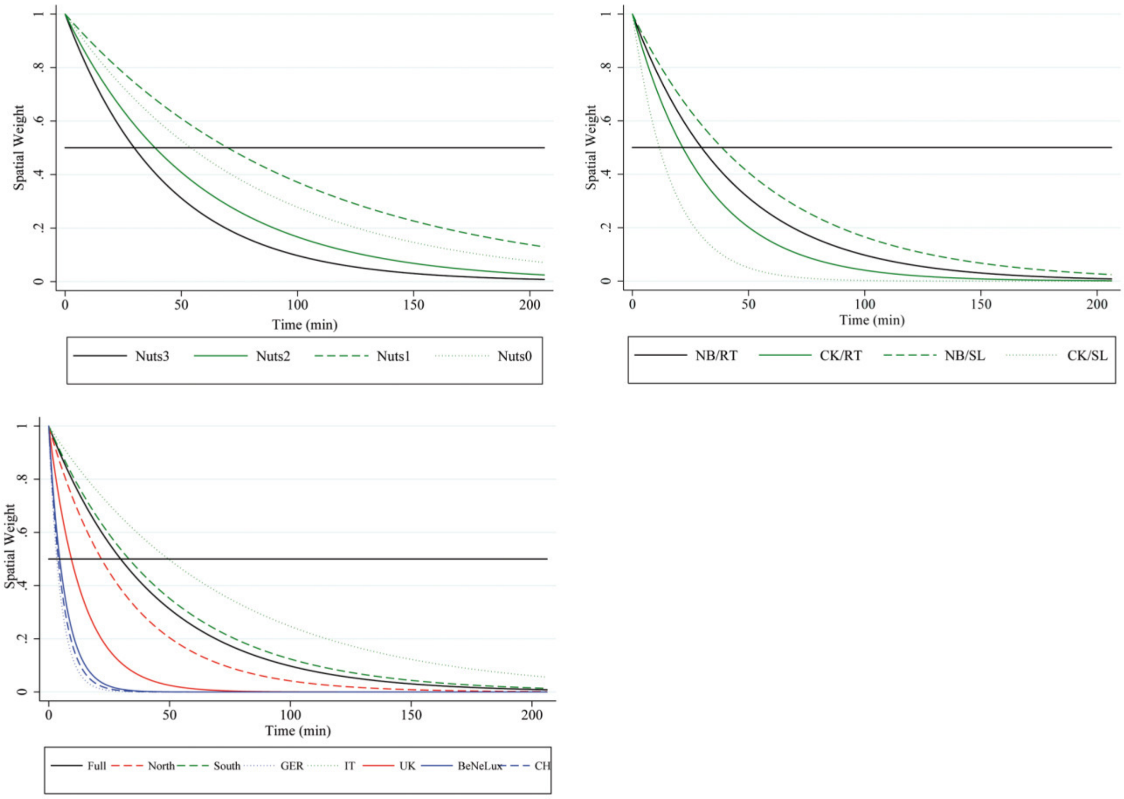
From comparison of estimated decay parameters α_2 presented in Table 1, columns (1)-(4), a tendency to smaller coefficients at higher levels of data aggregation is evident. This pattern is comprehensive given that, depending on the level of data interaction, we capture different mix of spatial interactions. At NUTS 3 level, for instance, our estimates may be driven by cross-regional commuting or business relations that are highly localized and therefore associated with a relatively high value of travel time. As the level of data aggregation increases, transportation of physical goods and input factors becomes the dominating factor, decreasing average travel costs. Notably however, even the relatively small decay parameter estimated for NUTS 1 regions (Table 1, column 3) is almost three times larger than the parameter provided by NIEBUHR (2006), which was conducted at a comparable level of data aggregation.[19] Since the reasons for these considerable differences remain unclear, we investigate the sensitivity of estimation results to a broader range of model specifications in the course of the next sub-sections. Figures 2 to 4 give a first visual impression of how the estimated decay parameter changes as we manipulate the underlying data.

Figure 2 depicts the estimated spatial weight functions from equation (1). Part (a) displays the results for the standard setup employed for different levels of aggregation and thus visualizes the estimation results from Table 1. Part (b) investigates the sensitivity to changes in the travel time definition: inter-region travel time (RT vs. SL) and intra-region travel time (NB vs. CKOT). Last, part (c) contains spatial weight estimates for different sub-samples. Consistently the spatial weights (travel times in minutes) are displayed on the *y*-axis (*x*-axis). The horizontal line indicates the half-life distance of the according exponential cost function. The bold black exponential cost function in all three parts refers to the reference setup described in the section above.

---

[19] Effectively, NIEBUHR (2006) used a mixture of NUTS 2 and NUTS 1 regions. However, according to her argumentation and our observation, the restriction to a full set of relatively larger NUTS 1 regions would lead to an even smaller coefficient value and hence to an even larger difference compared to our estimates.

Fig. 2 Spatial Weight Functions for Different Setup Variants



Source: Own illustration.

As discussed, we observe the highest decay parameter and hence the highest spatial discount at the lowest level of aggregation (NUTS 3) (a). The subsequent aggregation level (NUTS 2) generates a slightly lower spatial weight, while the spatial discount of the levels of higher aggregation (NUTS 1, NUTS 0) is noticeably lower. Part (b) and part (c), which rely on NUTS 3 data, reveal further sources of sensitivity to setup alterations. Part (b), which is based upon the full European sample, displays the four estimated decay parameters emerging from all possible combinations of the two travel time characteristics. It can be seen that the spatial weights employing the NB internal distance measure are larger than those using the CKOT measure, while no clear implications can be found regarding the used inter-region travel time matrix.[20] Lastly, part (c) gives a visualization of the influ-

[20] In the case of the NB measure the decay parameter relying on the road time travel matrix is larger than those relying on the straight line travel matrix. In contrast, the road-time-based spatial weight is smaller than the straight-line-based spatial weight when employing the CKOT internal distance measure.

ence of the chosen sample (size) – whose selection process is discussed in the next section – on the estimated distance decay parameter.[21] Based on the standard setup, the results for the two big samples "North" and "South" are quite similar. In contrast, it is very interesting that a much larger spatial discount is suggested on the basis of estimates referring to small sub-samples (with the exception of Italy). A straightforward explanation for this phenomenon is that the selection of a small excerpt of an integrated market implies the cutoff of effective hinterlands of border regions. The erroneous assumption of prohibitive border effects potentially leads to an upward bias in the estimation of travel/transport costs. We will investigate this phenomenon more profoundly in the next section.

