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Total factor productivity effects of interregional knowledge spillovers in manufacturing industries across Europe

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Abstract. The objective of this study is to identify knowledge spillovers that spread across regions in Europe and vary in magnitude for different industries. The study uses a panel of 203 NUTS-2 regions covering the 15 pre-2004 EU-member-states to estimate the impact over the period 1998-2003, and distinguish between five major industries. The study implements a fixed effects panel data regression model with spatial autocorrelation to estimate effects using patent applications as a measure of R&D output to capture the contribution of R&D (direct and spilled-over) to regional productivity at the industry level. The results suggest that interregional knowledge spillovers and their productivity effects are to a substantial degree geographically localised and this finding is consistent with the localisation hypothesis of knowledge spillovers. There is a substantial amount of heterogeneity across industries with evidence that two industries (*electronics*, and *chemical industries*) produce interregional knowledge spillovers that have positive and highly significant productivity effects. The study, moreover, confirms the importance of spatial autoregressive disturbance in the fixed effects model for measuring the TFP impact of interregional knowledge spillovers at the industry level.

Keywords. Total factor productivity, manufacturing industries, knowledge spillovers, patents, European regions, spatial econometrics

JEL Classification. C21, O33, O47, O52, R11

1 Introduction

Differences in national or regional income levels are often explained by differences in total factor productivity (TFP) (see, for example, Hall and Jones 1999; Prescott 1997). It is widely believed that technological progress plays a crucial role for productivity gains and economic growth. New growth theory, for example, emphasises that knowledge production of firms and other agents contribute to long-run economic growth because of the existence of industry-wide knowledge spillovers (see, for example, Romer 1990; Grossman and Helpman 1991). Knowledge spillovers may be defined to denote the benefits of knowledge to firms, not responsible for the original investment in the creation of this knowledge (see Fischer, Scherngell and Jansenberger 2006). Such spillovers may occur when some components of

new knowledge cannot be fully appropriated by the producer because it cannot be kept secret entirely, or because property rights do not guarantee full protection from imitation.

The last decade has seen the development of a significant body of empirical research on knowledge spillovers. Generally speaking, this research has shown that the productivity of firms or industries is related to their R&D productivity, and also to the R&D spending of other firms or other industries (see Griliches and Mairesse 1984; Mairesse and Sassenou 1991). We know, however, very little about knowledge spillovers and their productivity effects at the regional level, even though the regional dimension is particularly relevant at the European level. Fischer, Scherngell and Reismann (2007) is a notable exception that departs from previous research in two aspects: *first*, by constructing regional patent stocks to proxy industry-specific pools of interregional knowledge spillovers, and *second*, by incorporating spatial error dependence in the estimation of knowledge spillovers. The issue of spatial autocorrelation has been neglected in most studies dealing with the relationship of knowledge spillovers and productivity (see, for example, Keller 2002; Robbins 2006). Bias in this direction may lead to inefficient model coefficients as well as to biased standard errors and *t*-statistics. Based on a regional Cobb-Douglas production function Fischer, Scherngell and Reismann (2007) provide evidence that there exist close links between productivity and knowledge capital. Not only does a region's total factor productivity depend on its own knowledge capital, but – as suggested by theory – it also depends on interregional knowledge spillovers. This current study is similar in spirit, but explores the relationship with industry-specific data and an explicit treatment of industry-specific knowledge stocks to provide new valuable insights.

The objective of the study is to identify knowledge spillovers that spread across regions in Europe and vary in magnitude for different industries. By Europe we mean the 15 pre-2004 EU member-states. We use a panel of 203 NUTS-2 regions to estimate the impact over the period 1998-2003, and distinguish between five major industries at the two-digit level of the NACE classification system. These are *food, beverages and tobacco* (DA), *textiles and clothing* (DB, DC), *fuels and chemicals* (DF, DG, DH), *electronics* (DL), and *transport and equipment* (DM). The study implements a fixed panel data regression model with spatial error autocorrelation to estimate the effects using patent stocks as a measure of R&D output to capture the contribution of R&D (direct and spilled-over) to regional productivity at the industry level.

The remainder of the paper is organised as follows. *Section 2* outlines the framework of the study and the model to be used. *Section 3* describes the variables and the data in some detail. We use a multilateral region level relative TFP index as an approximation to the true TFP measure and patent stocks to proxy industry-specific knowledge capital stocks. *Section 4* discusses the estimation of the model and presents the estimation results, while *Section 5* concludes the paper.

2 The model

The regional Cobb-Douglas production function provides a suitable theoretical framework for our empirical analysis[1i]. The model used in this paper builds on an expanded version of the standard regional production function of the Cobb-Douglas type that can be written as

$$Y_{iqt} = A \; L_{iqt}^{\alpha_q} \; C_{iqt}^{\beta_q} \; K_{iqt}^{\gamma_{1q}} \; K_{iqt}^{*\gamma_{2q}} \tag{1}$$

where indices i, q and t denote the region, industry and time period, respectively. Y is some measure of output, L stands for the labour stock of the region, C for the physical capital stock, K for the region-internal stock of knowledge and K^* for the region-external stock of knowledge, i.e. for the so-called interregional knowledge spillover pool. A denotes a constant, α_q, β_q, γ_{1q} and γ_{2q} (q = 1, …, Q) are the industry-specific elasticities of output with respect to labour, physical capital, region-internal and region-external knowledge.

Dividing Equation (1) by factor share weighted physical capital and labour inputs, and assuming constant returns to scale gives the basic total factor productivity (TFP) equation in log-form that we are using in this study

$$tfp_{iqt} = \alpha + \sum_q \gamma_{1q} \, k_{iqt} + \sum_q \gamma_{2q} \, k^*_{iqt} \tag{2}$$

where $tfp_{iqt} \equiv \log TFP_{iqt}$, $\alpha \equiv \log A$, $k_{iqt} \equiv \log K_{iqt}$ and $k^*_{iqt} \equiv \log K^*_{iqt}$ for any industry q = 1, …, Q in any region i = 1, …, N at any point in time t = 1, …, T. The focus of interest is on

[1] See Griliches (1979) for a discussion on conceptual and empirical problems associated with the concept of knowledge capital within a Cobb-Douglas production function framework.

estimating the parameters γ_{1q} (q = 1, …, Q) and γ_{2q} (q = 1, …, Q). The γ_{1q} measure the industry-specific effects of region-internal knowledge, while the γ_{2q} capture the relative effects from region-external knowledge stocks at the industry level, i.e. the effects from industry-specific interregional knowledge spillovers.

The equation provides useful information on the long-run average relationship between knowledge and productivity in a reduced framework. It can be thought of as a industry-specific generalisation of the model given in Fischer, Scherngell and Reismann (2007) which would be a special case with $\gamma_{11} = \ldots = \gamma_{1Q}$ and $\gamma_{21} = \ldots = \gamma_{2Q}$.

