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Borders matter!: Regional integration in Europe and North America

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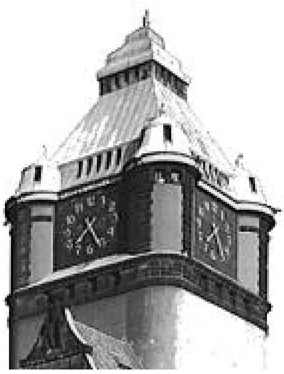
- Regional Integration in Europe and North America -

by

Ulrich Blum



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Borders Matter!

- Regional Integration in Europe and North America -

Ulrich Blum

Abstract
We analyze the spatial interaction among regions in North America and in Western Europe. We use a gravity model extended by a spatial correlation structures where data allows to evaluate the level of impact and the length of the spatial tail. This allows us to address to effects external to the gravity model: level of impact of neighboring regions on the region and size of the cluster of regions. We find that the methodology employed improves the statistical quality of results and their economic interpretation. We conclude that national borders matter and that North America is more polarized in the sense of connected clusters whereas regions Europe externalities are more evenly distributed. We argue that this relates to different types of institutional arrangements with effects on the spatial division of labor.

JEL-categories: C2, F1, L1, R1

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Contents

1. Do Borders Matter?

When on January 1st, 2002, the European currency union will irrevocably be completed, it is assumed that a convergence process that started in the Fifties with the founding of the European Economic Community has reached a sufficient stage not to generate any internal destabilizing effects. But is this really the case? Numerous articles portray, on the one side, that convergence among European nations is strong, on the other hand, that national borders still matter, that to say that "the world is becoming 'borderless' (MCCALLUM 1995) is at least premature. May economic convergence, a synonym for economic "stability", be compatible with border effects, i.e. separation effects?

In this paper, we take up the issue of economic impacts of borders and carry it into two directions:

(1) in a broader sense, we see borders as and additional element of distance (i.e. a metric) because of cultural, linguistic and judicial differences.

(2) in a narrower sense, spill-over effects may tie certain regions more together tan others, may lead to positive effects (convergence) or negative effects (divergence).

Economists have used concepts approaches to answer these questions by formulating the problem in terms of neoclassic stability, in terms of growth paths or in terms of spatial interaction. All of these approaches, however, only answer to some of the questions and leave others unanswered:

(1) Neoclassic theory has concentrated on the convergence and divergence among sets of regions relative to a steady-state equilibrium and sometimes conditional to other effects, i.e. borders. This work has been tremendously influenced by BARRO and SALA-I-MARTIN (1996) and has led to a family of models covering most of the industrialized world. They are either based on the assumption of a steady state situation around which individual regions are positioned (BARRO, SALA-I-MARTIN 1995) or the rate of rapprochement of one country to an individual or a basket of other countries (see, for instance, CHATTERJI 1992; BARROS, GAROUPA 1996). Integration is measured through the (annual) percentage rate of convergence.

Recently, a controversy has arisen into whether the methodology is very sensitive to model specification and the data used (BUTTON, PENTECOST 1995), whether steady-state growth paths exist for very different countries which might better be seen in terms of convergence clubs (QUAH 1995) or multiple steady states (BERNARD, DURLAUF 1996). In fact, without information on these structures, convergence tests may become meaningless, which makes the findings of cross-country studies difficult to assess, especially if rates of convergence in different countries are very similar (SALA-I-MARTIN 1996).

The model has also been successfully used to analyze historic convergence processes (BLUM, DUDLEY 2001).

These models explain (conditional) convergence or divergence within a formal statistical framework; they fail, however, to specifically include the drivers of economic development and the reasons for increasing returns that can actually be measured over time.

(2) Growth and new growth theory have produced a vast economic literature on economic growth processes and their path dependency. BAUMOL (1986) analyzed productivity growth in 16 early industrialized countries from 1870 to 1979 and concluded their productivity growth rates strongly correlate negatively with the initial productivity level of 1870. In a recent paper, TARGETTI and FOTI (1997) have analyzed within the framework of an integrated post-Keynesian cumulative growth model and a neoclassical convergence model that growth and catching-up performance for OECD and East Asian countries is satisfactory, but not for Latin American countries; this differential outcome is explained in terms of large dynamic external economies.

SUAREZ-VILLA and ROURA (1993) even reject neoclassic growth approaches in a analysis based on data for 171 European regions from 1960 to 1990 and conclude that divergence and convergence coexist because of special factors such as human capital. Based on regional wage equations, ABRAHAM and VAN ROMPUY (1995) as well as MOLLE and BOECKHOUT (1995) come to similar results.

These models explain development as consequences of changes in factor endowment, factor productivity and external economies but fail to assess the importance of space, especially spatial transactions costs, to development.