Based on these remarks, we can derive some stylized facts about the sensitivity of the estimated spatial weights resulting from differing setups. First, confirming previous presumptions, more disaggregated data tends to produce larger spatial discounts. Second, the results are sensitive to the chosen measure of the internal distance, while the used travel time matrix shows no systematic direction of cause. Last, the chosen sub-sample and especially its size and location seems to have a major influence on the value of the spatial weight. Regarding Figure (2), the broadest range of spatial discount can be found for variations of the used sample, while the modest changes can be observed for variations of the underlying travel time matrix.

5 Sensitivity Analysis

5.1 A Meta-Analysis within a Quasi Experimental Framework

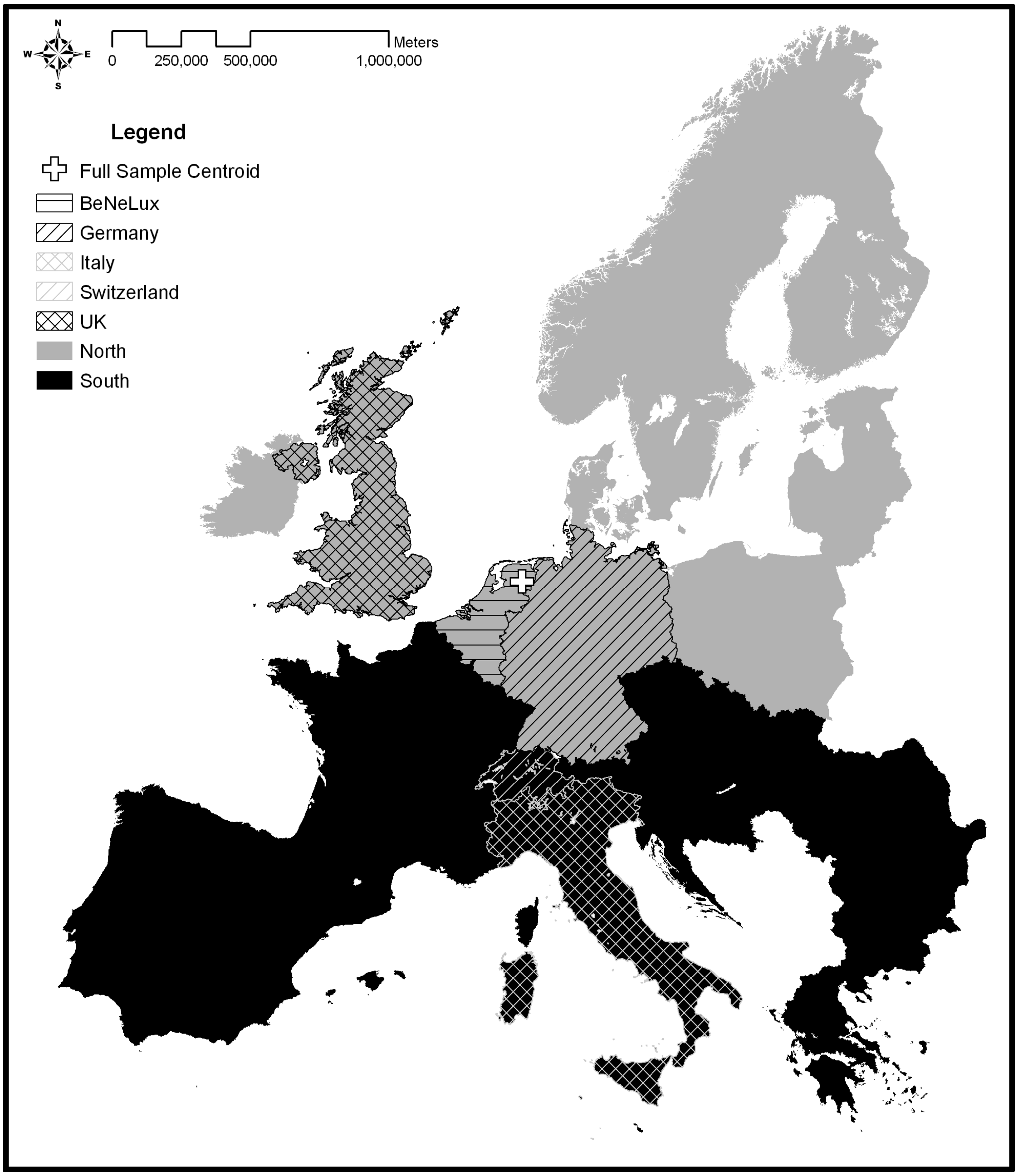
So far, in the previous section, we have learned a lot about potential sources of estimation sensitivity. This section provides a more analytical evaluation of the determinants of spatial weights in spatial wage equations. The method we use to analyze the effects of changes in the chosen setup is meta-analysis. Typically, meta-analyses synthesize results from diverse empirical studies conducted by differ-

[21] See Figure 3 for a map of the sub-samples.

ent researchers. In contrast, we follow the suggestion by BANZHAL & SMITH (2007, p. 1014) and use meta-analysis to summarize the influence of selectively altered model specifications on the outcome of our spatial wage equation. The advantages of this procedure are obvious. As we can precisely execute alterations of our setup, ceteris paribus, we arrive at a quasi-experimental design under laboratory conditions. Compared to a "traditional" meta-analysis based upon results available in the literature, the asset of our approach is that we can completely control for all differences across specifications. Despite these clear advantages this approach is still rarely used in economic research.

