

Bröcker, Johannes

**Book Part**

## Regional welfare effects of the European Monetary Union

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*Suggested Citation:* Bröcker, Johannes (2004) : Regional welfare effects of the European Monetary Union, In: Spatial implications of the European Monetary Union, ISBN 3-88838-232-7, Verlag der ARL - Akademie für Raumforschung und Landesplanung, Hannover, pp. 27-43

This Version is available at:

<https://hdl.handle.net/10419/59985>

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JOHANNES BRÖCKER

# Regional Welfare Effects of the European Monetary Union

## *Contents*

- 1 Introduction
  - 2 Model
  - 3 Calibration
  - 4 Currency Transaction Costs
  - 5 Results
  - 6 Discussion
  - 7 Summary
- References  
Appendix

## **1 Introduction**

The Euro is supposed to have led to a considerable decline of transaction costs between the Euro Zone member states. This is a further step on the way to deepen integration of goods and factor markets in the European Union. Ever since the European Economic Community has been established there was some concern about economic divergence that might be implied by deepening economic integration. It was argued that central regions might gain from increasing agglomeration advantages and attract factors of production from the periphery towards the centre of Europe. This argument has been put forward during the Maastricht-Treaty negotiations and has led to the introduction of the cohesion fund aiming at a compensation for pretended losses or disadvantages in the relatively poor countries of the European Union.

As far as capital markets are concerned, economic integration affects countries only as a whole. There are hardly any effects affecting regions within countries differently, with possible exceptions of financial centres such as Frankfurt and London (HALLET 1999, 2001). Regarding labour markets, incentives for wage bargaining are likely to change. Some authors also argue that employees and unions were subject to currency illusion before the Monetary Union. When these illusions dissolve with the common currency, unions in low productivity countries might opt for excessive wage claims. The German experience is taken as evidence in favour of this hypothesis. This experience does not apply to the European Monetary Union (EMU), however. The incentives for unions and employers in Germany were completely different. It was not Eastern but Western unions and employers' organisations sitting at the bargaining desk in East Germany. Furthermore, East German employees were fully eligible to the West German social security system, then becoming the social security system of entire Germany. Whatsoever, even if EMU would induce excessive wage claims, they are likely not to have effects systematically varying between regions within countries.

Further integration of goods markets brought about by the Monetary Union, however, will have effects varying over space. Different currencies with unpredictably floating exchange rates imply transaction costs affecting regions differently, depending on their respective direct and indirect linkages with foreign countries. This paper studies effects of the Currency Union using a multiregional general equilibrium model. The model is applied in a comparative static analysis, where transaction costs between EMU members are reduced by those amounts, that are supposed to represent the transaction cost savings due to a common currency. Section 2 explains the model and Section 3 its calibration. In Section 4 we try to figure out which transaction cost savings are to be expected from a currency union. The section is mainly based on estimates of GLICK and ROSE (2001) who showed considerable trade creating effects of currency unions in panel and cross-section regressions. Section 5 presents results for countries and regions in the EMU. Some qualifications of these results are discussed in Section 6. The concluding Section 7 summarizes.

## 2 Model

Our Model is a static general equilibrium model for a closed system of regions covering the whole world. The geographical Europe from Atlantic to Ural (including the Asian part of Turkey) is subdivided into 800 regions. Germany for example covers 99 so called “Raumordnungsregionen”. Luxembourg as well as several small countries in Central and Eastern Europe are not subdivided. The rest of the world is subdivided into five regions: North America, Latin America, Africa, Middle East and Asia-Australia-New-Zealand.

In each region reside identical immobile households owning the regional stock of production factors that are immobile as well. Their incomes stem from regional factor returns as well as from an interregional income transfer that can have a positive or negative sign. Income transfers are exogenous (in real terms) and add up to zero for the entire world. Households spend their income for buying goods and services partly produced in their own regions and partly produced in other regions. Households' demand represents total final demand, that means private as well as public consumption and investment. There is no separate public sector in the model; that is households have to be regarded as an aggregate of private and public households, their budget constraint is the consolidated budget constraint of private and public households in the region.

Households are price takers on all markets. They maximize a Cobb-Douglas utility depending on the quantity of local goods and the quantity of an index of diversified tradable goods. Hence, they spend fixed shares  $\varepsilon$  and  $1-\varepsilon$  of their income for local and tradable goods, respectively. Utility changes of households, measured in monetary terms by HICKS' equivalent variation concept, are our measure of regional welfare effects of the Monetary Union.

The production sector is represented by identical immobile firms. There are two types of firms: 1) firms producing local goods and 2) firms producing tradable product varieties. There is no further sectoral differentiation. Local goods are produced under constant returns to scale and, as the name says, can only be used within the region itself. Tradable goods, however, are produced by a “Dixit-Stiglitz-Industry”. Each firm is an exclusive producer of a single product variety supplied under monopolistic competition.

The number of firms is determined endogenously. For each product variety a fixed amount of the local good as well as a variable amount is required, that is proportional to the output. With a constant price elasticity of demand (which is given in our case) this is well known to imply a constant output per product variety. Hence, a region's output of tradable goods is proportional to the number of supplied varieties, and the product price equals unit cost. With an appropriate choice of units the mill price in the diversified sector equals the mill price for local goods, which is called  $p_r$  for region  $r$ .

For the sake of simplicity local goods are assumed to be produced by a Cobb-Douglas-technology with cost shares  $\alpha$ ,  $\beta$  and  $\gamma$  for primary factors, local goods and tradable goods that are used as inputs, respectively. Primary factors are modelled as a single homogeneous factor. One may also regard them as a composite of an arbitrary number of factors combined by a linear homogeneous technology. As we do not distinguish between sectors having different factor intensities, this would be formally equivalent.

Analogous to household consumption, firms use tradable goods as a composite index that is composed of all variants produced anywhere in the world. The same index is used for final demand as for intermediate inputs: as usual, varieties are composed by a symmetrical CES-index, with elasticity of substitution between varieties equal to  $\sigma > 1$ .

The decisive assumption for the issue under study in this paper is that there are transaction costs for goods delivered from region  $r$  to region  $s$  amounting to a share of  $\tau_{rs} - 1$  in the traded value. The local price of a good available in  $s$  and stemming from  $r$  is though  $p_r \tau_{rs}$ . The transaction cost depends on the transport distance and includes a term representing impediments to international trade:

$$\tau_{rs} - 1 = \zeta g_{rs}^\omega + \theta_{kl}. \quad (1)$$

$g_{rs}$  is the transport distance from  $r$  to  $s$ , measured as the shortest travel time of a route through the road network.  $\zeta$  and  $\omega$  are parameters.  $0 < \omega < 1$  takes account of the fact that transport cost increases less than proportional with increasing distance. If  $r$  notes a region in country  $k$  and  $s$  a region in a different country  $l$ , then  $\theta_{kl}$  is the tariff equivalent of impediments to international trade from country  $k$  to country  $l$ . For example,  $\theta_{kl} = 0.1$  means that the trade impediment is equivalent to a 10% tariff rate.  $\theta_{kl} = 0$  for  $k = l$ , by assumption.