The definition of k^*, the term capturing the impact of industry-specific interregional knowledge spillovers from any region j to region i, is given as a spatially weighted sum of the other regions' industry-specific knowledge stocks:

$$k^*_{iqt} = \sum_{j \neq i}^{N} k_{jqt}\, d_{ij}^{-\delta} \tag{3}$$

where d_{ij} denotes the geographical distance from region i to region j, measured in terms of the great circle distance [km] between the economic centres. Following the empirical literature on knowledge spillovers (see, for example, Fischer, Scherngell and Jansenberger 2006) this definition assumes that the closer regions are in geographic space, the more they can gain from each other's research effects. $\delta > 0$ is the distance decay parameter that captures the degree of localisation of interregional industry-specific knowledge spillovers. As given by Equation (3) we use a power functional form to represent the interaction process between two regions i and j.

3 The variables and the data

In this study the European coverage is achieved by using data on i = 1, …, N = 203 NUTS-2 regions of the 15 pre-2004 EU member-states. We exclude the Spanish North African territories of Ceuta and Melilla, and the French Départments d´Outre-Mer Guadeloupe, Martinique, French Guayana and Réunion (see Appendix for a detailed list of regions). The NUTS-2 level of spatial aggregation is an appropriate choice for modelling and analysis purposes and used in many other studies.

The empirical implementation of the model given by Equations (2)-(3) requires appropriate TFP and knowledge stock measures. Total factor productivity, often referred to as the residual or the index of technological progress, is defined as output per unit of labour and physical capital combined. There are several ways of measuring total factor productivity (see, for example, Nadiri 1970). TFP calculations at the industry level require real, interregionally comparable data on industry outputs, and inputs of primary factors and intermediate goods. For practical purposes, information on inputs other than physical capital and labour is not available in interregionally comparable form, so we calculate value-added TFP indices. Value-added TFP calculations are appropriate only when a well-defined, value-added function exists, which requires separability between labour, physical capital and other inputs. Consequently the TFP calculations used in this paper should be treated as approximations to the true TFP.

TFP comparisons are a classic index number problem and, thus, TFP indexes do not have a unique optimal form, but the index proposed by Caves, Christensen and Diewert (1982) is appropriate for the application in this study. This index is defined as

$$\log tfp_{iqt} = (\log Y_{iqt} - \overline{\log Y_{qt}}) - \sigma_{iqt}(\log L_{iqt} - \overline{\log L_{qt}}) - (1-\sigma_{qkt})(\log C_{iqt} - \overline{\log C_{qt}}) \quad (4)$$

with

$$\overline{\log Y_{qt}} = \tfrac{1}{2}\sum_{i=1} \log Y_{iqt} \quad (5)$$

$$\overline{\log L_{qt}} = \tfrac{1}{2}\sum_{i=1} \log L_{iqt} \quad (6)$$

$$\overline{\log C_{qt}} = \tfrac{1}{2}\sum_{i=1} \log C_{iqt} \quad (7)$$

where σ_{iqt} denotes the share of labour in total production costs in region *i* industry *q* at time *t*. This index is equivalent to an output index where labour and physical capital inputs are held constant across regions[2ii].

[2] The TFP index used is a region-relative index which implies that, for instance, a region with a calculated TFP level of 1.3 can produce 30 percent more output than the average region, with the same amount of conventional inputs (see Fischer, Scherngell and Reismann 2007). The index assumes that the regional output is characterised by constant returns to scale.

The data for calculating this industry-specific TFP index come from *Cambridge Econometrics*. Gross value added data in Euro (constant prices of 1995, deflated) are used as a measure of output *Y*. We adjust data on labour inputs to account for differences in average annual hours worked across countries. Neglecting differences in average annual hours worked would lead to overestimation of the productivity level in Greek and Portuguese regions, while the productivity level of Swedish and Dutch regions would be underestimated. Data on physical capital stocks is not available in the *Cambridge Econometrics* database, but gross fixed capital formation in current prices is. The perpetual inventory method has been used to generate the industry-specific fixed capital stocks applying a constant rate of ten percent depreciation and taking the mean annual growth rate which precedes the benchmark year 1998 to cover the period 1990-1998[3iii].

We use corporate patent counts[iv4] as a proxy for the increase in (economically profitable) knowledge and derive patent stocks from European Patent Office [EPO] documents[5v]. Our data source is the European Patent Office (EPO) database. Patents are direct outcomes of R&D processes. A patentable invention must be new, must involve an inventive step and must be capable of industrial application. We argue that an aggregation of patents is more closely related to the regional knowledge capital stock than is an aggregation of R&D expenditures or R&D capital.

Our core patent data set consists of all patents assigned to assignees located in the EU-15 countries with an application date in the years 1990-2004, totalling 655.353 patents. The patent documents provide information on the technological, geographical and temporal location (that is, their technological class, the geocoded location of the inventor(s) and the

[3] The perpetual inventory method yields an estimate of the stock of fixed capital assets by estimating how many of the fixed assets installed as a result of gross fixed capital formation undertaken in previous years have survived to the current period (OECD 2001). Thus, the estimated stocks depend on the assumed depreciation rate of the annual capital flows and on the annual growth rate of gross fixed capital formations during the period previous to the observations period.

[4] A patent is a document, issued by the Patent Office, which gives its owner an exclusive right to commercially use his/her invention for a period of up to twenty years. Patent protection means that the invention cannot be commercially made, used, distributed or sold without the patent owner's consent (WIPO 2004). Patents have been used widely in the scientific literature to capture knowledge outputs. They provide a very rich and useful source of data for the study of innovation and technological change (see, for example, Griliches 1990).

[5] This is convenient to avoid bias due to different administrative procedures at different patent offices. Furthermore, inventors increasingly make use of the EPO as they are looking for wider geographical protection for their inventions. But nevertheless it should be noted that data on patents from the EPO cover only a subsample of patents applied for in Europe (see Fischer, Scherngell and Jansenberger 2006).

date of application). All[6] patent applications are assigned to the region of the address of the inventor, rather than the address of the assignee, for tracing inventive activities back to the region of knowledge production. Assignment is done by using a concordance scheme between postal codes and NUTS-2 regions supplied by Eurostat. In the case of multiple inventors we follow the standard procedure of proportionate assignment[7][vi].

To create industry-specific regional patent stocks for 1998-2003, the EPO patents were transformed by first sorting based on the year that a patent was applied for, second the region where the inventor resides, and third by industry. The latter includes matching of International Patent Classes (IPC)[vii] with NACE industry classes. For this purpose we have used two concordance tables: MERIT's concordance table between the four-digit level of the IPC-system and the International Standard Industrial Classification (ISIC, Rev. 2) and a concordance table between ISIC (Rev. 2) and NACE provided by the United Nations (see United Nations 2007). Then for each region, the annual industry-specific patents were aggregated using the perpetual inventory method, with a constant 12 percent depreciation rate applied for each year to stock of patents created in earlier years. The assumption of a depreciation rate of 12 percent for the obsolescence of technological knowledge follows former empirical studies (see, for example, Caballero and Jaffe 1993, Robbins 2006).