(3) Spatial interaction models offer the potential to measure transactions costs in space based on micro-economic reasoning of utility maximization and entropy (NIJKAMP 1975); the model may be extended to the general equilibrium framework (BRÖCKER 1998)[1]. If we assume that an economy at a given level of development adapts to a certain organizational structure, interaction among regions should follow a uniform pattern. Deviations from this pattern could point to obstacles to integration. The most common approach is the application of trade theory, for instance with a gravity-type model. MCCALLUM (1995) analyzed North American Trade Flows, BLUM (1995) passenger flows in Europe and ILLERIS (1995) the integration of Nordic Countries in Europe. However, some very important questions often remain unsolved, for instance how mar-

1 NIJKAMP and POOT (1998) review recent articles on spatial development theories and conclude progress in theory, especially the microfoundation of growth and convergence models, but cite little relevant empirical work.

ket structure and firm structure influence interaction patterns even if industries are analyzed separately (HELLIWELL 1998).

However, these models leave open some very important questions on the impact of external economies:

- polarization effects: are development paths uniform or do they follow "trickling-down" or "backwash" effects (HIRSCHMAN 1958; MYRDAL 1956, 1957; BLUM 1986)?
- borders have a tremendous importance to information flows that are not measured within the context of spatial interaction models. The selection of goods increases and new opportunities emerge for all agents (V. HAYEK 1945, 1969).

Spatial interaction models, for instance those of the gravity type, explain development as outcome of optimizing agents in a given set of endowments and a given technology of to overcome spatial impedance. However, they fail to account for external economies.

This paper aims at deriving gravity-type functions from trade interaction and, thus, relate obstacles to trade flows to structural effects that can be identified in the gravity analysis. In doing so, we also want to relate our analysis to the findings on cross-country economic convergence which saw surprisingly similar convergence rates across countries and economic zones with the following aspects:

- Are there benefits if external economies are formally included in a model? We include a spatial autocorrelation scheme to capture cross-regional effects not accounted for in the gravity model..
- To what extent do the results differ across economic zone? We compare results for Europe and North America.

2. The Gravity Model and Its Extensions

2.1 Trade Theory, Spatial Interaction and Economic Efficiency

Let us depart from the classical gravity model

(1) $$t_{ij} = a \cdot o_i \cdot d_j \cdot s_{ij}^{-ß},$$

where t_{ij} are flows from region i to region j, o_i is a characteristic of the origin, d_j a characteristic of the destination, and s_{ij} a measure of distance with parameter $ß$.

There are arguments that flows t_{ij} may depend on characteristics outside those of the regions i and j, for instance:

(1) Transaction costs (COASE 1937; WILLIAMSON 1975) define the way, firms are organized. A decrease in economies of scale and in the ability to control agents leads to flatter organizations - ultimately to atomistic firms - that rely on trade interaction (BLUM, DUDLEY 1999). If spatial transaction costs fall, some existing monopolies seize to exist and others would benefit from a further exploitation of economies of scale; consequently, we would expect interaction to increase.

(2) Increased and more integrated markets may have an impact on market structure very difficult to account for as their interdependence is very complex to model perfectly (SCHERER 1980; TIROLE 1988); however, increased markets tend to reduce oligopolistic power as
- collusion is more difficult and, consequently, BERTRAND-pricing becomes more likely if products are completely homogeneous; a fall in prices expands interaction.
- product differentiation becomes more likely, so that the model of monopolistic competition would be more appropriate to apply; consumers would benefit from a larger variety of products at lower prices until an equilibrium in the number of firms is reached. Consequently, trade interaction increases with market size.

(3) External economies in some sectors would also tend to increase interaction; however, some adverse effects to trade should be mentioned, especially if used in the sense of strategic trade. New trade theory (HELPMAN, KRUGMAN 1990) suggests that
- if a small country benefits from external economies, it would increase its real wage and its terms of trade, thus strongly specializing on the respective good. Consequently, trade interaction would increase with heterogeneity.

- a large country benefits from external economies, it may be the remaining monopolist in integration, which increases trade.
- Sunk costs (also in the sense of national good-will) would allow to successfully block the entry of contestants, enforcing the spatial pattern of interaction.

Some intriguing examples reinforce the argument to account for external effects:

1. congestion in region *h* influences transport conditions in adjacent region *j* and thus flows between *i* and *j*.
2. interaction among regions not accounted for may be very important, e.g. commuting, that transfers wealth from production to consumption centers.

As a consequence, the maximization of utility for a pair of regions *i* and *j*, $U(t_{ij})$, may not only depend on characteristics at origin *i* and at destination *j*, but also on characteristics of all other regions.

2.2 The Emerging Spatial Pattern

In order to account for cross-effects among regions, we distinguish between two types of impacts:

- <u>level of impact</u>; how strong is the impact on the regions and what direction does it take – positive or negative?
- <u>spatial coverage of the impact</u>; how many regions may an impact (an innovation) cross?

These two measures define a two-dimensional table that allows us to characterize the external effects in question.