Trade impediments partly consist of tariffs (outside the EU), partly of administrative non-tariff barriers, and partly of cost of communication, contracting, monitoring etc. that are specific to international trade, and partly of cost resulting from different currencies. This latter cost is subject of our analysis. Simulating the effects of a currency union simply consists in reducing  $\theta_{kl}$  by a certain amount for pairs of countries jointly becoming EMU members. The appropriate amount of reduction will be discussed in the next section. Even though some trade impediments outside the EU consist in tariffs generating public income (to the extent that they are not completely used up by the customs administration), all expenditures for overcoming trade impediments are modelled as lost resources. Trade impediments are not measured directly, but drop out from the calibration procedure. They are calibrated such that international trade flows generated in the models' equilibrium are equal to observed trade flows.

In the general equilibrium one also has to specify where resources for performing the transactions come from. The standard approach is the “iceberg assumption” saying that, for performing the transaction, a certain share of a transferred good itself is used up (melts). We use a slightly different approach. According to our assumption not the individual good, but a certain amount of the composite tradable that is available in the region of destination, is used up. Hence, the composite tradable serves a triple purpose, it is used for transactions, it is used for consumption, and it is used as an intermediate good in production.

The explained assumptions imply the equilibrium to consist of a system with four equations per region determining four unknowns per region. This system of equations describes the market for tradable goods. The four unknowns are:

- $S_r$ : value of tradable goods supply from region  $r$ , valued at mill prices;
- $D_r$ : value of demand for tradable goods in region  $r$  valued at local prices, that is including transaction cost;
- $p_r$ : mill price for goods from region  $r$ ;
- $q_r$ : composite price per unit of tradable goods used in region  $r$ .

The corresponding four equations are (see the appendix for derivation):

$$S_r = \phi_r p_r (p_r / q_r)^{\gamma/\alpha} - \varepsilon G_r, \quad (2)$$

$$D_r = S_r + G_r, \quad (3)$$

$$q_r = \psi \left[ \sum_s S_s p_s^{-\sigma} \tau_{sr}^{1-\sigma} \right]^{\frac{1}{1-\sigma}}, \quad (4)$$

$$p_r = \left[ \frac{\sum_s \tau_{rs}^{-\sigma} D_s}{\sum_t S_t (p_t \tau_{ts})^{-\sigma}} \right]^{\frac{1}{\sigma}}. \quad (5)$$

$\gamma$ ,  $\alpha$ ,  $\varepsilon$ ,  $\sigma$  and  $\tau_{rs}$  are parameters that have already been explained.  $\phi_r$  is a further parameter measuring the effective regional stock of factors.  $\psi$  is a parameter scaling units of the composite good; its choice is arbitrary, having no consequences for the result. Finally,  $G_r$  is the exogenous interregional transfer already mentioned.

Note that the system of equations fixes nominal variables only up to a factor, as it should be. If, for any solution, all prices and values (including  $G_r$ ) are multiplied by an arbitrary positive factor, we obtain another solution that is however unchanged in real terms. Even though the equation system is not simple it can be solved for a world with more than 800 regions.

### 3 Calibration

In order to perform simulations we have to assign numerical values to all parameters. In the above equation system everything with a Greek symbol is a parameter. From national accounts one can infer that the shares of factors and intermediate goods in production costs have a ratio of 2:3, approximately. Furthermore, as a plausible guess, we assume a ratio of 2:3 between the respective shares of tradable and local goods in consumption and in production cost. This implies  $\alpha=0.4$ ,  $\beta=0.36$ ,  $\gamma=0.24$  and  $\varepsilon=0.6$ . Sensi-

tivity analysis shows that deviations from these specifications in a plausible range are non-critical. The parameter  $\phi_r$  is chosen such that the regional GDPs in the equilibrium solution coincide with observations. Observations are taken from the benchmark year 1995.

The remaining parameters are  $\sigma$  as well as those parameters determining  $\tau$  according to equation (1), namely  $\zeta$ ,  $\omega$  and  $\theta$ . In this context we exploit the fact that trade flows, measured in mill prices, follow a gravity equation, according to equation (2):

$$t_{rs} = A_r \tau_{rs}^{-\sigma} B_s \quad (6)$$

with

$$A_r = S_r p_r^{-\sigma} \quad (7)$$

and

$$B_s = \frac{D_s}{\sum_t S_t (p_t \tau_{ts})^{-\sigma}} \cdot \quad (8)$$

According to (1)

$$\tau_{rs} \approx \exp(\zeta g_{rs}^{\omega} - \sigma \theta_{kl}),$$

because  $\tau_{rs}$  is sufficiently close to 1. Inserting this into (6) yields

$$t_{rs} = \exp(a_r + b_s - \sigma \zeta g_{rs}^{\omega} - \sigma \theta_{kl}), \quad (9)$$

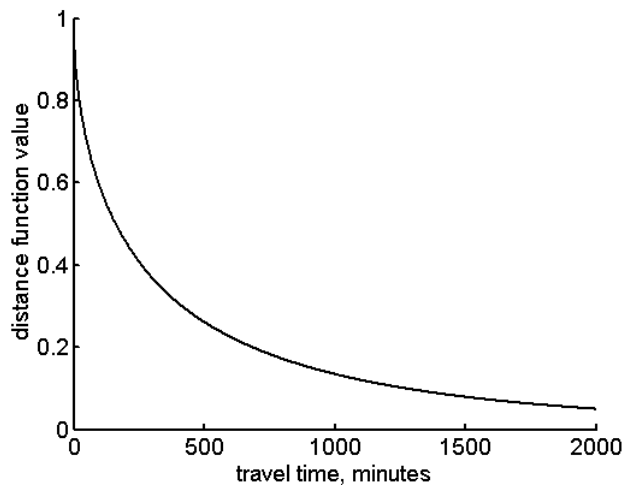
with  $a_r = \log A_r$  and  $b_s = \log B_s$ . We estimate this equation by a non-linear regression using data on international trade, because interregional trade data on a sub-national level are lacking.  $a_r$  and  $b_s$  are estimated as fixed effects, associated with the countries of origin and destination, respectively.  $\theta_{kl}$  is estimated as a linear function of dummies representing common languages and other influences. Unfortunately,  $\sigma$  is, however, not identified, but only the combinations  $\sigma \zeta$  and  $\sigma \theta_{kl}$  (the latter only up to an additive constant). We obtain highly significant and robust estimates for  $\sigma \zeta$  and  $\omega$  implying a “distance function”

$$f(g_{rs}) = \exp(-\sigma \zeta g_{rs}^{\omega})$$

shown in Figure 1. The distance function shows the factor by which a trade flow is reduced in comparison to a trade flow with a zero distance. The estimate of  $\omega$  is  $\hat{\omega} = 0.58$  which means that one obtains the expected concave shape of the transaction cost function.