To isolate the effects of the variations of our setup we replicate the model with stepwise alterations of (1) level of aggregation (NUTS 0, NUTS 1, NUTS 2, NUTS 3), (2) distance matrix (effective road time vs. straight line), (3) internal distance (NB vs. CKOT), (4) income proxy (GDP vs. GVA), and (5) sample size (8 geographic sub-samples). Figure 5 visualizes the considered geographic sub-samples.

Fig. 3 Discretionarily Geographic Sub-samples



Source: Own illustration.

The selection of the eight sub-samples followed two simple principles. First, we wanted to provide a wide range of heterogeneous samples. For this reason larger and smaller samples were composed. One sample is the overall European sample, including the EU as well as Switzerland, Norway, Croatia, and Liechtenstein. Two major European sub-samples were composed on the basis of the latitude of their centroids lying above (North) or below (South) 50°N. The Benelux countries are another grouped country sample. Beside these three samples representing a collection of states, we chose large (Germany, Italy, United Kingdom) as well as smaller (Switzerland) countries as individual samples. Second, some sub-samples were selected to be congruent with samples chosen by other researchers. For instance, MION (2004) estimated the spatial wage equation for Italy and ROOS (2001) such as BRAKMAN, GARRETSEN, & SCHRAMM (2000, 2004) picked Germany as an area of investigation. Of course, the selection of the sub-samples is somewhat arbitrary and a lot more reasonable choices would be possible. But with regard to the effort required to estimate the spatial wage equation for a set of additional sub-samples, we limited the number of sub-samples to eight.[22]

From a combination of all the mentioned characteristics we obtain 208 permutations of equation (3) to be estimated. The empirical analysis of this section entails a model of model variants and, hence, a meta-analysis (BANZHAF & SMITH, 2007). Therefore, we created a data-base that contains the results for the spatial weight parameters from all 208 separately estimated spatial wage equations. Subsequently, all characteristics of the respective equation (e.g. sample size, aggregation level, distance measure) were stored into this data-base in order to facilitate a meta-regression analogous to the model suggested by STANLY & JARRELL (1989).

$$\alpha_{2_j} = \beta_0 + \sum_{k=1}^{K} \beta_k Z_{jk} + \varepsilon_j, \quad j = 1, 2, 3, \cdots, N \tag{5}$$

where α_{2_j} is the saved spatial weight of equation j from the total of N=208 regressions, Z_{jk} are meta-independent variables capturing the characteristics of model permutation i, β_k denote meta-regressions coefficients, which reflect the impact of these characteristics on the decay parameter estimates, and ε_j is the meta-regression disturbance term.

The vector of meta-independent variables contains the following variables: First, a set of dummy variables indicating whether the respective aggregation level is NUTS 0 (N0), NUTS 1 (N1), NUTS 2 (N2), leaving NUTS 3 as references. Each of the

---

[22] A list describing the countries listed in the respective sub-samples is provided in Table 5 in the appendix.

variables takes the value of one if the considered setup is based upon the respective geographic unit, and zero otherwise. Two additional dummy variables are employed to similarly isolate the effects caused by the chosen distance measure (one if SL) and internal distance measures (one if CKOTB). Last, a dummy variable (*GVA*) is set to distinguish between income proxies, taking the value of one if the permutation is based upon gross value added and zero if GDP is used instead. Note that coefficients on the abovementioned dummies give differences to our reference setup. Besides these dummies capturing model characteristics, two sample specific variables are introduced: the share of observations within a (sub-) sample relative to the whole sample (*SOBS*) and an index of centrality (*CI*). *SOBS* is employed to take account of the upward bias in transport costs due to a relatively large loss of border-regions hinterlands. The basic idea behind the inclusion of a centrality index is that producers, employees and consumers in core regions have a relatively large market potential within a small distance, which may lead to relatively localized spatial demand linkages. A similar market size within peripheral regions will cover a much larger area. This would be reflected by an estimated distance decay parameters that is relatively higher (lower) for core (peripheral) sub-samples.

Tab. 2 Results of the Meta-regression

	(1)	(2)	(3)	(4)	(5)
C	0.160***	0.179***	0.188***	0.049**	-0.057
	(0.017)	(0.022)	(0.020)	(0.020)	(0.044)
SOBS	-0.094**	-0.094**	-0.115***	-0.041	-0.010
	(0.036)	(0.036)	(0.036)	(0.032)	(0.037)
N0	-0.124***	-0.169***	-0.124***	-0.087***	-0.070***
	(0.024)	(0.039)	(0.023)	(0.021)	(0.024)
N1	-0.115***	-0.159***	-0.121***	-0.106***	-0.084***
	(0.019)	(0.030)	(0.019)	(0.016)	(0.019)
N2	-0.041**	-0.048*	-0.045**	-0.031**	-0.026
	(0.018)	(0.029)	(0.017)	(0.015)	(0.017)
SL	0.015	0.038	0.015	0.015	0.015
	(0.013)	(0.023)	(0.013)	(0.011)	(0.012)
CKOT	0.035***	0.051**	0.035***	0.035***	0.035***
	(0.013)	(0.023)	(0.013)	(0.011)	(0.012)
GVA	$-5.58e^{-5}$	$-5.58e^{-5}$	$-5.58e^{-5}$	$-5.58e^{-5}$	$-5.58e^{-5}$
	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)
CI			-0.049**	0.001***	0.007***
			(0.020)	($1.46e^{-4}$)	(0.001)
SLN0		-0.037			
		(0.044)			
SLN1		-0.036			
		(0.034)			
SLN2		-0.027			
		(0.033)			
CKOTN0		-0.054			
		(0.044)			
CKOTN1		-0.051			
		(0.034)			
CKOTN2		0.013			
		(0.033)			
R^2	0.228	0.253	0.250	0.418	0.323
adj. R^2	0.204	0.207	0.224	0.398	0.300
F-stat	9.860***	5.500***	9.520***	20.540***	13.650***
N	208	208	208	208	208

Notes: Endogenous variable is log of wage in all models. Standard errors are in parenthesis. * denotes significance at the 1% level. ** denotes significance at the 5% level. *** denotes significance at the 1% level.