<u>Table 2.2.1</u>: Characteristics of External Impacts

	short ($\pi = 1$)	**long** ($\pi \approx 0$)
positive ($\rho = 1$)	externality clusters (trickling down)	high level of positive interaction
low	low integration	externality noise
negative ($\rho = -1$	externality clusters (backwash effects)	high level of negative interaction

spatial distance

ARMSTRONG (1995), for instance, analyses the convergence process of the European Regions from 1950 to 1990 and estimates a new growth theory type equation, which fundamentally is a AR-scheme including parameters of technological change. In the following, we will model a special measure of spatial correlation; the impact will be represented by a spatial ρ, the spatial distance by a spatial lag developed by BLUM (1987) and BLUM, BOLDUC, GAUDRY (1996). The parameters in brackets will be explained in the next chapter.

3. Econometric Model and Data Used

3.1 The Systematic Component of the Regression Model

We depart from a standard linear regression model to which we apply a transformation of variables

$$(2) \qquad y_{ij}^{(\lambda_y)} = \sum_{k=1}^{K} \beta_k \cdot X_{ijk}^{(\lambda_k)} + u_{ij} \ ,$$

where y_{ij} is the endogenous variable of interaction from region i to region j, X_{ijk} are $k=1,2,...,K$ explanatory variables, and u_{ij} is an error term.

An analysis of functional form is essential to the proper formulation of the model, because it can be shown that inappropriate a-priori functional forms may produce inadequate and implausible results, including sign inversion of regression coefficients. All variables can be subjected to a variable (BOX-COX) transformation:

$$(3) \qquad X_{ij}^{(\lambda)} = \begin{cases} \dfrac{X_{ij}^{\lambda} - 1}{\lambda} & if \ \lambda \neq 0, \\ \ln X_{ij} & if \ \lambda = 0. \end{cases}$$

If the transformation coefficient $\lambda = 0$, we obtain the multiplicative (log-log) regression model, for $\lambda = 1$ the linear and for $\lambda = 2$ a square power model. Current gravity models find values of λ close to the multiplicative case.

3.2 The Error Part of the Regression Component

We depart from

$$(4) \qquad u_{ij} = v_{ij} \cdot f(Z_{ij})^{1/2} ,$$

which defines a very general form of heteroskedasticity that may include BOX-COX-transformations on one or many Z variables and f(.) guarantees positive variance;

Serial autocorrelation may be accounted for by using a BOX-JENKINS approach which relates consecutive observations - however, the notion of consecutiveness is arbitrary in spatial samples as it depends on the ordering scheme. In a regional sample, this becomes senseless, which makes it necessary to define *impact matrices*, which take the value of 1 if a relationship exists, and 0 otherwise. The original residual term is then corrected by a spatial correlation coefficient ρ in the weighted neighborhood matrix, which is normalized to guarantee that all eigenvalues are in absolute terms smaller than 1 (otherwise, the Log-Likelihood function through the included Jacobian would have points of indetermination). In addition, more than one degree of neighborhood is accounted for with a geometric weighting system:

$$(5) \qquad v_{ij} = \rho \cdot \sum_{gh} \tilde{r}_{gh} \cdot u_{gh} + e_{ij}, \qquad i, j, = 1, 2, \ldots, n;$$

where $\tilde{r}_{gh}$ is an element of the matrix $\tilde{R} = \pi \left[I - (1-\pi)R \right]^{-1} R$ and $\pi \in (0,1]$; this matrix is computed from a geometric series of initial matrices weighted with a factor (1-π). If we multiply a matrix of simple contiguity (that has values of 1 for elements r_{gh} where regions g and h share a common border, and 0 otherwise) by itself, we obtain the neighbor of neighbors, i.e. second degree neighborhood. The matrix knows two extreme positions: if π is 1, we obtain the initial impact matrix; once π goes to 0, a matrix emerges, where the value of its elements depends on the share of borders with other regions compared to the total. π is a spatial lag-factor, analogue to the geometric KOYK-lag in time series: the smaller, departing from a value of 1, π becomes, the more regions are included bin the autocorrelation process, i.e. the initially „steep“ weighting function becomes „flatter“. The residual e_{ij} is white noise.

3.3 Adding to the Economic Interpretation

The coefficient of spatial autocorrelation may take values $\rho \in [-1,1]$. Let us assume a completely vertically integrated structure of the economy, i.e. each product is only produced by a single firm or – in our context – by a single region. We then would assume that $\rho = 0$ or close to zero as an increase in the sales of one good would be independent from sales of other goods. The more firms become flatter or even atomized, the more the number of regional firm locations will grow. Rising sales of one product then relate to positive effects in other regions; the extreme case would be $\rho = 1$. If this argument holds true, than negative values would be economically improbable.

The coefficient of the spatial lag may take values $\pi \in [0,1]$. If $\pi = 1$ only the neighbors of a region are included in our considerations, which implies a very small network (a star-shaped centralized network). If $\pi = 0$ all regions are treated as equal neighbors, i.e. no spatial friction exists, i.e. an integrated network is assumed. In between we may find distributed networks.