4 Error specification and Model Estimation

Our data encompasses 6,090 observations (203 regions, five industries and six time periods). The estimation equations emerge by adding random errors, u_{iqt}, to Equation (2). These error terms incorporate the effects of omitted variables. Classical regression analysis assures that the omitted variables are independent of the included right-hand-side variables, and are independently, identically distributed. When using panel data, however, we can further classify the omitted variables into some groups such as region varying time- and industry-invariant, time varying region- and industry-invariant, and industry-varying region- and time invariant omitted variables.

[6] Proportionate counting gives the interregional cooperative inventions lower weight than full counting (see Fischer, Scherngell and Jansenberger 2006).

[7] The IPC system is an internationally developed and widely agreed non-overlapping hierarchical classification system that consists of five aggregation levels.

The estimation of Equation (2) without consideration of such effects can generate misleading results for ordinary least squares regression. In this study we restrict our attention to fixed effects estimation and assume the following two-way error components specification (see, for example, Baltagi 2001)

$$u_{iqt} = \mu_t + \nu_q + \varepsilon_{iqt} \tag{8}$$

where μ_t and ν_k are time-specific and industry-specific components, while ε_{iqt} are remainder effects. Conditional upon the specification of the variable intercept, our spatial panel data model can be estimated as fixed or a random effects model (see, for example, Elhorst 2003). A Hausman (1978) test of specification shows a test statistic of 23.31 (p = 0.000). The null hypothesis is rejected and we conclude that the fixed effects specification is consistent.

Under this error components specification model (2) can be written in vector form as

$$\boldsymbol{tfp} = \alpha \boldsymbol{\iota}_{NQT} + \boldsymbol{X}\boldsymbol{\gamma} + \boldsymbol{Z}_{\mu}\boldsymbol{\mu} + \boldsymbol{Z}_{\nu}\boldsymbol{\nu} + \boldsymbol{\varepsilon} \tag{9}$$

where ***tfp*** is NQT-by-1. The observations are ordered with t being the fast running index, q the medium running indexm, and i the slow running index. $\boldsymbol{\iota}_{NQT}$ is a vector of ones of dimension NQT, $\boldsymbol{X}$ is the NQT-by-$2Q$ matrix of explanatory variables, $\boldsymbol{\gamma}$ is $2Q$-by-1, $\boldsymbol{\varepsilon}$ is NQT-by-1, and represents the effects of the omitted variables that are peculiar to the industry classes and time periods. We assume that ε_{iqt} can be characterised by an independently, identically distributed random variable with mean zero and constant variance σ_{ε}^2. $\boldsymbol{Z}_{\mu} = \boldsymbol{I}_T \otimes \iota_{NQ}$ and $\boldsymbol{Z}_{\nu} = \boldsymbol{I}_Q \otimes \iota_{NT}$. $\boldsymbol{I}_T$ and $\boldsymbol{I}_Q$ are identity matrices of dimension T and Q, respectively. $\boldsymbol{\iota}_{NQ}$ and $\boldsymbol{\iota}_{NT}$ are vectors of ones of dimension NQ and NT, respectively, and $\otimes$ denotes the Kronecker product.

Model (9), using the fixed effects estimator, assumes that $\boldsymbol{\mu} = (\mu_1, ..., \mu_T)$ and $\boldsymbol{\nu} = (\nu_1, ..., \nu_Q)$ are fixed parameters to be estimated. The fixed-effects estimator can be obtained by running the regression with time-specific and industry-specific dummy variables or by performing the within transformation and then running OLS (see Hsiao 1986). The distance decay parameter

δ which determines the extent to which region-external knowledge is effective in determining regional productivity, is identified from variation of the productivity effects of knowledge capital in other regions conditional on bilateral distance (see Equation (3)). δ is optimised with respect to the log-likelihood function using Brent's direct search procedures (see Press et al. 1992).

Table 1 Estimates of the total factor productivity model with time-specific and industry-specific fixed effects

	Fixed effects estimates	**Fixed effects estimates with spatial error autocorrelation**
Parameter estimates (*p*-values in brackets)		
Constant **[α]**	-0.105 (0.000)**	-0.165 (0.000)**
Internal knowledge capital stocks		
Food and beverages $[\gamma_{11}]$	0.057 (0.000)**	0.027 (0.007)*
Textiles and clothing $[\gamma_{12}]$	0.009 (0.468)	-0.006 (0.630)
Fuels and chemicals $[\gamma_{13}]$	0.039 (0.171)	0.024 (0.008)*
Electronics $[\gamma_{14}]$	0.280 (0.000)**	0.241 (0.000)**
Transport and equipment $[\gamma_{15}]$	-0.102 (0.132)	-0.100 (0.098)
Interregional knowledge spillovers		
Food and beverages $[\gamma_{21}]$	0.071 (0.665)	0.075 (0.284)
Textiles and clothing $[\gamma_{22}]$	-0.262 (0.254)	-0.271 (0.303)
Fuels and chemicals $[\gamma_{23}]$	0.380 (0.000)**	0.297 (0.000)**
Electronics $[\gamma_{24}]$	0.951 (0.000)**	0.925 (0.000)**
Transport and equipment $[\gamma_{25}]$	-0.884 (0.000)**	-0.899 (0.113)
Distance decay parameter **[δ]**	1.095	0.647
The spatial autoregressive parameter **[λ]**	——	0.303 (0.000)**
Likelihood ratio test statistic	——	-292.512 (0.000)**
Log Likelihood	-5,331.383	-5,162.119
Adjusted R^2	0.203	0.264
Sigma Square	0.337	0.311

Notes: The dependent variable is the multilateral industry-specific TFP index, as defined in the text. $\gamma_{1Q}(q = 1, ..., 5)$ measures the effect of industry-specific region-internal stocks of knowledge, while γ_{2Q} determines the strength of industry-specific interregional knowledge spillover effects on productivity. δ – implicit in the construction of out-of-region-external industry-specific stocks of knowledge capital – defines the distance effects and is optimised with respect to the log-likelihood function using direct search procedures. ** denotes significance at the 0.001 significance level, and * significance at the 0.05 significance level.