Column (1) contains the results of the basic meta-analysis setup using sample size (share at total regions,) and the discussed sets of dummy variables as regressors in order to empirically evaluate the phenomenon summarized in the stylized facts. Confirming the previous notions, higher levels of data aggregation leads to smaller spatial weights, with the largest difference appearing when switching from NUTS 2 to NUTS 1. In line with expectations, the share of observed regions (*SOBS*) is negative and significant. Relatively smaller samples, ceteris paribus, yield higher transport cost parameters. In contrast, no significant impact is revealed for the used income proxy, making this attribute less of a concern. While this result might not be very surprising, the fact that the employed travel time matrix also turned out to be insignificant is indeed somewhat unexpected. Although we believe that data should generally be geared to reality as much as possible, these results suggest that application of straight line distance represents a feasible approximation under normal conditions. The internal distance measure, however, is more crucial. The negative and significant sign of the variable *CKOT* indicates that decay parameters resulting from setups using this measure, *ceteris paribus*, are smaller than parameters produced on the basis of the alternative specification (NB). From equation (4) and (5) it can be assessed that the CKOT measure produces smaller internal distances for a given area. Analogously to the argumentation given for the level of aggregation (section 4), the key to understanding this influence probably lies in the higher relative own weight that is attached to a region by the CKOT measure, due to smaller internal distances. Therefore, localized customer, business and employee relations that take place within regions are more influential, increasing the average value of travel time, which – in turn – is revealed in a higher decay parameter. Unfortunately it is difficult to arrive at a reliable recommendation on which internal distance measure should be used since reality does not hold as a benchmark. It is, nevertheless, important to note that this little regarded detail exhibits a significant influence on the outcome of the estimation of the nominal wage equation. It certainly deserves more attention in further research. In column (2) additional interactive terms are included to analyze if the travel time matrix and the internal distance measure impact differently at distinct levels of aggregation. On the basis of the respective parameter estimates on interactive terms the hypothesis of homogenous impact cannot be rejected.

Columns (3)-(5) introduce three alternative measures of the centrality of the used sample: The distance of the sub-sample's centroid to the centroid of the full sample in 1,000 km (3), the sum of market potential of the sub-samples' regions (4) and the average GDP per capita (5). The negative sign for the distance to the full sample centroid (3) as well as the positive signs for the sum of market access (4) and the average GDP per capita (5) consistently imply that sub-samples which are more central in an economic sense yield a higher spatial discount. In other words, smaller decay parameters can be found in peripheral sub-samples and higher decay parameters can be found in central sub-samples, as expected. According to the coefficient of determination, the sum of market access seems to be the most precise indicator of centrality.

Notably, the findings discussed above are consistently found in all specifications. Moreover, the R^2 values suggest that the meta-explanatory variables could account for a reasonable proportion of the differences among our 208 estimates. With the exception of the selection of the internal distance measure, which remains somewhat arbitrary, the results of the meta-regression support our reference setup, although should there be restrictions in availability of data or computational power, application of, for example, straight-line distances, might be justifiable.

5.2 Asymmetric Samples

As discussed, a restriction of the observation area to subsamples of European regions implies the assumption of 100% border effect between the considered sample and the rest of Europe. As a consequence, a downward bias of estimated spatial demand linkages is likely to arise from the exclusion of effective hinterlands. This effect can also be seen in the realm of a mix of different spatial interactions discussed in the context of data aggregation and internal distances. If a sample in the model is restricted to a single country (or a small group of countries), then a large fraction of particularly long-range regional interactions inevitably remains unconsidered. Since – on average – inter-regional distances are shorter on a within-country scale than on a continental scale, the model will calibrate to spatial dependencies occurring on a more localized level. The opposite effect is likely to occur if the most natural strategy to overcome the discussed small sample border bias is employed: Using wages for a sub-sample of European regions (left-hand side regions) while considering access and income of all European regions (right-hand side regions). This strategy, however, leads to a large fraction of (right-hand side) regions exhibiting an influence on regional wages in their function as long-distance trade partners, while their localized impact on wages remains unconsidered. We would, therefore, expect an estimate of the transport cost parameter, which is biased towards the relatively low transport costs of physical goods as localized interactions that strongly discount on travel time, to become less influencing.

These notions are confirmed by Table 3, which shows estimation results for 3 samples of European regions (East, West, and South) while controlling for access to the whole set of European (NUTS 3) regions. For purposes of comparability, we also repeat this approach for the sample used by NIEBUHR (2006), who similarly distinguishes between left-hand and right-hand side cross-sections.[23]

[23] The samples consist of following countries (in country codes). South: PT, ES, IT, GR, CY; East: EE, LT, LV, PL, CZ, SK, SI, HR, HU, RO, BG; West: EU without East sample; Niebuhr: West sample without CH, LI, MT, NO, SE and East Germany.