As the gravity estimate does not allow for a separate identification of  $\sigma$  and  $\zeta$ , respectively, other information is required. According to equation (1),  $\zeta$  determines the distance related transaction cost. According to the literature about logistics, these costs have a share between 5% and 10% in the traded value. Reproducing these shares in the equilibrium solution implies a  $\sigma$ -parameter in the range of 15 to 25. As these elasticities are high in comparison to what is usually assumed in the literature, we choose  $\sigma = 16$ , that is a value at the lower bound of this range. Figure 2 shows the transaction cost  $\hat{\tau}_{rs} = \exp(\hat{\zeta} g_{rs}^{\hat{\omega}})$  as a function of time distance as implied by these parameter choices.

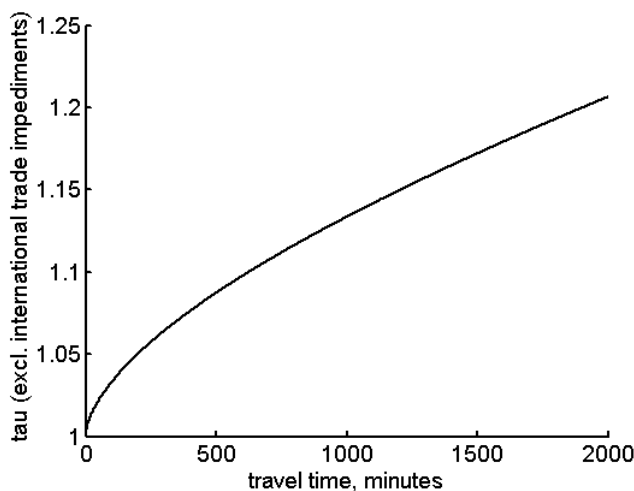
Figure 1: distance function  $f(g_{rs})$



Source: Own calculations

Some authors (e.g. HUMMELS 1999) present  $\sigma$ -estimates in the order of 3 to 8. These estimates, however, imply implausibly high transaction costs. Anyway we do not trust HUMMELS' estimates because of his non-sensible specification  $\tau_{rs} = g_{rs}^{\delta}$  implying the transaction cost for sufficiently small distances to become negative!

Figure 2: transaction-cost function



Source: Own calculations

Finally, the tariff equivalents  $\theta_{kl}$  have to be determined. They are calibrated such that international trade flows in the equilibrium solution coincide with observed international trade for 1995. Thereby we assume symmetry,  $\theta_{kl} = \theta_{lk}$ , because otherwise the tariff equivalent would not be identified.

Beyond parameters, exogenous transfers  $G_r$  have to be specified as well. As already mentioned, these equal the regional trade balance deficits. There are no observations for regional trade balance deficits. Therefore we simply divide the national trade balance deficit by region proportional to regional GDPs. We only make an exception for Germany because of the extremely high transfers from West Germany to East Germany. In this case we subdivide the total East German trade deficit, which is known, by region

according to GDP. The influence of variations of  $G_r$  in plausible ranges is negligible, according to our sensitivity analysis.

#### 4 Currency Transaction Costs

The transaction costs in international trade,  $\theta_{kl}$ , are partly due to costs resulting from the fact that different countries have different currencies, as already mentioned. The impact of these costs on trade can be estimated by a regression, again applying trade equation (9) to international trade. An estimation is possible if we have data for country pairs not having a common currency as well as for country pairs with a common currency.

Let  $\theta_{kl} = \mu_{kl} + \pi \cdot z_{kl}$ , with  $\mu$  representing currency costs (measured as tariff equivalents),  $z_{kl}$  denoting a vector of further explaining variables (dummies for common language etc.) and  $\pi$  denoting a parameter vector of appropriate length. Furthermore, let

$$\mu_{kl} = \begin{cases} \bar{\mu} & \text{if } k \text{ and } l \text{ have different currencies,} \\ 0 & \text{else.} \end{cases}$$

Then one substitutes for  $\theta_{kl}$  in equation (9) and estimates the regression for international trade:

$$t_{kl} = \exp(a_k + b_l - \sigma \zeta g_{kl}^{\omega} - \sigma \bar{\mu} \delta_{kl} - \sigma \pi \cdot z_{kl}) + u_{kl} \quad (10)$$

with dummy

$$\delta_{kl} = \begin{cases} 1 & \text{if } k \text{ and } l \text{ have different currencies,} \\ 0 & \text{else.} \end{cases}$$

$u_{kl}$  is the error term. Again, only the product  $\sigma \bar{\mu}$  is identified, not the cost-component  $\bar{\mu}$  itself. As mentioned in the beginning we rely on regression estimates of ROSE (2000), ROSE and VAN WINCOOP (2001) and GLICK and ROSE (2001), who use regression equations such as equation (10). ROSE and van WINCOOP estimate the equation for a pool of three cross-sections (1980, 1985 and 1990) with 143 countries, taking the endogeneity of  $a_k$  and  $b_l$ , as shown by equations (7) and (8), into account. These estimates correct earlier ones by ROSE (2000) that neglected these endogeneities. Different from equation (9), these authors specify a distance influence as  $\log g_{kl}$  rather than  $g_{kl}^{\omega}$ . This makes no sense, as it implies  $\tau_{kl} = 0$  for  $g_{kl} = 0$ . The estimated currency union effect, however, which only interests us here, is sufficiently robust such that this difference can be disregarded. The resulting estimate is  $\sigma \bar{\mu} = 0.91$ , which is an enormously high value. According to this estimate, trade between countries with a common currency is 2.5 as large as trade between countries without a common currency, *ceteris paribus*<sup>1</sup>.

An obvious problem of this estimate is the potential endogeneity of the establishment of a currency union. If the currency union was endogenous, this parameter estimate just

<sup>1</sup> In this case the *ceteris-paribus* clause also includes the multipliers  $a_k$  and  $b_l$ , that in fact depend on  $\bar{\mu}$  and therefore can not be taken as constant. In general equilibrium, trade increases by less than the factor 2.5 if currency costs are reduced to zero [see the discussion of this point in ANDERSON and VAN WINCOOP (2001)].



expresses the fact that countries trading intensively with one another for what reason ever are inclined to form a currency union. In this respect the estimate of GLICK and ROSE (2001) is less vulnerable. These authors estimate the effect of a common currency in a panel covering a time series of trade matrices, catching all influences that are specific for country pairs but constant over time by fixed country pair effects. In this case the effects of a currency union are based on observations of the change in trade over time that is synchronous with entering a currency union or exit from a currency union.