We may summarize our findings as follows:

Table 3.3.1:
Economic Interpretation of Spatial Correlation and Spatial Lag

External Economies / Internal Economies	**Centralized Network**	**Decentralized Network**
Flat Organization	high value of ρ, high value of π i.e.: integration within the region	high value of ρ, low value of π i.e.: low intra-regional integration and high inter-regional integration
Steep Organization	low value of ρ, high value of π i.e.: high intra-regional integration and low inter-regional integration	low value of ρ, low value of π i.e.: integration among regions

The lower left structure may be considered as a *monopolar* structure where a regional only serves a specialized market (FUJITA and MORI, 1998). The lower right structure is polypolar structure.

3.3 Data Used and Economic Specification

We used two data sets produced by MCCALLUM (1995) and by BLUM, MENDE (1996) for North America and the European Union where the first is centered on Canada, the second on West Germany.

- In the North American case, they contain cross-section data on 1988 value shipments among 10 Canadian provinces, as well as between them and 30 US states (but not among US-states).
- In the European case, they contain 1987 tonnage flows among 11 German provinces, as well as between them and 10 other European countries (but not among European countries).

Flows are described as a function of *Gross Domestic Product* at origin and at destination, by geographic *Distance* and a *Border Effect Dummy* for trade within Canada or within Germany to account for the US-Canadian border and the border between Germany and its neighbors.

4. Empirical Results

4.1 The Reporting Format

We report our results in the TABLEX-Format generated by the TRIO-algorithm. Tables 1 and 2 fall into 3 parts:

- the first part reports on coefficients, partial derivatives and elasticities with the corresponding t-statistics, and heteroskedasticity structures.
- the second part reports in its upper section on the functional form by giving the results from the transformation coefficients λ = LAMBDA and the two t-statistics for the BOX-COX-transformation, and how they are related to the variables; in its lower section, it reports on spatial correlation ρ = rho (with the t-statistic) and the distance weighting factor π = pi (with two t-statistics of interest against $\pi = 0$ and $\pi = 1$);
- the third part reports on general statistics, especially the log-likelihood value.

Each model is reported in a column. From the first column onwards, the nested structure becomes apparent: each consecutive column is a generalization of the preceding column, which is a necessary method to access the log-likelihood ration test. Column 4 in Table 1, for instance, is a generalization of Column 3 because the function no longer is restricted to the multiplicative case ($\lambda = 0$), but a common transformation ($\lambda = 0{,}064$) that was applied on all variables and improved the log-likelihood by 25 points, which is extremely significant. We applied the same pattern of statistical development to both samples.

4.2 Statistical Results

Starting with the multiplicative model in Column 1, we included spatial autocorrelation in Column 2. We then let the distance parameter find its optimal value in Column 3; here statistical improvements in the North-American sample were more significant then in the European sample. We note that in both samples, the functional form of the gravity model is close to multiplicative if we go to Column 4. Gains obtained by putting separate transformation coefficients on the endogenous and the exogenous variables are small in Column 5. The optimal model is produced by including a heteroskedasticity variable (the product of GDP at origin and at destination), which makes the transformation variables of the endogenous and the exogenous to converge - most strikingly in the European sample.

4.3 Economic Results

Let us first look at the results in Columns (1) of Tables 1 and 2. They represent the usual specifications of the gravity model; in fact, the result from Column (1) of Table 1 is identical to the first specification from MCCALLUM (1995). Both models have elasticities of the GDP at destination that exceed those at origin. Whereas elasticities in North America are above unity – expressing increasing returns, those of Europe are blow unity – expressing decreasing returns. This is compatible with other findings (HELLIWELL 1998 and BLUM 1985). The elasticities of distance are strikingly similar.

The inclusion of spatial correlation in ever more general forms leads to a steady convergence to unity elasticities from Columns (1) to Columns (5) - unless heteroskedasticity is accounted for. Then, in Columns (6), we nearly fall back to the multiplicative model structure.

The spatial ρ is always some 20% to 30% higher in the North American sample than in the European sample. The spatial lag of North America is more stable with respect to changes of model specification than the European one.

We now refer to the optimal models given in Columns 6 of Tables 1 and 2, discuss them and relate them – if applicable – to other work.

(1) Elasticities of GDP in North America exceed those of Europe which makes sense as we measured American shipments in money value and European shipments in tons, thus underestimating high-end goods. American values exhibit slightly increasing returns, European values become indeterminate.

(2) GDP-elasticities at destination always exceed those at origin, which may have to do with symmetry problems of the matrix; this result was also found by BLUM (1995) for passenger trips in Europe related to West Germany.

(3) Distance elasticities that were very close in the initial models diverge in Columns 5 and 6: distance becomes more limiting to trade flows in case of Europe once we include a second λ for all dependent variables. The fourth root transformation seems to interact with heteroskedasticity, as its inclusion makes this λ fall and come closer to that of the dependent variable. There seems to be a very strong non-linearity in European impedance structure not captured by the dummy structure.