Tab. 3 Empirical Results for the Standard Setup

	(1) (NLS) (South)	(2) (NLS) (East)	(3) (NLS) (West)	(4) (NLS) (Niebuhr)
α_0	4.460*** (0.432)	0.622* (0.369)	-10.895 (167.048)	5.933*** (0.365)
α_1	0.202*** (0.015)	0.349*** (0.016)	0.705 (5.556)	0.150*** (0.012)
α_2	0.005*** (0.001)	0.016*** (0.001)	4.10e-4 (0.003)	0.004*** (0.001)
Obs.	225	211	1124	942
adj. R²	0.453	0.687	0.096	0.207

Notes: Endogenous variable is log of wage in all models. Standard errors are in parenthesis. * denote significance at the 1% level. ** denotes significance at the 5% level. *** denotes significance at the 1% level.

As expected, the decay parameters for sub-samples with the unrestricted set of right-hand side variables are small compared to the reference results provided in Table 1, column (1). Notably, the overall model fit suggested by the coefficients of determination is relatively poor in models (3) and (4). Three similarly defined samples for Scandinavian, central European and north-east European countries even caused serious estimation problems and therefore remain unconsidered in Table 3. The high sensitivity of estimation results to the sample selection becomes most apparent in the distinct pattern of results for the West (3) and the Niebuhr (4) sample. While column (4) results almost replicate the pattern provided by NIEBUHR (2006),[24] the fairly similar West sample produced a decay parameter that is one order of magnitude lower, a wage elasticity that is almost 7 times as high and an overall explanatory power more than 50% lower. As we could not find a comprehensive rationale, we assume that NIEBUHR (2006) selected her sample mainly driven by data limitations, giving her unique estimate an accidental character.

[24] Effectively, the decay parameter estimated by NIEBUHR (2006) is slightly smaller than the respective parameter in Table 3. According to her argumentation as well as our results from the previous sub-sections, this minor difference might be caused by the higher level of disaggregation which underlies the data frame employed in our study.

Briefly summarized, our results suggest that a reduction in sample size with the exclusion of respective right-hand side regions tends to raise the estimated decay parameter, implying a narrower scope of regional integration. In contrast, if observations are excluded without reducing the set of right-hand side regions, the opposite effect is likely to occur. In both cases, the sensitivity of results is large compared to the effects of attributes like data aggregation or distance measures. This finding is strongly in support of our reference setup, which avoids problems of border impediments and exploits both the full variation of wage and income available within an area that may reasonably be assumed to represent a feasible market area.

6 Conclusion

This article contributes to the empirical New Economic Geography literature by providing a comparative analysis on the spatial relation of wage and market potential as a measure of regional economic integration in Europe. Similar to previous studies we find a significant impact of market potential on regional wage levels. Our estimates are conducted on the basis of a uniquely disaggregated dataset of up to 1,335 European NUTS regions, connected by a full matrix of effective road-based travel times. Previous studies either use more aggregated data (NIEBUHR, 2006), smaller (national) samples (BRAKMAN, GARRETSEN, & SCHRAMM, 2000, 2004; MION, 2004; ROOS, 2001) or a combination of highly disaggregated left-hand side but more aggregated right-hand side variables (HANSON, 2005). Across Europe, we find a robust increase in wage levels within a range of 0.19% to 0.26% for any 1% increase in market potential, according to our careful SAR estimates.

The key-objective of this study, however, is to address the unanimous results on the geographic scope of regional economic integration available in the literature by providing an in-depth analysis of estimates' sensitivity to model specification on the basis of the established nominal wage equation. Based on an evaluation of a set of more than 200 own estimates, we identify specification characteristics that significantly impact on the estimation output. In contrast to standard metaanalytic approaches, based on estimates taken from the literature, we are able to control for any single specification characteristic, giving the analysis a quasi-experimental character. Somewhat surprisingly, we cannot reject the idea that the application of straight-line distances and road travel times yield the same results. Restrictions in data availability or computation power may therefore justify the use of straight lines as a feasible approximation, at least in the absence of major natural or artificial barriers within the considered sample. In contrast, we find a significant impact for the chosen type of internal distance measure used to correct for heterogeneity in the regions' size. Although it remains difficult to assert which of the available definitions is appropriate, this finding is important since these measures are often employed in an ad-hoc manner without further justification.

Our estimate building on the most disaggregated data (NUTS 3 level) available for almost the whole area of the European continent suggests spatial demand linkages that range approx. 200 km, halving every 30 km. Accordingly, the core-periphery structure emphasized by NEG models seems neither to refer exclusively to a highly localized relationship between urban and rural areas nor to a large international scale, but to intermediate distances that lie within the typical scope of customer and employee's relations. However, in line with the distinct spatial interactions captured at different levels of aggregation, our estimates reveal lower average travel costs when data is aggregated to larger geographic units. There is, therefore, not one "right" spatial weight parameter to be recommended but a range of parameters depending on the data an analysis is conducted on. Our recommended iceberg cost parameters referring to travel time in minutes vary as much as from 0.023 (NUTS 3) over 0.018 (NUTS 2) to 0.01 (NUTS 1). However, this effect is not strong enough to explain either very high values (BRAKMAN, GARRETSEN, & SCHRAMM, 2000, 2004) or very low estimates (NIEBUHR, 2006) available in the literature. Based on the results of our sensitivity analysis, such extreme estimates potentially result from a strong sensitivity to sample restrictions.

As earlier cross-sectional studies exploring regional wage and income differentials, our results provide evidence for a highly significant correlation between economic wealth and access to markets, but not for a causal relationship that may comprehensively be established by investigation of exogenous variation in market potential (REDDING & STURM, 2008). However, we would like to emphasize that our study was explicitly designed to provide reliable estimates on the scope of regional economic integration in order to facilitate further research in this particular area.