If the unobserved reasons making countries trade intensively with one another remain constant over time, these reasons are not contained in the parameter now anymore. However, we can not be sure about the constancy of these reasons either. Many currency unions cover less developed countries. Here it is possible that unobserved political events are the reasons for both, decreasing trade as well as dissolution of currency unions, even though the latter may not influence the former.

A further problem is that the observations mainly contain exits from currency unions, not entries. Note that the estimate only depends on exits and entries. Effects of a currency union existing over the whole observation period of the panel are not measured by the parameter but are fully contained in the country-pair specific dummies. If we use these estimates for simulating the Euro effect, we apply evidence from dissolutions of currency unions to the formation of a currency union. Obviously this is a problem, but unfortunately formations of currency unions are rare events in recent history such that there is only little evidence about their effect.

Using the panel estimate, GLICK and ROSE (2001) come up with a smaller, but still considerable estimate of  $\sigma\bar{\mu}=0.65$ , corresponding to a doubling effect of a currency union on trade, *ceteris paribus*<sup>2</sup>. We use this as an estimate for variant I of our results. Taking as given our guess for the elasticity of substitution ( $\sigma=16$ ), this estimate implies a tariff equivalent  $\bar{\mu}$  of 4%.

Simulating welfare effects of EMU by reducing all trade impediments  $\theta_{kl}$  between EMU members uniformly by this amount generates welfare gains that are particularly large in the Netherlands, Belgium, Luxembourg and in the western parts of Germany. This means in a European context that it's relatively rich regions that are the beneficiaries of the EMU. Given our basic question this is in fact a politically important result. One can object, however, that a currency union is likely to reduce transaction cost differently for different pairs of countries. In particular, transactions between Germany and other countries were probably cheaper than transactions between countries other than Germany among each other before EMU. This is because the DEM played an import role as a vehicle currency that was not only used in transactions with Germany, but also in transactions between other countries among each other. We try to take account of different levels of transaction costs before EMU in variants II and III in our results by introducing proxies for transaction costs among different currencies. Using these proxies we construct estimates  $\hat{\mu}_{kl}$  varying over pairs of countries such that the weighted average over all country pairs of the EMU equals  $\hat{\mu}=0.65/\hat{\sigma}$ . Trade volumes are taken as weights.

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<sup>2</sup> Remember the qualification of the *ceteris paribus* clause.

One proxy related to transaction costs is the bid-ask spread, that is the percentage deviation of the ask from the bid exchange rate. We use daily exchange rates in inter bank exchange, averaged over the days of January 1996 (excluding weekends). The rates are very stable over time: each day (except 27.1.96, which is obviously disturbed by special influences) correlates with the average with a correlation coefficient between 0.93 and 0.97. The matrix of spreads is close to symmetry. The lower left triangle in Table 1 shows spreads averaged over both directions. The range is between 0.05 per thousand (NLG-DEM)<sup>3</sup> and 2.4 per thousand (FIM-IEP). The non-weighted average is 1.2 per thousand, the standard deviation is 0.5 per thousand.

The pattern of the matrix is plausible. The entries are well approximated by a sum of two amounts relating to the respective currencies. That means, for the spread  $s_{kl}$  we have

$$s_{kl} \approx \bar{s}_k + \bar{s}_l.$$

Table 2 shows least square estimates of  $\bar{s}_k$ . Obviously DEM is by far the cheapest, FIM and IRL are the most costly currencies. Spreads are the higher, the smaller the respective transaction volume and the higher the volatility of the respective currency was in the past. Regressing spreads on volatilities (as measured as explained below) and trade volumes (as proxies for transaction volumes) over the respective country pairs shows a highly significant impact of both variables with expected signs, positive for volatility and negative for trade volume.  $R^2$  is 0.57. Hence, spreads seem to be a plausible indicator for transaction costs between the respective currencies. Therefore we fix  $\mu_{kl}$  proportional to spreads for EMU countries  $k$  and  $l$ ,  $k \neq l$ , in variant II of our estimates. As already said, the weighted average is held constant at the same level as for variant I.

In variant III  $\mu_{kl}$  is fixed proportional to the volatilities of the exchange rate between their respective currencies, measured ex post over the period 1992-1995. This is because transaction costs to a large extent do not result directly from the cost of exchange itself, but from the uncertainty of price predictions.

Table 1: Volatility (upper right) and spread (lower left) in per thousand

	DEM	FRF	ITL	NLG	BEF	IEP	GRD	ESP	PTE	FIM	ATS
DEM	-	1.6	4.7	0.2	1.4	4.7	4.6	5.9	2.9	5.2	4.4
FRF	0.2	-	4.3	1.6	1.5	4.7	4.7	5.7	2.9	5.2	4.7
ITL	0.4	0.5	-	4.7	4.6	5.9	6.0	6.6	5.0	6.2	6.4
NLG	0.1	0.7	1.0	-	1.4	4.7	4.6	5.9	2.9	5.2	4.4
BEF	0.1	0.9	1.2	0.4	-	4.8	4.8	5.8	2.9	5.2	4.7
IEP	1.6	1.5	1.8	1.6	1.7	-	4.4	5.8	5.0	6.3	4.5
GRD	0.9	0.8	1.1	0.8	0.9	1.6	-	4.9	5.0	6.6	3.3
ESP	1.1	0.9	1.2	1.0	1.1	1.8	1.0	-	5.5	7.2	4.9
PTE	0.4	1.1	1.4	1.2	1.2	2.0	1.2	1.4	-	5.6	5.0
FIM	1.0	1.5	1.8	1.6	1.6	2.4	1.6	1.8	1.9	-	6.6
ATS	0.9	0.8	1.1	0.8	0.9	1.6	0.8	1.0	1.2	1.6	-

Source: WWW.OANDA.COM 2002; own calculations

<sup>3</sup> Currencies are: German Mark (DEM), French Franc (FRF), Italian Lira (ITL), Dutch Guilder (NLG), Belgian Franc (BEF), Irish Pound (IEP), Greek Drachma (GRD), Spanish Peseta (ESP), Portuguese Escudo (PTE), Finish Mark (FIM) and Austrian Schilling (ATS).