(4) The inter-provincial trade dummy is nearly four times higher in North America than in Europe, i.e. the existence of a border matters more in North America than in Europe.

Onece we account for the functional form, the difference rises to the factor 8 as trade within Canada c.p. exceeds that between Canada and the US by the Factor of 17,.5 and trade within Germany exceeds that between Germany and its neighbors by the factor of 2.2 . Other results show slightly higher effects for North America based on a simpler model (HELLIWELL 1998). Within the French context, freight flows were analyzed by PLAT and RAUX (1998), who show a high degree of complexity when pairing different countries, i.e. dummies were associated with pairs of countries and not to individual countries: France vs. Germany was 2.5 times less integrated than Belgium vs. the Netherlands.

(5) Spatial autocorrelation is always important; we see a trade-off between the values of ρ and π; if the first increases, the second decreases, which implies that a trade-off exists between internal and external integration. The high values found contrast to results found in earlier studies on passenger flows (BLUM 1995).

An interesting final question could run as follows: By what factor would the distances among regions in Canada or in West Germany have to rise to reduce intraprovincial trade to the level experienced between Canada and the US, and between West Germany and its neighbors respectively? A reduction by the value of the dummy would translate into an increase of distance. By equating

(6) $$\Delta s_{ij}^{-\beta} = e^{-d_{ij}} \Leftrightarrow \Delta s_{ij} = \sqrt[-\beta]{e^{-d_{ij}}}$$

we obtain a factor of 8 for Canada and 1,4 for Germany, i.e. the ration is reduced from 8:1 in terms of pure border dummies to 6:1 in terms of real distance: although the intraprovincial trade dummy is eight times higher for Canada than for West Germany which seems to imply the same for barrier effects for Canada against the US vs. West Germany against its neighbors, this is partly compensated by the extremely steep impedance of spatial distance of West Germany. An increase of trade distance by 1% lowers flows by 1.378% in North America but by 2,474% in Europe.

Overall we can state that the European economy is more integrated than the North American. Had we not accounted for internal regional structural effects, we would have found a less clear picture: the classical log model yielded nearly identical elasticities of distance. Thus, the dummies would have signaled a comparatively by far more integrated European economy than it actually is. The autocorrelation and lag structure points to a internally flatter and externally more decentralized industry structure than in case of North America which may explain this difference in spatial reach.

Table 1:
Trade Model for North America, 1988

I. ELASTICITY E(y) (EP) (COND. T-STATISTIC)		LEVEL-2	LEVEL-2	LEVEL-2	LEVEL-2	LEVEL-2	LEVEL-2
	TYPE =	LEVEL-2	LEVEL-2	LEVEL-2	LEVEL-2	LEVEL-2	LEVEL-2
	VARIANT =	LOG	LOG+ AU	LOG+ AU+PR	BC1+ AU+PR	BC2+ AU+PR	BC2GH1+ AU+PR
	VERSION =	1	1	1	1	1	1
	DEP.VAR. =	ship	ship	ship	ship	ship	ship
LEVEL VARIABLES							
GROSS DOMESTIC PRODUCT AT ORIGIN	agdpm	1.062 (34.33) LAM 1	1.084 (26.48) LAM 1	1.055 (25.58) LAM 1	1.017 (26.76) LAM 1	1.016 (26.88) LAM 1	1.073 (25.82) LAM 1
GROSS DOMESTIC PRODUCT AT DESTINATION	agdpx	1.206 (38.59) LAM 1	1.236 (28.34) LAM 1	1.226 (28.45) LAM 1	1.145 (29.19) LAM 1	1.147 (29.27) LAM 1	1.163 (28.11) LAM 1
DISTANCE	dist	-1.425 (-22.66) LAM 1	-1.458 (-13.80) LAM 1	-1.534 (-13.75) LAM 1	-1.613 (-15.16) LAM 1	-1.561 (-3.24) LAM 1	-1.378 (-4.94) LAM 1
INTERPROVINCIAL TRADE DUMMY	cdummy ======	3.093 (23.69)	2.980 (23.61)	3.024 (24.06)	2.708 (28.34)	2.709 (28.26)	2.861 (27.34)
HETEROSKEDASTICITY STRUCTURE							
DELTA COEFFICIENTS							
PRODUCT OF GDP AT ORIGIN AND DESTINATION	dpmdpx						-.085 (-7.06) LAM