The resulting estimates are reported as fixed effects estimates in Table 1. γ_1 measures the (elasticity) effect of the region-internal knowledge stocks on productivity, while γ_2 captures

the relative elasticity from out-of-region stocks of knowledge. A positive and significant $\gamma_{2Q}\,(q=1,...,Q)$ is interpreted as evidence of cross-region knowledge spillovers from industry q. For two industries (q = 3, 4) – *fuels and chemicals*, and *electronics* – there are significant and positive parameter estimates. For these industries, this suggests the presence of interregional knowledge spillovers and that these spillovers contribute to regional TFP. A one percent increase in the spatially weighted out-of-region patent stocks in *electronics*, for example, leads to a 0.951 percent increase in relative TFP which supports the hypothesis that *electronics* provide important enabling technologies for the arising knowledge based economy. This is preliminary evidence that holding the level of knowledge activities constant within a region, the increase in knowledge stock in nearby regions has a positive effect on industry-level productivity. The distance decay or localisation parameter δ is estimated to be equal to 1.095, indicating that interregional knowledge spillovers from *electronics*, and *fuels and chemicals* are to a substantial degree geographically localised, i.e. they increase with geographic proximity.

But the fixed effects estimates ignore spatial autocorrelation due to neighboring regions. The second column in Table 1 gives the fixed effects estimates with spatial error autocorrelation using maximum likelihood estimation. We assume the error term $\boldsymbol{\varepsilon}$ in Equation (9) to follow a standard first-order spatial autoregressive process with a scalar spatial autoregressive coefficient $|\lambda| < 1$ and a conventional binary spatial weights matrix[8viii] (see Anselin 1988). These ML estimates were obtained by using the *errorsarlm* procedure of Bivand's *spdep package*[9ix] in combination with Brent's direct search procedure (see Press et al. 1992). For technical details of the estimation approach see Fischer, Scherngell and Reismann (2007).

The MLE estimates accounting for spatial autocorrelation do not differ much from the fixed-effects estimates ignoring spatial autocorrelation. The γ_{23} and γ_{24} estimates provide evidence for the presence of interregional knowledge spillovers for the industries *electronics*, and *fuels and chemicals*. The λ estimate is equal to 0.303, with a standard error of 0.029. A likelihood ratio test of λ = 0 yields a χ_1^2 test statistic of 292.512. This is statistically significant and confirms the importance of a spatial disturbance term in the fixed-effects model for

[8] In this study, the spatial weights matrix is constructed so that a region sharing a common border takes the value of one and zero otherwise.

[9] Source package: *spdep* 0.3-17 retrieved from http://cran.r-project.org/src/contrib/Descriptions/spdep.html.

measuring the total factor productivity effects of interregional knowledge spillovers. The distance decay parameter δ is estimated to be 0.647. When spatial autocorrelation is not taken account the degree of geographical localisation of knowledge spillovers is overestimated. Incorporation of spatial error dependence decreases the estimated distance decay parameter by about 41 percent.

5 Summary and Discussion

The objective of this paper was to estimate TFP effects of interregional knowledge spillovers in manufacturing industries across European regions. We used patent stocks constructed from EPO patent applications as a proxy for a region's industry-specific knowledge capital stock and the TFP index suggested by Caves, Christensen and Diewert (1982) to measure productivity effects of industry-specific interregional knowledge spillovers in a spatial panel data model framework with fixed effects.

The analysis has produced a number of interesting results. *First*, geographic distance appears to have a strongly limiting effect on knowledge spillovers among regions. This suggests that interregional knowledge spillovers and their productivity effects are to a substantial degree geographically localised and this finding is consistent with the localisation hypothesis of knowledge spillovers. *Second*, the study provides evidence that a region's total factor productivity depends not only on its own knowledge capital but also on interregional knowledge spillovers. *Third*, there is a substantial amount of heterogeneity across industries. There is evidence that two industries (*electronics*, and *chemical industries*) produce cross-region knowledge spillovers that have positive and highly significant productivity effects. The coefficients on spatially weighted, out-of-region stocks of knowledge from *foods and beverages*, *textiles and clothing*, and *transport and equipment* are not significant. *Finally*, the analysis confirms the importance of spatial autoregressive disturbance in the fixed effects model for measuring the TFP impact of interregional knowledge spillovers at the industry level.

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Appendix

The sample of regions is composed of 203 NUTS-2 regions located in the pre-2004 EU member-states (NUTS revision 1999, except for Finland NUTS revision 2003). We exclude the Spanish North African territories of Ceuta and Melilla, and the French Départments d'Outre-Mer Guadeloupe, Martinique, French Guayana and Réunion. Thus, we include the following NUTS 2 regions:

Austria:	Burgenland; Niederösterreich; Wien; Kärnten; Steiermark; Oberösterreich; Salzburg; Tirol; Vorarlberg
Belgium:	Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest; Prov. Antwerpen; Prov. Limburg (BE); Prov. Oost-Vlaanderen; Prov. Vlaams-Brabant; Prov. West-Vlaanderen; Prov. Brabant Wallon; Prov. Hainaut; Prov. Liége; Prov. Luxembourg (BE); Prov. Namur
Denmark:	Danmark
Germany:	Stuttgart; Karlsruhe; Freiburg; Tübingen; Oberbayern; Niederbayern; Oberpfalz; Oberfranken; Mittelfranken; Unterfranken; Schwaben; Berlin; Brandenburg; Bremen; Hamburg; Darmstadt; Gießen; Kassel; Mecklenburg-Vorpommern; Braunschweig; Hannover; Lüneburg; Weser-Ems; Düsseldorf; Köln; Münster; Detmold; Arnsberg; Koblenz; Trier; Rheinhessen-Pfalz; Saarland; Chemnitz; Dresden; Leipzig; Dessau; Halle; Magdeburg; Schleswig-Holstein; Thüringen
Greece:	Anatoliki Makedonia; Kentriki Makedonia; Dytiki Makedonia; Thessalia; Ipeiros; Ionia Nisia; Dytiki Ellada; Sterea Ellada; Peloponnisos; Attiki; Voreio Aigaio; Notio Aigaio; Kriti
Finland:	Itä-Suomi; Etelä-Suomi; Länsi-Suomi; Pohjois-Suomi
France:	Île de France; Champagne-Ardenne; Picardie Haute-Normandie; Centre; Basse-Normandie; Bourgogne; Nord-Pas-de-Calais; Lorraine; Alsace; Franche-Comté; Pays de la Loire; Bretagne; Poitou-Charentes; Aquitaine; Midi-Pyrénées; Limousin; Rhône-Alpes; Auvergne; Languedoc-Roussillon; Provence- Côte d'Azur; Corse
Ireland:	Border, Midland and Western, Southern and Eastern