Table 2: Country components of volatilities and spreads in per thousand

	DEM	FRF	ITL	NLG	BEF	IEP	GRD	ESP	PTE	FIM	ATS
Spread	0.03	0.27	0.57	0.31	0.41	1.24	0.48	0.67	0.75	1.15	0.48
Volat.	1.14	1.28	3.23	1.12	1.30	2.81	2.60	3.64	1.93	3.77	2.60

Source: WWW.OANDA.COM 2002; own calculations

It would be preferable to measure uncertainties ex ante by implied volatilities, obtained from option prices. There are no appropriate data for all pairs of countries, however. Hence, we choose a common volatility measure, namely the standard deviation over daily relative changes of exchange rates. For volatility predictions in applied option pricing this standard deviation is usually calculated over sixty days. Such simple predictions outperform predictions obtained from sophisticated time series models, according to KRONER (1996). Hence, we stick to the simple standard deviation measure. As we are interested in long term patterns, however, we prefer a longer time period. Our measure is the standard deviation over daily log changes of exchange rates between 1.1.1992 and 31.12.1995. Exchange rates are taken from (WWW.OANDA.COM 2002). The upper triangle in Table 1 shows volatilities in per thousand per day. The range is between 0.2 per thousand (HFL-DEM) and 7.2 per thousand (FIM-ESP). The non weighted average of volatilities is 4.6 per thousand, the standard deviation is 1.5 per thousand. FIM, ESP and ITL were the most volatile currencies over the observation period.

## 5 Results

Welfare gains by country, measured as equivalent variations as a percentage share in GDP, are shown in Table 3. Belgium and Luxembourg are merged under BEF. Taking all member countries together, the welfare gain is approximately 1% of GDP. Not surprisingly, the overall level for the whole EMU hardly differs between variants, because the savings are assumed to be equal in all three variants, on average. According to variant I, in which equal savings are assumed for each country pair, small open economies like the Netherlands and Belgium/Luxembourg gain most. The pattern changes considerably with the two other variants. The gains are larger for Ireland, Finland, Austria, Portugal and Spain, who had relatively high costs of currency exchange before EMU, because these differences are accounted for in variants II and III. The effects for Germany and the Netherlands are correspondingly smaller in variants II and III, as compared to variant I.

The spatial patterns are depicted in Figures 3 to 5. The left and right maps in Figures 3 to 5 show the same numbers, respectively. The right maps are just differently classified zooms of the left maps, respectively, showing clearer the spatial variation in Germany and neighbouring countries.

According to variant I, relative effects correlate significantly positive ( $r = 0.29$ ) with GDP per capita over regions. Correspondingly, absolute effects per capita correlate even stronger ( $r = 0.57$ ) with GDP per capita. Hence, taking this serious, we would have to conclude that, on average, richer regions gain more than poorer ones from establishing the EMU. This result turns out not to be robust, however. It relies on the assumption that the relatively rich regions in the centre of Western Europe save transaction costs to the same extent as more peripheral regions. As the analysis of spreads and volatilities

shows, however, this is not the case. Germany, the Netherlands and France enjoyed relatively low costs of international transactions before EMU. In Variants II and III, taking this fact into account, we therefore do not observe higher gains in richer regions. The correlation of relative welfare gains with GDP per capita is virtually zero in these variants. Therefore, EMU turns out to be neutral with regard to spatial effects measured in relative terms. We trust more in the results of variants II and III rather than those of variant I because more information about pre-EMU transaction cost is incorporated in the estimates of variants II and III. We may therefore conclude that the EMU does not contradict the cohesion objectives of the European Union. This is our first empirical result.

Table 3: National welfare effects of EMU, equivalent variations in percent of GDP

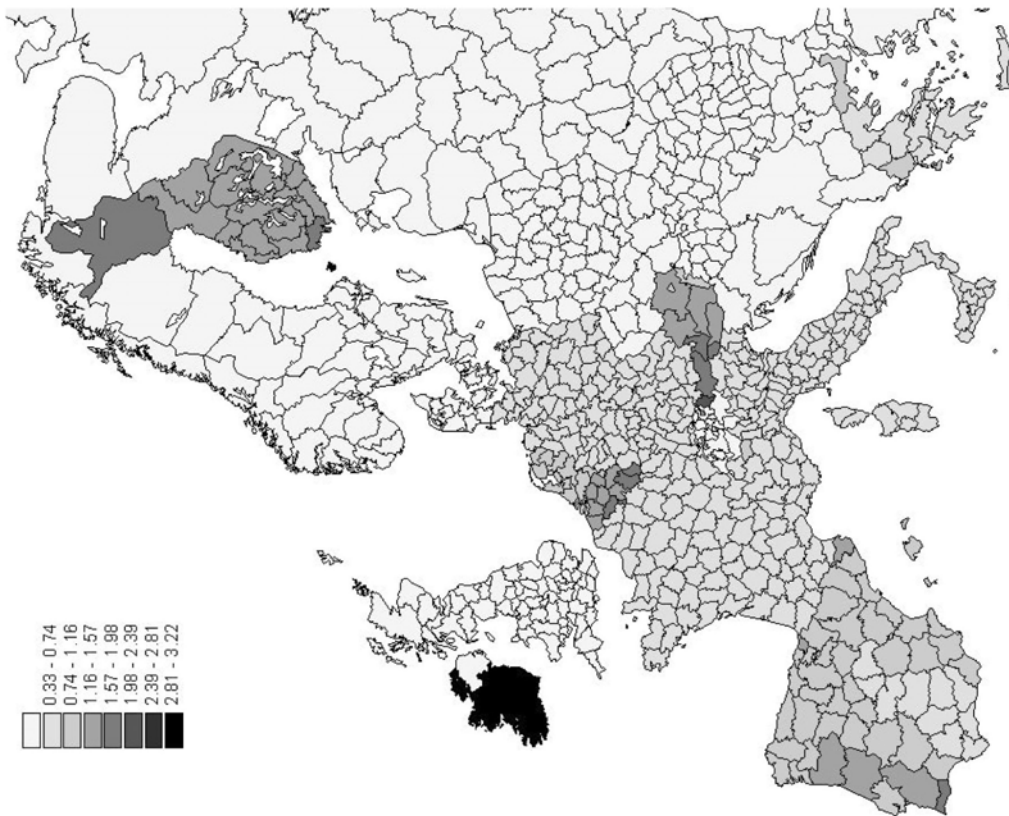
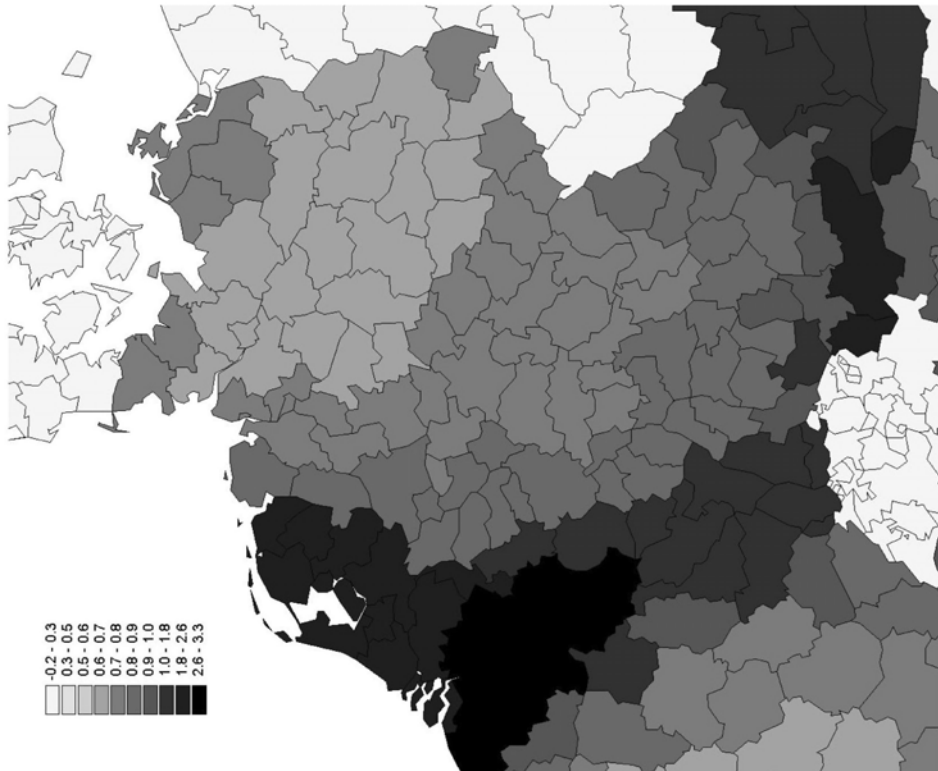
variant	DEM	FRF	ITL	NLG	BEF	IEP	GRD	ESP	PTE	FIM	ATS	EMU
I	0.8	0.8	0.6	2.1	2.8	1.4	0.5	0.7	1.0	0.7	1.4	1.1
II	0.5	0.7	0.8	1.7	3.0	6.6	0.9	1.6	2.4	2.8	2.6	1.1
III	0.7	0.7	1.2	1.1	1.7	2.7	0.9	1.7	1.3	1.7	2.5	0.9