Appendix

Tab. 4 EU Country Codes

EU Code	Country	Capital	Date of Accession	Population
AT	Austria	Vienna	1 January, 1995	8,282,424
BE	Belgium	Brussels	25 March 1957	10,547,958
BG	Bulgaria	Sofia	1 January 2007	7,699,020
CH	Switzerland	Berne	Non-member	7,483,934
CY	Cyprus	Nicosia	1 May 2004	772,549
CZ	Czech Republic	Prague	1 May 2004	10,269,134
DE	Germany	Berlin	25 March 1957	82,376,451
DK	Denmark	Copenhagen	1 January 1973	5,437,272
EE	Estonia	Tallinn	1 May 2004	1,343,547
ES	Spain	Madrid	1 January 1986	44,116,441
FI	Finland	Helsinki	1 January 1995	5,266,268
FR	France	Paris	25 March 1957	63,195,457
UK	United Kingdom	London	1 January 1973	60,622,964
GR	Greece	Athens	1 January 1981	11,148,460
HR	Croatia	Zagreb	Candidate Country	4,442,061
HU	Hungary	Budapest	1 May 2004	10,071,370
IE	Ireland	Dublin	1 January 1973	4,261,827
IT	Italy	Rome	25 March 1957	58,941,499
LI	Liechtenstein	Vaduz	Non-member	35,037
LT	Lithuania	Vilnius	1 May 2004	3,394,082
LU	Luxembourg	Luxembourg	25 March 1957	472,637
LV	Latvia	Riga	1 May 2004	2,287,948
MT	Malta	Valletta	1 May 2004	406,408
NL	Netherlands	Amsterdam	25 March 1957	16,346,101
NO	Norway	Oslo	Non-member	4,660,677
PL	Poland	Warsaw	1 May 2004	38,141,267
PT	Portugal	Lisbon	1 January 1986	10,584,344
RO	Romania	Bucharest	1 January 2007	21,587,666
SE	Sweden	Stockholm	1 January 1995	9,080,505
SI	Slovenia	Ljubljana	1 May 2004	2,006,868
SK	Slovakia	Bratislava	1 May 2004	5,391,409

Notes: Population is the mean population of a country in 2006 (Source: EUROSTAT).

Tab. 5 Sub-samples used in the Meta-regression

(1) Full	(2) North	(3) South	(4) Benelux	(5) Germany	(6) United Kingdom	(7) Italy	(8) Switzer-land
AT	FI	AT	BE	DE	UK	IT	CH
BE	SE	BG	LU				
BG	NO	CH	NL				
CH	EE	CY					
CY	LV	CZ					
CZ	LT	ES					
DE	DK	FR					
DK	IE	GR					
EE	UK	HR					
ES	NL	HU					
FI	BE	IT					
FR	LU	LI					
GR	DE	MT					
HR	PL	PT					
HU		RO					
IE		SI					
IT							
LI							
LT							
LU							
LV							
MT							
NL							
NO							
PL							
PT							
RO							
SE							
SI							
UK							

Source: Own illustration.

Literature

ANSELIN, L. (1988). *Spatial Econometrics: Methods and Models.* Dordrecht: Kluwer.

ANSELIN, L. (2003). Spatial Externalities. *International Regional Science Review, 26*(2), 147.

ANSELIN, L., & BERA, A. K. (1996). Simple Diagnostic Tests for Spatial Dependence. *Regional Science & Urban Economics, 26*(1), 77.

ANSELIN, L., & BERA, A. K. (1998). Spatial Dependency in Linear Regression Models with an Introduction to Spatial Econometrics. In A. ULLAH & D. E. GILES (Eds.), *Handbook of Applied Economic Statistics* (pp. 237-289). New York: Marcel Dekker.

ANSELIN, L., & FLORAX, R. J. G. M. (1996). Small Sample Properties of Tests for Spatial Dependency in Regression Models: Some Further Results. In L. ANSELIN & R. J. G. M. FLORAX (Eds.), *New Directions in Spatial Econometrics* (pp. 21-74). Berlin: Springer.

BANZHAF, H. S., & SMITH, V. K. (2007). Meta-Analysis in Model Implementation: Choice Sets and the Valuation of Air Quality Improvements. *Journal of Applied Econometrics, 22*(6), 1013-1031.

BORUKHOV, E., & HOCHMAN, O. (1977). Optimum and Market Equilibrium in a Model of a City without a Predetemined Center. *Environment and Planning A, 9*(8), 849-856.

BRAKMAN, S., GARRETSEN, H., & SCHRAMM, M. (2000). The Empirical Relevance of the New Economic Geography: Testing for a Spatial Wage Structure in Germany, *CESifo GmbH, CESifo Working Paper Series*.

BRAKMAN, S., GARRETSEN, H., & SCHRAMM, M. (2004). The Spatial Distribution of Wages: Estimating the Helpman-Hanson Model for Germany. *Journal of Regional Science, 44*(3), 437-466.

BRÖCKER, J. (2001). *Wie wirken sich neue Verkehrstechnologien und die Entwicklung Transeuropäischer Netze auf die europäische Standortverteilung aus? DFG Project, BR 1542/3-1, Forschungsbericht* (Vol. 1).

BRÖCKER, J. (2003). Regionale Wirkungen der Europäischen Währungsunion. *Review of Regional Research, 23*, 3-22.

CLARK, C., WILSON, F., & BRADLEY, J. (1969). Industrial Location and Economic Potential in Western Europe. *Regional Studies, 3*(2), 197-212.

CRAFTS, N. (2005). Market Potential in British Regions, 1871-1931. *Regional Studies: The Journal of the Regional Studies Association, 39*(9), 1159-1166.

DAVIS, D. R., & WEINSTEIN, D. E. (1999). Economic Geography and Regional Production Structure: An Empirical Investigation. *European Economic Review, 43*(2), 379-407.