Italy:	Piemonte; Valle d'Aosta; Liguria; Lombardia; Trentino-Alto Adige; Veneto; Friuli-Venezia Giulia; Emilia-Romagna; Toscana; Umbria; Marche; Lazio; Abruzzo; Molise; Campania; Puglia; Basilicata; Calabria; Sicilia; Sardegna
Luxembourg:	Luxembourg (Grand-Duché)
Netherlands:	Groningen; Friesland; Drenthe; Overijssel; Gelderland; Flevoland; Utrecht; Noord-Holland; Zuid-Holland; Zeeland; Noord-Brabant; Limburg (NL)
Portugal:	Norte; Centro (P); Lisboa e Vale do Tejo; Alentejo; Algarve; Açores; Madeira
Spain:	Galicia; Asturias; Cantabria; Pais Vasco; Comunidad Foral de Navar; La Rioja; Aragón; Comunidad de Madrid; Castilla y León; Castilla-la Mancha; Extremadura; Cataluña; Comunidad Valenciana; Islas Baleares; Andalucia; Región de Murcia
Sweden:	Stockholm; Östra Mellansverige; Sydsverige; Norra Mellansverige; Mellersta Norrland; Övre Norrland; Småland med öarna; Västsverige
United Kingdom:	Tees Valley & Durham; Northumberland & Wear; Cumbria; Cheshire; Greater Manchester; Lancashire; Merseyside; East Riding & .Lincolnshire; North Yorkshire; South Yorkshire; West Yorkshire; Derbyshire & Nottingham; Leicestershire; Lincolnshire; Herefordshire; Shropshire & Staffordshire; West Midlands; East Anglia; Bedfordshire & Hertfordshire; Essex; Inner London; Outer London; Berkshire; Surrey; Hampshire & Isle of Wight; Kent; Gloucestershire; Dorset & Somerset; Cornwall & Isles of Scilly; Devon; West Wales; East Wales; North Eastern Scotland; Eastern Scotland; South Western Scotland; Highlands and Islands; Northern Ireland

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The Importance of Material Flow Analysis for Commodity Transport Demand and Modelling

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Biographical notes

Jan S. Kowalski is Professor of Economics (International Economic Policy) at the Institute For Economic Policy Research at the University of Karlsruhe.
His research activities focus on comparative economic systems, transformation problems in Central and Eastern Europe, regional development and policy, particularily the role of SMEs, technology and innovations, technology transfer policy, responses of the public institutions to changes in the framework for regional competition, transborder cooperations and consequences of the implementation of the EU..

After obtaining a graduate degree from the Faculty of Foreign Trade of the Warsaw School of Planning and Statistics he joined the doctoral programme of the Institute of Geography of the Polish Academy of Sciences followed by a lecturership at the Faculty of Geography and Regional Studies of the Warsaw University. 1980 he went to Germany to the Institute for Economic Policy Research of the University of Karlsruhe on a scholarship of the Humboldt-Foundation. In the fall of 1989 he was guest professor at the Universite de Montreal, 1992 he became Professor of Economics at the University of Münster, since 1995 he joined the University of Karlsruhe where he is professor of economics and the Head of the Section of International Economic Policy at the Institute for Economic Policy Research. 1999-2000: guest professor at the Economics Department , San Diego State University.

Gernot Liedtke, born in 1973, studied physics at the University of Stuttgart and industrial engineering at the Ecole Centrale Paris. He works for the Institute of Economic Policy Research (IWW) since 2000. He defended his PhD-thesis on behaviour-oriented commodity transport simulation in 2006. For his dissertation he received the Hans-Jürgen Ewers-Price for applied infrastructure research of the free University of Berlin and the International German Science Award for Logistics of the German Logistics Association (BVL).
In the current research, he combines normative tools from Logistics science with descriptive simulation methods to map de-central decision making in transport and logistics systems and thereby to study emergence of logistics-networks.

Axel Schaffer, born in 1970, studied industrial engineering at the University of Karlsruhe (TH) between 1990 and 1996. He works for the Institute of Economic Policy Research (IWW) since 1996 and defended his doctorate on ecological input-output analysis in 2002.
For a presentation on the very same topic he received the "Edwin von Böventer Price" of the German speaking section of the Regional Science Association International.
His current research puts an emphasis on socio-ecological input-output models that combine time use data with traditional input-output tables and material balances. The results of this research also define the core of his habilitation (completed in 2007).

Ralph Spiering, born in 1965, finished his studies of communication-sciences, politics and economics in Munich and Vienna in 1993. He is the managing partner of PACKSERVICE, a company with core activities in co-packing and logistic supports. Under his direction, PACKSERVICE now runs locations in Germany (Karlsruhe, Bühl, Pforzheim, Augsburg, Stuttgart, Unna) and Austria (Linz and Vienna).
Recently he formed the PS Consulting (2005), a company for consulting services in logistic supply chain management and set up the new PS Academy in 2007 for internal and external trainings and workshops related to modern logistics.

Abstract

It can be shown that generated and attracted transport volumes, measured in tons, are closely related to direct material input (DMI). However, structural changes and new logistics concepts still lead to an increase of transportation performance. Therefore, the paper at hand aims to explain the scales of freight transport volumes (measured in tons) and performance (measured in ton-kilometers) from material flow analysis by additionally taking into account information from physical input-output tables. In so doing, effects of changing final demand on transport indicators can be identified. But while input-output tables give a good idea about technological processes, important information on the transport chain is missing. For this reason, the macroscopic approach of input-output analysis is supported by a microscopic analysis on freight transport markets and modern logistic concepts.

1 Introduction

In all post-communist countries the transportation sector composition and its performance experienced deep changes during the transition period from the centrally planned to market based economic system. On the one hand, especially in the first transition period, transport demand for goods decreased due to the rationalization processes connected with the transition. On the other hand high growth rates (as compared to their Western European counterparts) which are recorded in these countries for the last 10 years resulted in increased

demand for transport services. Simultaneously a deep evolution in the modal split towards the long distance road transport was recorded.. In this contribution we present an approach permitting the new market economies in Central and Eastern Europe to prepare for the challenges of this rash and deep structural change in a more efficient manner than the traditional approaches permit.

Material flow analysis generates highly aggregated indicators for the material flows at the scale of national economies. It can be assumed that generated and attracted transport volumes (measured in tons), measured in tones, closely relate to material flows. Thus material flow analysis can be considered a complementary tool for properly designed commodity transport models.

The paper at hand presents an approach to explain the scales of freight transport volumes from material flow analysis for the German economy. For this purpose, findings of the German system of environmental accounting are combined with traditional instruments of input-output analysis and calibrated by transport statistics.

The first part of the paper identifies interdependencies between material inputs and transport volumes. The key prediction is that transport volumes closely relate to direct material inputs, regardless the considered production branch.

In contrast, the model calculations suggest a weaker correlation between transport volumes and transport performance (measured in ton-kilometers) among production branches. This in turn, can be explained by the heterogeneity of freight markets and logistic concepts (second part).

Finally, the findings of the first and the second part allow for drawing first conclusions concerning the future development of the transport performance.