Source: Own calculations

Figures 4 and 5 show regional results for variants II and III. Despite of different measurements of transaction costs before EMU, the spatial patterns of all three variants show close similarities. The results of variant I correlate with those of variants II and III with  $r = 0.75$  and  $r = 0.81$ , respectively. Variants II and III show the closest correlation ( $r = 0.88$ ). The similarity of intranational spatial patterns appears as lines of points in the scatter plot in Figure 6. The extreme outliers on the right in variant II are Ireland and a Finish region (Ålands).

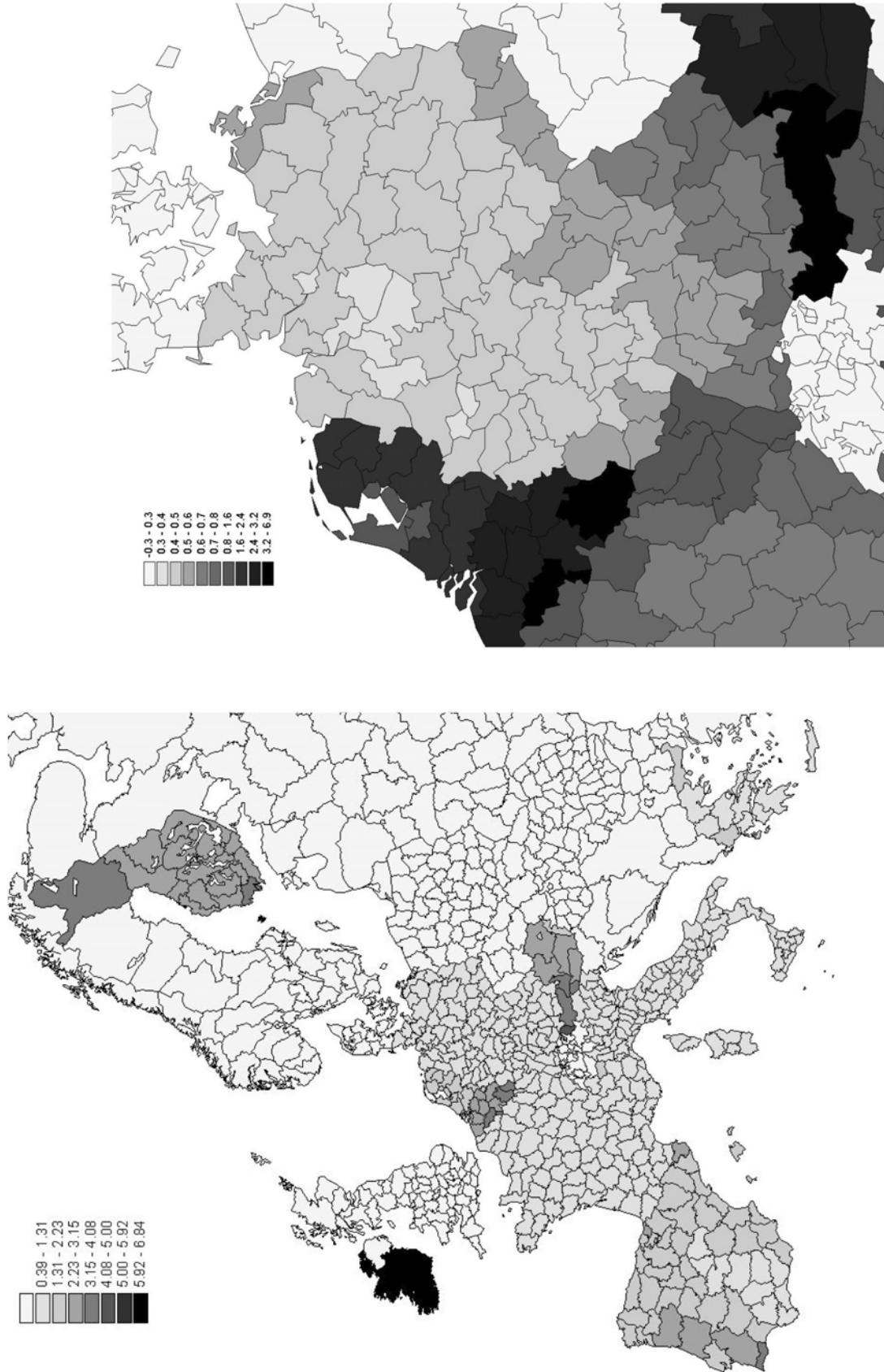
Within each country the pattern is governed by the gravity hypothesis that is implied by the model. Regions close to the border trade more intensively with foreign countries and therefore gain relatively more from transaction costs savings than regions in the respective centres of a country. According to variant II, relative effects in Germany range from 0.4% for the region Südheide (Lower-Saxony) to 0.8% for the region Rosenheim (Bavaria). In spite of the pronounced distance effect, the standard deviation of relative effects is with 0.1% still small.