II. PARAMETERS	VARIANT =	LOG	LOG+ AU	LOG+ AU+PR	BC1+ AU+PR	BC2+ AU+PR	BC2GH1+ AU+PR
HETEROSKEDASTICITY STRUCTURE							
BOX-COX TRANSFORMATIONS: UNCOND: [T-STATISTIC=0] / [T-STATISTIC=1]							
LAMBDA(Z)	dpmdpx						.000 FIXED
BOX-COX TRANSFORMATIONS: UNCOND: [T-STATISTIC=0] / [T-STATISTIC=1]							
LAMBDA(Y)	ship	.000 FIXED	.000 FIXED	.000 FIXED	.064 [8.34] [-122.15]	.066 [8.52] [-120.90]	.037 [4.00] [-104.05]
LAMBDA(X) - GROUP 1	LAM 1	.000 FIXED	.000 FIXED	.000 FIXED	.064 [8.34] [-122.15]	.032 [1.35] [-40.67]	.014 [.52] [-36.34]
SPATIAL AUTOCORRELATION: COND: [T-STATISTIC=0] / [T-STATISTIC=1]							
O and D: DIST (400 miles)							
RHO (DIST_OD)			.530 [10.88]	.662 [11.46]	.670 [11.19]	.651 [10.46]	.656 [10.58]
PI (DIST_OD)			1.000 FIXED	.383 [3.13] [-5.02]	.387 [2.65] [-4.19]	.422 [2.65] [-3.63]	.459 [2.95] [-3.48]

Table 1:
Trade Model for North America, 1988 (end)

III.GENERAL STATISTICS VARIANT =	LOG	LOG+ AU	LOG+ AU+PR	BC1+ AU+PR	BC2+ AU+PR	BC2GH1+ AU+PR
LOG-LIKELIHOOD	-8089.56	-8019.24	-8011.54	-7976.36	-7975.42	-7960.31
PSEUDO-R2 : - (E)	-15.391	-3.382	-3.186	.683	.683	.550
- (L)	.999	.999	.999	.999	1.000	1.000
- (E) ADJUSTED FOR D.F.	-15.487	-3.414	-3.223	.680	.679	.544
- (L) ADJUSTED FOR D.F.	.999	.999	.999	.999	1.000	1.000
AVERAGE PROBABILITY (Y=LIMIT OBSERV.)	.000	.000	.000	.000	.000	.000
SAMPLE : - NUMBER OF OBSERVATIONS	683	683	683	683	683	683
- FIRST OBSERVATION	1	1	1	1	1	1
- LAST OBSERVATION	683	683	683	683	683	683
NUMBER OF ESTIMATED PARAMETERS :						
- FIXED PART :						
. BETAS	5	5	5	5	5	5
. BOX-COX	0	0	0	1	2	2
- SPATIAL AUTOCORRELATION :						
. RHO	0	1	1	1	1	1
. PI	0	0	1	1	1	1
- HETEROSKEDASTICITY :						
. DELTAS	0	0	0	0	0	1

Table 2:

Trade Model for Europe, 1987

I. ELASTICITY E(y) (EP)		TYPE =	LEVEL-2	LEVEL-2	LEVEL-2	LEVEL-2	LEVEL-2	LEVEL-2
		VARIANT =	LOG	LOG+ AU	LOG+ AU+PR	BC1+ AU+PR	BC2+ AU+PR	BC2GH1+ AU+PR
(COND. T-STATISTIC)		VERSION =	1	2	3	4	5	6
		DEP.VAR. =	goods	goods	goods	goods	goods	goods
LEVEL VARIABLES								
GROSS DOMESTIC PRODUCT AT ORIGIN	mecu87_o		.709	.812	.834	.867	.972	.983
			(14.65)	(12.49)	(12.14)	(12.49)	(12.75)	(13.24)
			LAM 1	LAM 1	LAM 1	LAM 1	LAM 1	LAM 1
GROSS DOMESTIC PRODUCT AT DESTINATION	mecu87_d		.731	.829	.855	.903	1.016	1.038
			(15.15)	(12.92)	(12.49)	(13.10)	(13.37)	(13.56)
			LAM 1	LAM 1	LAM 1	LAM 1	LAM 1	LAM 1
DISTANCE	dist		-1.298	-1.342	-1.406	-1.734	-2.345	-2.474
			(-15.54)	(-12.39)	(-13.50)	(-17.61)	(-16.05)	(-17.44)
			LAM 1	LAM 1	LAM 1	LAM 1	LAM 1	LAM 1
INTERPROVINCIAL TRADE DUMMY	gdummy ======		0.990	1.082	1.024	0.799	0.762	0.769
			(6.38)	(3.47)	(3.19)	(2.97)	(2.72)	(3.10)
HETEROSKEDASTICITY STRUCTURE								
DELTA COEFFICIENTS								
PRODUCT OF GDP AT ORIGIN AND DESTINATION	mecuprod							-.087
								(-4.33)
								LAM