2 Direct material input and transport volumes

2.1 The relevance of direct material input for the satisfaction of final demand

By common sense reasoning, it should be expected that an increase in material input into a country's economy (such as reflected in Direct Material Input (DMI), one of the standard indicators of material flow analysis) should boost, on the one hand, the volume of final demand and, on the other hand, freight transport within this country. DMI comprises the total volume of materials extracted from the domestic environment to enter economic processing,

plus the total volume of imports from other countries, expressed in tons per year (Eurostat and IFF, 2004).

Each ton of the DMI enters the economic cycle and will then be processed through several stages, from the extracting primary sector to manufacture, from manufacture to manufacture or commerce, from commerce to consumers, and from consumers to waste deposits. Alternately, products can be exported to another country. In this context, the German System of Environmental Accounting identifies the usage of DMI by 72 production branches (Statistisches Bundesamt, 2006). The combination of these findings with traditional input-output analysis further allows for the assignment of DMI to diverse categories of final demand (Schaffer and Stahmer, 2006a). These categories are based on the traditional input-output tables for Germany and include private and public consumption, investments and exports. A more detailed analysis further allows for separating specific categories of final demand. In this context, the presented study additionally separates final demand for food without animal feed (Schaffer, 2005; Schaffer and Schulz, 2006).

The amount of DMI necessary to satisfy the final demand for domestically produced goods M^{dom} is calculated according to equation (1). In order to combine tons of DMI with monetary input-output data, DMI coefficients (M_{beom}) are derived from the division of physical flows with the (total) production value of the consuming branch. The index *beom* points to the fact that DMI is further subdivided into: *b*iomass, *e*nergy sources, *o*res and other *m*inerals. Finally, the application of the classical Leontief inverse matrix allows for the allocation of directly and indirectly needed tons of DMI to the different categories of final demand (Schaffer and Stahmer, 2006b). The following relations set up the basic equations:

$$M^{dom} = M_{beom} \cdot B^{dom} \cdot Y^{dom} \tag{1}$$

$$M_{beom} = \begin{pmatrix} m_{biomass} \\ m_{energy\ sources} \\ m_{ores} \\ m_{other\ minerals} \end{pmatrix} \tag{2}$$

$$B^{dom} = (I - A^{dom})^{-1} \tag{3}$$

m_i: Row vector (n elements) of DMI coefficients differentiated by four type. The vector results from the division of tons of DMI related to n (=71) branches' by the corresponding production values.

M_{beom}: s x n matrix of DMI coefficients by s (=4) categories of DMI and n branches.[1]

I: Unity matrix.

A^{dom}: n x n monetary matrix of input-coefficients (domestic production of the German economy in 2000).[2]

Y^{dom}: n x k matrix of monetary final demand of domestic production (by n commodity groups and k (=5) categories of final demand.

M^{dom}: s x k matrix of DMI necessary to satisfy final demand of domestic production.

Following these equations, table 1 shows the annual DMI necessary to satisfy the different categories of final demand for domestic products. Due to the application of the Leontief inverse, DMI usage at all production stages is considered.

Table 1

DMI necessary to satisfy consumers' needs for food and other categories of final demand in 1000 tons per year, Germany, 2000, (domestic production)

	Consumption of food	Other private consumption	Public consumption	Investments	Export	Total
Biomass	117 928 *47.6%*	52 027 *21.0%*	9 456 *3.8%*	12 166 *4.9%*	56 027 *22.6%*	247 604 *100.0%*
Energy sources	18 203 *3.7%*	245 872 *50.1%*	35 269 *7.2%*	42 268 *8.6%*	148 735 *30.3%*	490 348 *100.0%*
Ores	728 *0.7%*	10 704 *10.5%*	1 339 *1.3%*	12 008 *11.7%*	77 430 *75.8%*	102 209 *100.0%*
Other minerals	16 570 *2.0%*	107 767 *13.3%*	44 022 *5.4%*	512 360 *63.3%*	128 711 *15.9%*	809 431 *100.0%*
Total DMI	153 430 *9.3%*	416 371 *25.2%*	90 086 *5.5%*	578 802 *35.1%*	410 903 *24.9%*	1 649 592 *100.0%*

In order to satisfy, for example, consumers' needs for food (without animal feed), approximately 117.9 million tons of biomass are necessary. This refers to 47.6% of total biomass. In addition 18.2 million tons (3.7%) of energy sources, 0.7 million tons of ores (0.7%) and 16.6 million tons of other minerals (2.0%) can be assigned to this category of final

[1] Calculations differentiate by gender and three age groups: young persons younger than 18 years, adults aged between 18 and 65 years and seniors 65 years and older (s = 6 demographic groups). For the sake of clarity, figures and tables show aggregated results by gender.

[2] It is assumed that each of the n industries produces goods that belong to one out of n commodity groups.

demand. Thus, the total DMI needed to satisfy demand for food amounts to 153.4 million tons which accounts for about 9.3% of total DMI absorbed by the economy. The physical flows include DMI assigned directly to the branch *food production* and to intermediated branches such as agriculture, energy supply, chemistry, transportation etc.

2.2 The relationship of direct material input and transport volumes

Supposing all material inputs into the national economy would be directly delivered to their final destination. In this case the transport volume would be equal to DMI. However, in order to satisfy final demand, direct material inputs run through a multiple stage production process. On the one hand, combustion processes that occur at all stages diminish the weight to be further processed. On the other hand, goods are loaded for transportation several times.

Thus, transport volume is a function of DMI and a *re-loading factor* that depends on the number of production stages and the combustion. Obviously, the re-loading factor differs significantly among the branches. A branch at the beginning of the extraction-production-consumption-disposal (EPCD) chain shall have lower factors compared to branches at the very end, despite generally higher combustion at the beginning of the chain. However, it could be assumed that the factors differ less strongly, if it comes to the satisfaction of different categories of final demand. In this case, the corresponding products went through several (partly similar) production stages and now belong to the same stage of the EPCD chain.

The use matrix of the physical input-output table (PIOT) allows for an empirical test of this assumption. This is true, since one of the PIOT sub-matrices provides a first overview on transportable physical flows used by production branches. It should be emphasized that only incoming flows are considered. Thus, double counting can be avoided.

The procedure to estimate transported flows, necessary to satisfy the different categories of final demand follows the approach outlined by equations (1) to (3). However, coefficients result from the division of incoming transport flows by the production value of the corresponding branch. Furthermore, transport volume is not subdivided anymore. Thus coefficients are given as vector and as matrix.

$$\mathrm{tv}^{\mathrm{dom}} = \mathrm{tv} \cdot \mathrm{B}^{\mathrm{dom}} \cdot \mathrm{Y}^{\mathrm{dom}} \tag{4}$$

tv: Row vector (n elements) of transport volume coefficients. The vector results from the division of incoming transport (measured in tones) related to n (=71) branches' by the corresponding production values.