DAVIS, D. R., & WEINSTEIN, D. E. (2003). Market Access, Economic Geography and Comparative Advantage: An Empirical Test. *Journal of International Economics, 59*(1), 1-23.

EATON, J., & KORTUM, S. (1999). International Technology Diffusion: Theory and Measurement. *International Economic Review, 40*(3), 537.

EATON, J., & KORTUM, S. (2002). Technology, Geography, and Trade. *Econometrica, 70*(5), 1741-1779.

FUJITA, M., KRUGMAN, P., & VENABLES, A. J. (1999). *The Spatial Economy: Cities, Regions, and International Trade*. Cambridge and London: MIT Press.

FUJITA, M., & OGAWA, H. (1982). Multiple Equilibria and Structural Transition of Non-Monocentric Urban Configurations. *Regional Science and Urban Economics, 12*(2), 161-196.

FÜRST, F., HACKL, R., KRAMAR, A., SCHÜRMANN, C., SPIEKERMANN, K., & WEGENER, M. (1999). The Sasi Model: Model Implementation. *Berichte aus dem Institut für Raumplanung, 49*.

HANSON, G. H. (1996). Localization Economies, Vertical Organization, and Trade. *American Economic Review, 86*(5), 1266-1278.

HANSON, G. H. (1997). Increasing Returns, Trade, and the Regional Structure of Wages. *Economic Journal, 107*(440), 113-133.

HANSON, G. H. (2005). Market Potential, Increasing Returns and Geographic Concentration. *Journal of International Economics, 67*(1), 1-24.

HANSON, G. H., & CHONG, X. (2004). The Home-Market Effect and Bilateral Trade Patterns. *American Economic Review, 94*(4), 1108-1129.

HARRIS, C. D. (1954). The Market as a Factor in the Localization of Industry in the United States. *Annals of the Association of American Geographers, 44*(4), 315-348.

HEAD, K., & MAYER, T. (2004a). Empirics of Agglomeration and Trade. In V. HENDERSON & J. THISSE (Eds.), *Handbook of Regional and Urban Economics* (Vol. 4). Amsterdam: North Holland.

HEAD, K., & MAYER, T. (2004b). Market Potential and the Location of Japanese Investment in the European Union. *Review of Economics & Statistics, 86*(4), 959-972.

HEAD, K., & RIES, J. (2001). Increasing Returns Versus National Product Differentiation as an Explanation for the Pattern of U.S.-Canada Trade. *American Economic Review, 91*(4), 858.

HELPMAN, E. (1997). The Size of Regions. In D. PINES, E. SADKA & I. ZILCHA (Eds.), *Topics in Public Economics: Theoretical and Applied Analysis* (pp. 33-54). Cambridge; New York and Melbourne: Cambridge University Press.

HELPMAN, E. (1998). The Size of Regions. In D. PINES, E. SADKA & I. ZILCHA (Eds.), *Topics in Public Economics: Theoretical and Applied Analysis* (pp. 33-54). Cambridge; New York and Melbourne: Cambridge University Press.

KEEBLE, D., OWENS, P., & THOMPSON, C. (1982). Regional Accessibility and Economic Potential in the European Community. *Regional Studies, 16*(6), 419-432.

KRUGMAN, P. (1980). Scale Economies, Product Differentiation, and the Pattern of Trade. *American Economic Review, 70*(5), 950-959.

KRUGMAN, P. (1991). Increasing Returns and Economic Geography. *Journal of Political Economy, 99*(3), 483-499.

KRUGMAN, P. (1992). A Dynamic Spatial Model. *NBER Working Paper*, No. 4219.

LAYARD, R., NICKELL, S., & JACKMAN, R. (2005). *Unemployment: Macroeconomic Performance and the Labour Market* (2 ed.). Oxford: Oxford University Press.

LUCAS, R. E., JR. (2001). Externalities and Cities. *Review of Economic Dynamics, 4*(2), 245-274.

LUCAS, R. E., JR., & ROSSI-HANSBERG, E. (2002). On the Internal Structure of Cities. *Econometrica, 70*(4), 1445-1476.

MION, G. (2004). Spatial Externalities and Empirical Analysis: The Case of Italy. *Journal of Urban Economics, 56*(1), 97-118.

NEARY, J. P. (2001). Of Hype and Hyperbolas: Introducing the New Economic Geography. *Journal of Economic Literature, 39*(2), 536.

NICKELL, S. (1997). Unemployment and Labor Market Rigidities: Europe Versus North America. *Journal of Economic Perspectives, 11*(3), 55-74.

NIEBUHR, A. (2006). Market Access and Regional Disparities: New Economic Geography in Europe. *Annals of Regional Science, 40*(2), 313-334.

OTTAVIANO, G. I. P. (2003). Regional Policy in the Global Economy: Insights from New Economic Geography. *Regional Studies, 37*(6/7), 665.

OTTAVIANO, G. I. P., & PUGA, D. (1998). Agglomeration in the Global Economy: A Survey of the 'New Economic Geography'. *World Economy, 21*(6), 707.

OVERMAN, H. G., REDDING, S., & VENABLES, A. J. (2003). The Economic Geography of Trade, Production and Income: A Survey of Empirics. In J. HARRIGAN & E. K. CHOI (Eds.), *Handbook of International Trade*. Basil: Blackwell.

REDDING, S. J., & STURM, D. M. (2008). The Costs of Remoteness: Evidence from German Division and Reunification. *American Economic Review, 98*(5), 1766-1797.

REDDING, S. J., & VENABLES, A. J. (2004). Economic Geography and International Inequality. *Journal of International Economics, 62*(1), 53-82.

ROOS, M. (2001). Wages and Market Potential in Germany. *Review of Regional Research, 21*(2), 171-195.

STANLEY, T. D., & JARRELL, S. B. (1989). Meta-Regression Analysis: A Quantitative Method of Literature Surveys. *Journal of Economic Surveys, 19*(3), 299-308.