II. PARAMETERS		VARIANT =	LOG	LOG+ AU	LOG+ AU+PR	BC1+ AU+PR	BC2+ AU+PR	BC2GH1+ AU+PR
HETEROSKEDASTICITY STRUCTURE								
BOX-COX TRANSFORMATIONS: UNCOND: [T-STATISTIC=0] / [T-STATISTIC=1]								
LAMBDA(Z)	mecuprod							.000
								FIXED
BOX-COX TRANSFORMATIONS: UNCOND: [T-STATISTIC=0] / [T-STATISTIC=1]								
LAMBDA(Y)	goods		.000	.000	.000	.078	.079	.074
			FIXED	FIXED	FIXED	[4.04]	[4.07]	[3.21]
						[-47.85]	[-47.33]	[-40.17]
LAMBDA(X) - GROUP 1	LAM 1		.000	.000	.000	.078	.270	.028
			FIXED	FIXED	FIXED	[4.04]	[4.40]	[4.86]
						[-47.85]	[-11.89]	[-12.47]
SPATIAL AUTOCORRELATION: COND: [T-STATISTIC=0] / [T-STATISTIC=1]								
O and D: DIST (300 km)								
RHO (DIST_OD)				.425	.543	.760	.870	.876
				[4.77]	[5.26]	[11.35]	[23.19]	[27.28]
PI (DIST_OD)				1.000	.435	.186	.142	.125
				FIXED	[1.08]	[1.53]	[2.07]	[2.25]
					[-1.40]	[-6.73]	[-12.51]	[-15.78]

Table 2:
Trade Model for Europe, 1987 (end)

III.GENERAL STATISTICS VARIANT =	LOG	LOG+ AU	LOG+ AU+PR	BC1+ AU+PR	BC2+ AU+PR	BC2GH1+ AU+PR
LOG-LIKELIHOOD	-2356.63	-2341.23	-2339.99	-2329.95	-2327.14	-2318.49
PSEUDO-R2 : - (E)	-.271	-.370	-.765	.369	.630	.583
- (L)	.990	.991	.991	.991	.992	.992
- (E) ADJUSTED FOR D.F.	-.288	-.392	-.799	.355	.620	.571
- (L) ADJUSTED FOR D.F.	.990	.991	.991	.991	.991	.992
AVERAGE PROBABILITY (Y=LIMIT OBSERV.)	.000	.000	.000	.000	.000	.000
SAMPLE : - NUMBER OF OBSERVATIONS	316	316	316	316	316	316
- FIRST OBSERVATION	1	1	1	1	1	1
- LAST OBSERVATION	316	316	316	316	316	316
NUMBER OF ESTIMATED PARAMETERS :						
- FIXED PART :						
. BETAS	5	5	5	5	5	5
. BOX-COX	0	0	0	1	2	2
- SPATIAL AUTOCORRELATION :						
. RHO	0	1	1	1	1	1
. PI	0	0	1	1	1	1
- HETEROSKEDASTICITY :						
. DELTAS	0	0	0	0	0	1

5. Conclusions

Spatial interaction inside North America and inside Europe is rather similar in the final models with the exception of the two metrics, distance and interprovincial trade dummies. This is the result of an addition of an autocorrelation structure that allows data to decide on the level of interaction and the number of regions involved. This reduces initially increasing returns in the North American Model and raises decreasing returns in the European model to nearly constant returns and provides a nearly multiplicative (classical) gravity-model specification.

We interpret the differences in the autocorrelation structure as results of institutional arrangements that lead to a different division of labor. In this sense, North America is more hierarchical and Europe flatter – which is compatible with increasing and decreasing returns in the initial specification.

Europe, which is more densely populated than North America, has a much steeper impedance of distance, i.e. the (absolute) value of distance elasticity is nearly twice as high as in North America. The preference for interprovincial trade in Europe is eight times lower than in North America (seen from West Germany and Canada respectively). Taken together, this reduces the border effects considerably. However, borders still matter relatively less in Europe than in North America, i.e. a huge integration potential is still available in North America.

References

Abraham, F.; van Rompuy, P., 1995, Regional Convergence in the European Monetary Union, *Papers in Regional Science* 74, 2, pp. 125-142.

Armstrong, H. W., 1995, Convergence Among Regions of the European Union, 1950-1990, *Papers in Regional Science* 74, 2, pp. 143 - 152.

Barro, R.; Sala-I-Martin, X., 1995, Economic Growth, McGraw-Hill, New York

Barros, P.; Garoupa, N., 1996, Portugal-European Union Convergence: Some Evidence, *European Journal of Political Economy* 12, 545-553.

Baumol, W.J., 1986, Productivity Growth, Convergence, and Welfare: What the Long-Run Data Show, *American Economic Review* 76, No. 5, 1072 - 1085.

Bernard, A.; Durlauf, S., 1996, Interpreting Tests of the Convergence Hypothesis, *Journal of Econometrics* 71, 161-173.

Blum, U., 1986, Growth Poles and Regional Evolution, *Jahrbuch für Sozialwissenschaft* 37, 3. pp. 325-353.

Blum, U., 1987, A Distributed Lag for Spatially Correlated Residuals. Université de Montréal, CRT- Publication No. 512.