Figure 3: Regional welfare effects of EMU, equivalent variations, percent of GDP, variant I



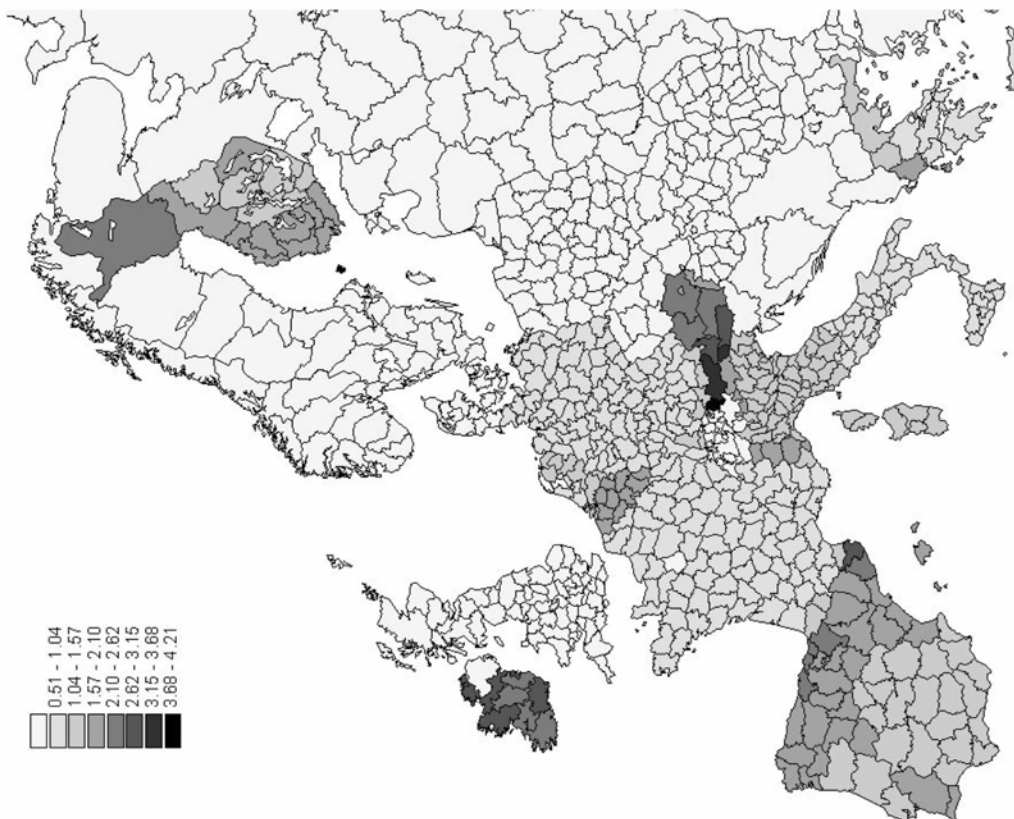
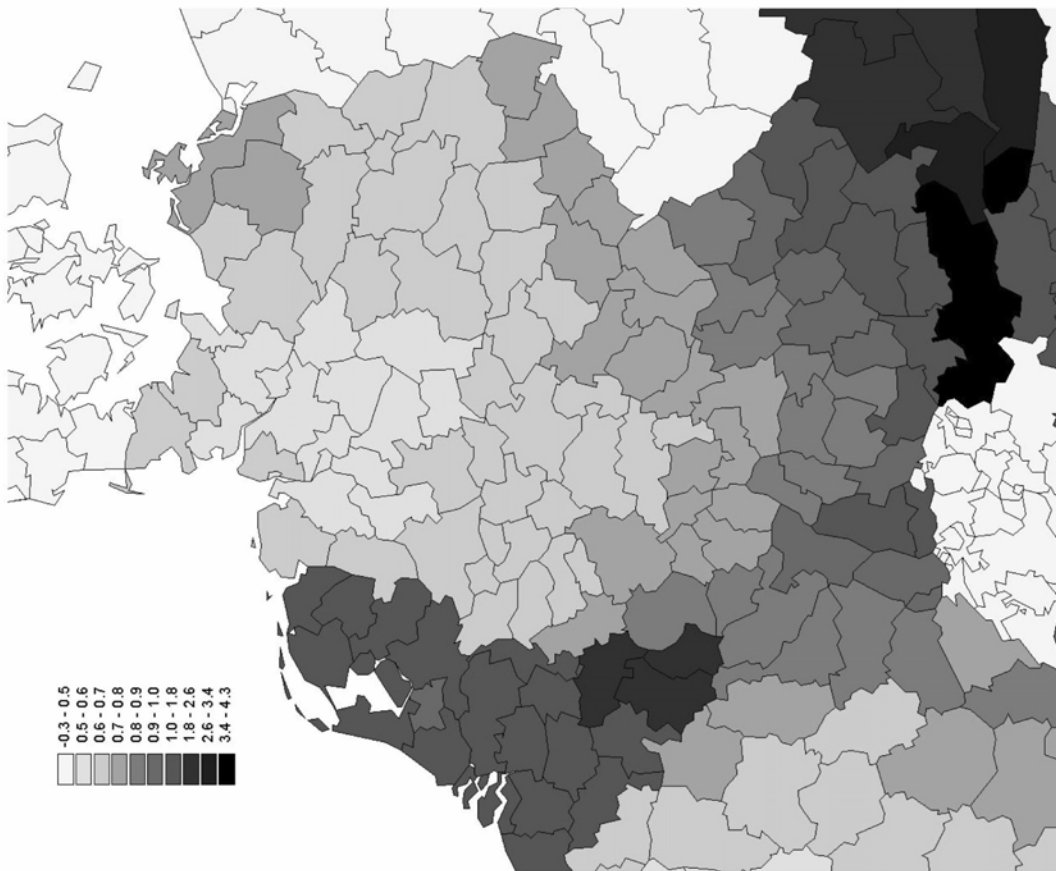
Source: Own calculations

Figure 4: Regional welfare effects of EMU, equivalent variations, percent of GDP, variant II



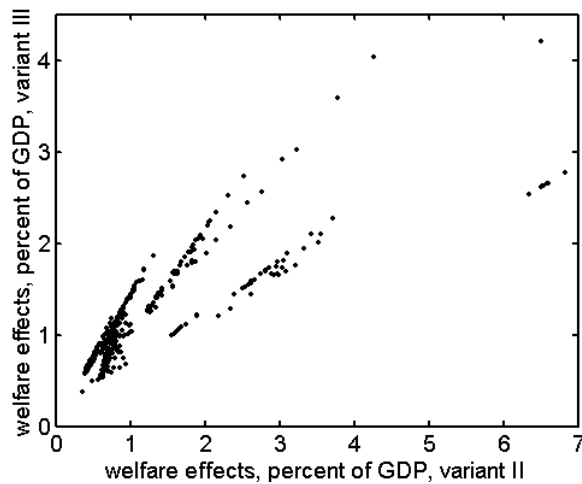
Source: Own calculations

Figure 5: Regional welfare effects of EMU, equivalent variations, percent of GDP, variant III



Source: Own calculations

Figure 6: Correlation between effects according to variants II and III, respectively



Source: Own calculations

## 6 Discussion

To be sure, the numerical results must not be taken as precise estimates. They should rather be regarded as model-based guesses. The characteristic spatial pattern within the countries, with stronger effects close to the borders to other EMU countries, results from the gravity hypothesis that is an integral part of the model. We have not used any direct information about international trade intensities on the regional level. But in judging the reliability one should be aware that hardly any hypothesis in empirical economics is that robust as the gravity hypothesis, such that we feel justified to take it as a central pillar to base our guesses about spatial effects of EMU on.