TEN RAA, T. (1984). The Distribution Apprach to Spatial Economics. *Journal of Regional Science, 24*(1), 105-117.

Hamburg Contemporary Economic Discussions

(Download: http://www.uni-hamburg.de/economicpolicy/discussions.html)

01/2005	FEDDERSEN, A. / MAENNIG, W.: Trends in Competitive Balance: Is there Evidence for Growing Imbalance in Professional Sport Leagues?, January 2005.
02/2005	SIEVERS, T.: Information-driven Clustering – An Alternative to the Knowledge Spillover Story, February 2005.
03/2005	SIEVERS, T.: A Vector-based Approach to Modeling Knowledge in Economics, February 2005.
04/2005	BUETTNER, N. / MAENNIG, W. / MENSSEN, M.: Zur Ableitung einfacher Multiplikatoren für die Planung von Infrastrukturkosten anhand der Aufwendungen für Sportstätten – eine Untersuchung anhand der Fußball-WM 2006, May 2005.
01/2006	FEDDERSEN, A.: Economic Consequences of the UEFA Champions League for National Championships – The Case of Germany, May 2006.
02/2006	FEDDERSEN, A.: Measuring Between-season Competitive Balance with Markov Chains, July 2006.
03/2006	FEDDERSEN, A. / VÖPEL, H.: Staatliche Hilfen für Profifußballclubs in finanziellen Notlagen? – Die Kommunen im Konflikt zwischen Imageeffekten und Moral-Hazard-Problemen, September 2006.
04/2006	MAENNIG, W. / SCHWARTHOFF, F.: Stadium Architecture and Regional Economic Development: International Experience and the Plans of Durban, October 2006.

Hamburg Contemporary Economic Discussions

(Download: http://www.uni-hamburg.de/economicpolicy/discussions.html)

01	AHLFELDT, G. / MAENNIG, W.: The Role of Architecture on Urban Revitalization: The Case of "Olympic Arenas" in Berlin-Prenzlauer Berg, 2007.
02	FEDDERSEN, A. / MAENNIG, W. / ZIMMERMANN, P.: How to Win the Olympic Games – The Empirics of Key Success Factors of Olympic Bids, 2007.
03	AHLFELDT, G. / MAENNIG, W.: The Impact of Sports Arenas on Land Values: Evidence from Berlin, 2007.
04	DU PLESSIS, S. / MAENNIG, W.: World Cup 2010: South African Economic Perspectives and Policy Challenges Informed by the Experience of Germany 2006, 2007.
05	HEYNE, M. / MAENNIG, W. / SUESSMUTH, B.: Mega-sporting Events as Experience Goods, 2007.
06	DUST, L. / MAENNIG, W.: Shrinking and Growing Metropolitan Areas – Asymmetric Real Estate Price Reactions? The Case of German Single-family Houses, 2007.
07	JASMAND, S. / MAENNIG, W.: Regional Income and Employment Effects of the 1972 Munich Olympic Summer Games, 2007.
08	HAGN, F. / MAENNIG W.: Labour Market Effects of the 2006 Soccer World Cup in Germany, 2007.
09	HAGN, F. / MAENNIG, W.: Employment Effects of the World Cup 1974 in Germany.
10	MAENNIG, W.: One Year Later: A Re-appraisal of the Economics of the 2006 Soccer World Cup, 2007.
11	AHLFELDT, G., MAENNIG, W.: Assessing External Effects of City Airports: Land Values in Berlin, 2007.
12	AHLFELDT, G.: If Alonso was Right: Accessibility as Determinant for Attractiveness of Urban Location, 2007.
13	AHLFELDT, G.: A New Central Station for a Unified City: Predicting Impact on Property Prices for Urban Railway Network Extension, 2007.

Hamburg Contemporary Economic Discussions

(Download: http://www.uni-hamburg.de/economicpolicy/discussions.html)

14 FEDDERSEN, A. / MAENNIG, W.: Arenas vs. Multifunctional Stadia – Which Do Spectators Prefer?, 2007.

15 AHLFELDT, G. / FEDDERSEN, A.: Geography of a Sports Metropolis, 2007.

16 FEDDERSEN, A. / GRÖTZINGER, A. / MAENNIG, W.: New Stadia and Regional Economic Development – Evidence from FIFA World Cup 2006 Stadia, 2007.

17 AHLFELDT, G. / MAENNIG, W.: Monumental Protection: Internal and External Price Effects, 2008.

18 MAENNIG, W. / PORSCHE, M.: Managing the Feelgood at Mega Sport Events – Contributions to an Eclectic Theory Informed by the Experience of the FIFA World Cup 2006, 2008.

19 AHLFELDT, G.: The Train has Left the Station: Real Estate Price Effects of Mainline Realignment in Berlin, 2008.

20 MAENNIG, W. / WELLBROCK, C.-M.: Sozio-ökonomische Schätzungen Olympischer Medaillengewinne: Analyse-, Prognose- und Benchmarkmöglichkeiten, 2008.

21 MAENNIG, W. / ALLERMS, S.: South Africa 2010: Economic Scope and Limits, 2008.

22 AHLFELDT, G. / FEDDERSEN, A.: Determinants of Spatial Weights in Spatial Wage Equations: A Meta-Analysis within a Consistent Framework, 2008.

23 AHLFELDT, G. / WENDLAND, N.: Fifty Years of Urban Accessibility: The Impact of Urban Railway Network on the Land Gradient in Industrializing Berlin, 2008.

Hamburg

Contemporary Economic Discussions

ISSN 1865-2441 (PRINT)
ISSN 1865-7133 (ONLINE)

ISBN 978-3-940369-64-2 (PRINT)
ISBN 978-3-940369-65-9 (ONLINE)