The application of equation (4) enables the estimation of direct and indirect transport volumes that come along with the satisfaction of final demand. Table 2 compares transport volumes with DMI and provides the corresponding re-loading factor.

Table 2

Transport volumes and DMI necessary to final demand in 1000 tons per year, re-loading factors, Germany, 2000, (domestic production)

	Consumption of food	Other private consumption	Public consumption	Investments	Export	Total
DMI	153 430 *9.3%*	416 371 *25.2%*	90 086 *5.5%*	578 802 *35.1%*	410 903 *24.9%*	1 649 592 *100.0%*
Transport volume	330 136 *10.8%*	766 723 *25.1%*	152 554 *5.0%*	984 180 *32.2%*	825 875 *27.0%*	3 059 468 *100.0%*
Reporting: *re-loading factor*	*2.2*	*1.8*	*1.7*	*1.7*	*2.0*	*1.9*

The re-loading factor, which results from the division of transport volume by DMI, ranges from 1.7 in the case of public services to 2.2 in the case of final demand for food. The re-loading factor does not necessarily equal with the separated factor of the main production branch responsible for the satisfaction of the corresponding demand. Food production, for example, shows a loading factor of about 3. Contrary, the loading factors of contributing branches, such as agriculture (1.5) or energy supply (1.2) are significantly smaller. However, due to the application of the input-output model, the re-loading factors given by table 2 account for factors of all branches that deliver inputs to food production.

It can be concluded that loading factors assigned to different categories of final demand range in a rather small corridor.

2.2 Additional impacts caused by the logistic system

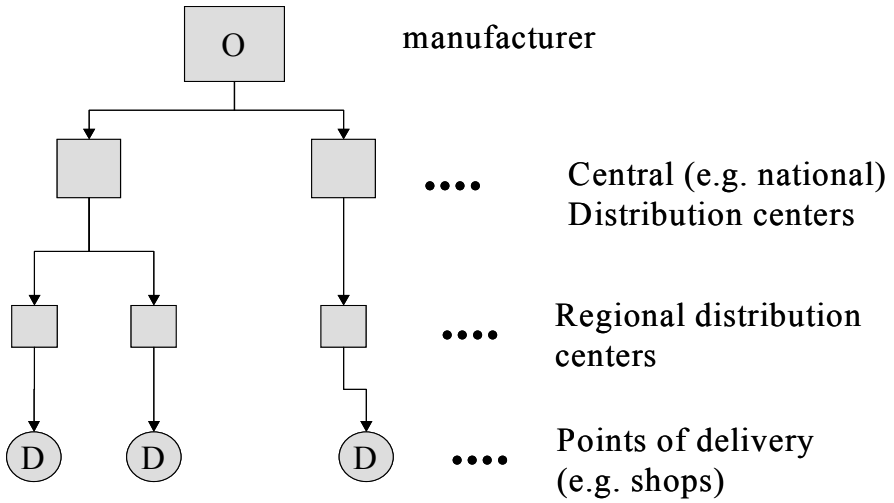
Using the information of physical input-output tables, it is possible to deduce impacts of changes in the final commodity demand by segment on transportation volume measured in tons. The factor describing the relationship between final demand and transportation volume has been rather constant over time.

But while input-output tables give a good idea about technological processes, important information on the transport chain is missing. Transport stimuli, initiated by wholesale and retail trade cannot be considered in a sufficient way. In fact, only physical inputs needed for the performance of these services, e.g. building materials for warehouses etc. are taken explicitly into account. In contrast, the PIOT hardly gives any information on goods re-loaded without undergoing any physical transformation (besides being re-loaded and transported). Thus, the calculated transport volume under-estimates the real transport volume.

In order to close this gap, impacts of the logistic system are additionally taken into account. Generally, commodities are not directly delivered from their location of production to the location of consumption (which would equal to re-loading factor of 1). The division of the production process, often performed at different locations, requires the re-loading for several times. After the final production stage, goods are either delivered to their final destinations, or they are stored. In the case of storage, goods might be transported to a warehouse before being delivered to the final destination. This intermediate step, clearly adds to the above-calculated re-loading factors. The more complex modern logistics and transport systems are involved, the more the re-loading factors are determined by effects apart from the technologically driven production processes. Consequently, logistics and transportation operations lead to an additional transportation volume that is not captured in the PIOT.

In some cases, companies cannot circumvent to play an active role in the distribution of their commodities. Distribution logistics systems are used, when a large amount of articles should be delivered from a certain production to a large number of customers in space. A typical example is the replacement part logistics of car manufacturers. National and regional distribution centers assure a trade-off between storage costs and articles' availability. The final points of delivery are reached using rather small lorries performing local distribution tours. Thus, replacement parts would be re-loaded twice after the original production process (figure 1).

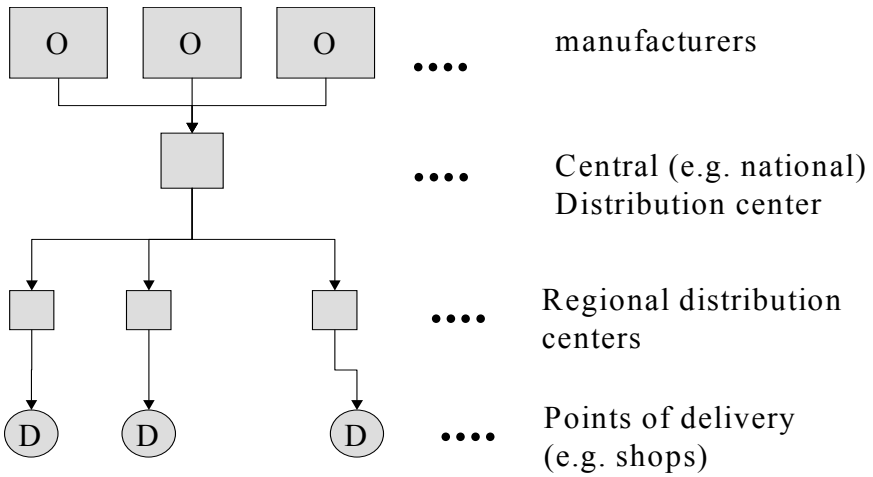
Figure 1: Basic schema of an industrial distribution system



Source: Liedtke, 2006

Retail and wholesale systems have a close similarity to the pure distribution systems operated by the manufacturers. In these cases, a central purchasing unit of a retailing group or a retailing association orders large quantities of products from different producers re-commissions them and delivers them to shops (figure 2).