The deviation of effects in regions close to the border from those more distant from the border depends on the distance sensitivity of trade. This sensitivity is measured by the combined parameter  $\sigma\zeta$  in our model. At least for foreign trade, the estimate of this parameter is highly reliable, though the application of the parameter obtained from international trade to interregional trade could be called in question, of course. More uncertain than the regional distribution of effects are the estimates of the national levels. The regression estimates that our results are based on deliver just one single parameter for the suggested effect of a currency union, and additional assumptions had to be introduced in order to come up with estimates of cost savings specific to each country pair. To be sure, spreads and volatilities are just rough proxies for transaction costs by country pairs.

Even more doubts are in order with regard to the overall level of welfare effects, because it is inversely proportional to  $\sigma$ , the elasticity of substitution between tradable product varieties. The econometric estimates from the literature deliver only an estimate of a combined parameter  $\sigma\bar{\mu}$ , but the tariff equivalent  $\bar{\mu}$  itself is not known. It is only obtained after fixing  $\sigma$ , and as the estimates of  $\sigma$  are very uncertain, those of  $\bar{\mu}$  are uncertain as well. Doubling  $\sigma$  halves the level of welfare effects, and vice versa. Following the literature, ROSE and VAN WINCOOP (2001) assume  $\sigma$  to be equal to 5, which makes them go that far as to claim the establishment of the EMU to generate a welfare gain amounting to 11% of GDP of the participating countries! Except that this estimates must be called into doubt also for other reasons not discussed in this paper, an



estimated tariff equivalent of transaction costs amounting to 13% of the trade value, as implied by  $\sigma=5$ , is clearly a severe exaggeration of the level of transaction costs before EMU. Note that these transaction costs are not payments generating an income to other agents in the economy, but lost resources due to the necessity of handling different currencies. Cost savings due to EMU of such a magnitude are absurd, taking results from questionnaire studies (IFO INSTITUTE 1998) into consideration. Even our implicit estimate of a tariff equivalent of 4% of the trade values is still high, compared to the empirical studies just mentioned. Hence, the overall level of effects is still uncertain, and even 1% of GDP seems to be quite optimistic.

## 7 Summary

The reduction of transaction cost in international trade brought about by EMU is likely to lead to a deeper integration of labour, capital and goods markets. While effects on factor markets will hardly generate any impact differing by region, goods market effects will affect regions differently, depending on their respective international trade intensities. This paper estimates welfare effects resulting from reduced transaction costs in international trade, using a static multiregional general equilibrium model. The kernel of the model is the trade part specified in Dixit-Stiglitz-style. Interregional trade shows a gravity pattern due to transaction costs depending on distance. Transaction cost reductions brought about by EMU are based on econometric estimates by GLICK and ROSE, relying on trade intensification following the establishment of other currency unions worldwide.

According to our results EMU could imply a welfare gain for the participating countries amounting to 1% of GDP annually. This is considerably less than the authors just mentioned have suggested, but still all but a negligible quantity. The aim of this paper was, however, to estimate the spatial distribution rather than the overall level. There is some concern that the spatial effect of EMU might contradict the cohesion objectives of the European Union in benefiting richer regions in central Europe more than relatively poorer ones.

Our simulation results show this concern not to be substantiated. We find neither a positive nor a negative correlation of relative effects with base year levels of GDP per capita. The highest gains are predicted for regions close to the borders. These regions are supposed to have the highest trade intensities with partner countries and therefore gain most from saving of transaction costs in international trade.

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## Appendix

Let  $F_r$  denote the stock of factors,  $w_r$  the factor price and  $P_r$  the value of production in region  $r$ . From the Cobb-Douglas assumption we get  $w_r F_r = \alpha P_r$  and  $p_r = w_r^\alpha p_r^\beta q_r^\gamma / \nu_r$ , with the level of productivity of  $\nu_r$ . Solve the latter equation for  $w_r$  and insert  $w_r$  as well as  $P_r = w_r F_r / \alpha$  into the equation  $S_r = P_r - \beta P_r - \varepsilon(w_r F_r + G_r)$  stating that tradables supply equals output minus local goods, both in value terms. The value of local goods is the value of intermediate ( $\beta P_r$ ) and final ( $\varepsilon(w_r F_r + G_r)$ ) use of local goods. This yields equation (2) with  $\phi_r = (1 + \gamma / \alpha - \varepsilon) \nu_r^{1/\alpha} F_r$ .

Equation (3) is the regional budget constraint. Equation (4) is the well-known CES-price-index

$$q_r^{1-\sigma} = \sum_s \ell_s (p_s \tau_{rs})^{1-\sigma}$$

with number of variants  $\ell_s$  in region  $s$ .  $\ell_s$  is proportional to the real output  $S_s / p_s$ , which yields equation (4).

Finally, as to equation (5): The expenditure share of the respective region of origin  $r$  in expenditures for tradables in region  $s$  is proportional to  $\ell_r (p_r \tau_{rs})^{1-\sigma}$ , hence proportional to  $S_r p_r^{-\sigma} \tau_{rs}^{1-\sigma}$ . These shares include the respective transaction cost. Hence, expenditures for purchases from  $r$ , valued at mill prices, are proportional to  $S_r (p_r \tau_{rs})^{-\sigma}$ . Summing these purchases over  $r$  yields  $D_s$ . Thus deliveries from  $r$  to  $s$ , valued at mill prices, are

$$t_{rs} = \frac{S_r (p_r \tau_{rs})^{-\sigma}}{\sum_t S_t (p_t \tau_{ts})^{-\sigma}} D_s. \quad (11)$$

Inserting  $t_{rs}$  from equation (11) into the equilibrium condition  $S_r = \sum_s t_{rs}$  and solving for  $p_r$  yields equation (5). A similar expression would be obtained from the standard iceberg-assumption, with the only difference that the  $\tau$ s in the nominator and denominator are raised to the power  $1-\sigma$  rather than  $-\sigma$ . This difference is negligible for large  $\sigma$ .