Blum, U., 1995, Verkehrsnachfrageschätzung und Raumstruktur, in: *Jahrbuch für Wirtschaftswissenschaften - Review of Economics* 46, No. 3, 277 - 294)

Blum, U.; Bolduc, D.; Gaudry, M., 1996, From Correlation to Distributed Contiguities: A Family of AR-C-D Processes, *Jahrbuch für Regionalwissenschaft* 16/17 (99-128).

Blum, U.; Dudley, L., 1999, The Two Germanies: Information Technology and Economic Divergence, 1949-1989, *Journal of Institutional and Theoretical Economics* Vol. 155, No. 4, 710-737.

Blum, U.;, Dudley, L., 2001a, Religion and Economic Growth: Was Weber Right?, *Journal of Evolutionary Economics*, 11, 2, S. 207-230.

Blum, U.; Mende, M., 1996, The Impact of European Integration on Transport and the Environment, SPES-Project for the European Union, Dresden, mimeo.

Bröcker, J., 1998, How would an EU-Membership of the Visegrad-Countries afect Europe's Economic Geography, Annals of Regional Science, Vol. 32, 91-114.

Button, K.; Pentecost, E., 1995, Testing for Concergence in EU Regional Economies, *Economic Inquiry* XXXII, 664-671.

Chatterji, M., 1992, Convergence Clubs and Endogenous Growth, *Oxford Review of Economic Policy* 8, 57-69.

Coase, R., 1937, The Nature of the Firm, Economica (386-405);

Freyhold, H.; Gessner, V.; Vial, E.; Wagner, H., 1995, Costs of Judicial Barriers for Consumer in a Single Market, Report to the European Commission, Bremen and Hagen.

Fujita M.; Mori, T., 1998, On the Dynamics of Frontier Economics: Endogenous Growth or the Self-Organization of a Dissipative System, Annals of Regional Science, Vol. 32, No. 1, 39-62.

Hayek, F. A. v., 1945, The Use of Information in Society, *American Economic Review* 35, 519 – 530.

Hayek, F. A. v., 1969, Der Wettbewerb als Entdeckungsverfahren, in: Freiburger Studien, Tübingen, pp. 249 - 265.

Helliwell, J. F., 1998, How Much Do National Borders Matter? Brookings Institution, Washington DC.

Helpman, E. Krugman, P.R., 1990, Market Structure and Foreign Trade. MIT-Press, Cambridge, Mass.

Hirschman, A. O., 1958, The Strategy of Economic Development, New-Haven and London.

Illeris, S., 1995, Peripherality and European Integration: the Challenge Facing Nordic Countries, in: Competitive European Regions, H. Eskelinen and F. Snickars ed., Springer, Berlin 113-130.

McCallum, J., 1995, National Borders Matter: Canada-U.S. Regional Trade Patterns, *American Economic Review* 85, 3, p. 615-623

Molle, W.; Boeckhout, S., 1995, Economic Disparity under Conditions of Integration - A Long Term View of the European Case, *Papers in Regional Science* 74, 2, pp. 105-123.

Myrdal, G., 1956, An International Economy, Problems and Prospects, Harper and Bros., New York.

Myrdal, G., 1957, Economic Theory and Underdeveloped Regions, Duckleworth and Co., London.

Nijkamp, P., 1975, Reflections on Gravity and Entropy Models, *Regional Science and Urban Economics* 5, 203 - 205.

Nijkamp, P.; Poot, Jacques, 1998, Spatial Perspectives on New Theories of Economic Growth, Annals of Regional Science Vol. 32, 7-37.

Plat, D.; Raux, C., 1998, Frontier Impedance Effects and the Growth of International Exchanges: an Empirical Analysis for France, Papers of Regional Science Vol. 77, No. 2, 155-172.

Quah, D., 1996, Empirics for Economic Growth and Convergence, *European Economic Review* 40, 1353-1375.

Rietveld, P.; Wintershoven, P., 1998, Border Effects and Spatial Autocorrelation in the Supply of Network Infrastructure, Papers of Regional Science Vol. 77, No. 3, 265 – 276.

Sala-I-Martin, X., 1996, Regional Cohesion: Evidence and Theories of Regional Growth and Convergence, *European Economic Review* 40, 1325-1352.

Scherer, W., 1980, Industrial Market Structure and Economic Performance. 2. Aufl. Rand McNally College Publications, Chicago.

Suarez-Villa; L.; Cuadrado-Roura, J. R., 1993, Regional Economic Integration and the Evolution of Disparities, *Papers in Regional Science* 72, 4, pp. 369-387.

Targetti, F.; Foti, A., 1997, Growth and Productivity: a Model of Cumulative Growth and Catching Up, *Cambridge Journal of Economics* 21, 27-43.

Tirole, J., 1988, The Theory of Industrial Organization, MIT-Press, Cambridge (Mass.) and London.

Williamson, O., 1975, Markets and Hierarchies, Norton, New Haven.