Figure 2: Basic schema of a wholesale/retail sale system

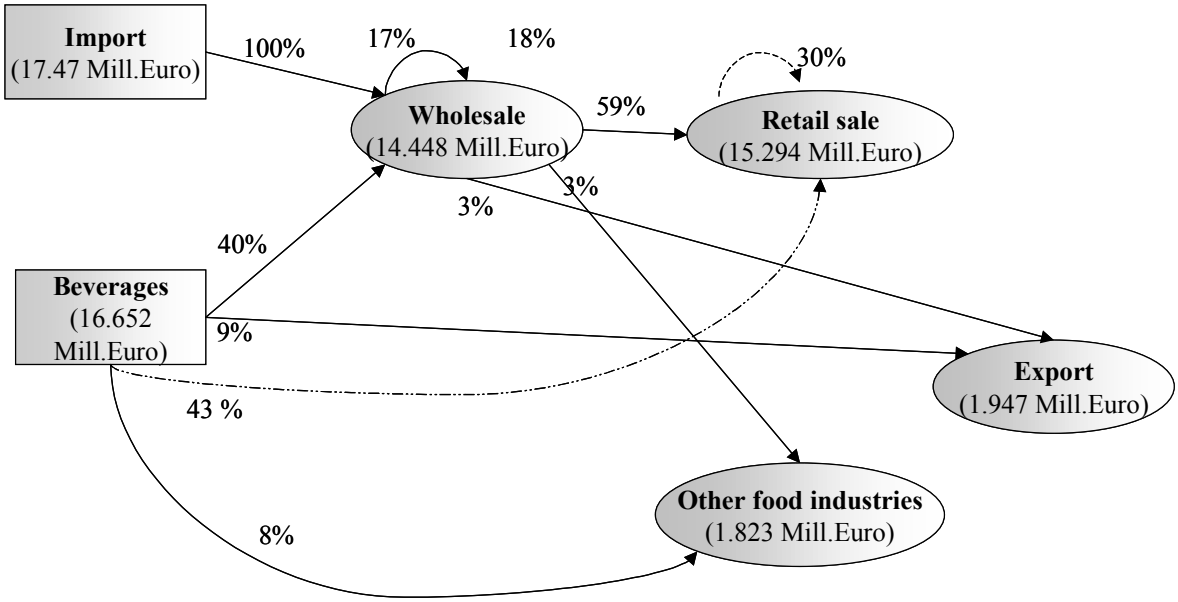


Source: Liedtke, 2006

In reality, different types of logistics systems are mixed. For instance, it might happen, that a producer's distribution system directly delivers the shops or that certain articles do bypass the central distribution centers. The highest share of consumption goods, for instance, is directed via one distribution centre to the final customers in the shops. Thus the re-loading factor

would just increase by 1. In the case of food, however, products are often distributed by central and regional distribution centers. Liedtke (2006) gives a detailed insight into the different logistic concepts by main commodity groups. The different methods applied to get a plausible picture of inter-sectoral flows through trade networks are described by Babani et al. (2006). The results of these analyses can be presented in form of connection graphs (figure 3).

Figure 3: The flow of „beverages“ through distribution systems in Germany (2002).



Source: Babani et al., 2006

The findings allow for a first estimation of the additional freight volume induced by the different distribution systems. This volume can be assigned to the production branches wholesale and retail trade.

An additional source of double counting should only be sketched: Parallel to distribution systems, freight transportation service companies have build up hub-and spoke systems for single pallets, parcels and containers. In cases, when companies have a too few flow of commodities, such networks are used, where the forwarder combines shipments with many other ones form other shippers.

As a consequence thereof, trade volume, assigned to the different categories of final demand can be re-calculated by following equation (4). Table 3 gives an overview on the revised findings. The total just complies with the transport volume given by the federal transport statistics (DIW, 2002).

Table 3

Revised transport volumes necessary to final demand in 1000 tons per year, revised re-loading factors, Germany, 2000, (domestic production)

	Consumption of food	Other private consumption	Public consumption	Investments	Export	Total
Transport volume (revised)	422 169 *10.9%*	895 534 *23.1%*	177 984 *4.6%*	1 413 141 *36.5%*	963 546 *24.9%*	3 872 374 *100.0%*
revised re-loading factor (and changes compared to old re-loading factors	*2.8* *+0.6*	*2.2* *+0.4*	*2.0* *+0.3*	*2.4* *+0.7*	*2.3* *+0.3*	*2.3* *+0,4*

It should be emphasized that additional re-loading is significant for final products. However, effects on intermediate flows are much smaller. Thus, the calculated effects (which account for re-loading factors of intermediate products as well) are considerably small. Strongest effects can be observed for trade volumes assigned to the consumption of food and investments. Increases related to food production are mainly driven by the above mentioned distribution system for food products. In the case of investments, waste treatment might add to the factor.[3]

In fact, the revised re-loading factor for the whole economy has been quite stable for the German economy in the last decade (Fischer-Kowalski et al., 2006). Thus, additional transport volumes that result from changes of final demand can indeed be estimated by the DMI necessary to satisfy final demand and a re-loading factor close to 2.5.

Considering total DMI a decreasing trend has been observed in the last decade. This is particularly true for abiotic DMI but does not hold for the consumption of biomass, which has increased (Statistisches Bundesamt, 2006). The question, whether DMI will further decrease in the future or whether this favorable trend will come to an end cannot be discussed in further detail here. However, according to several studies in the field of material flow analysis, total DMI is unlikely to increase significantly in the future (Fischer-Kowalski et al., 2006; Eurostat and IFF, 2004). Consequently, it is unlikely that transport volumes will increase significantly in the future.

[3] Waste is considered input to landfills, which belong to the group of investments.

3 Direct material input and transport performance

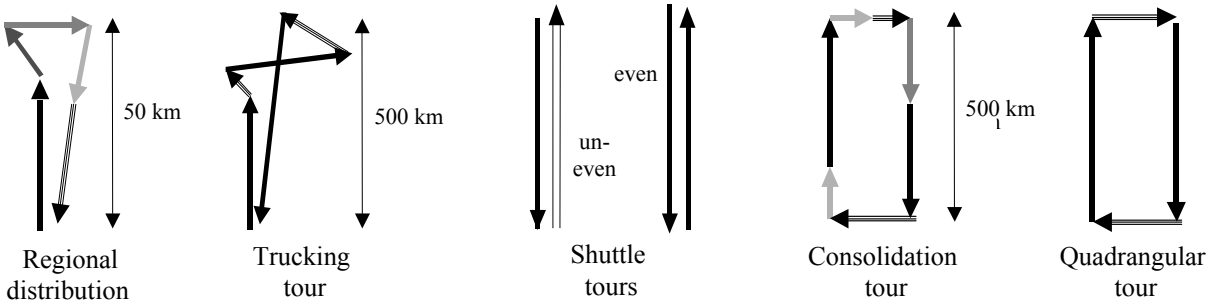
Although transport volumes are unlikely to grow substantially in the future, transport performance measured in tkm, could indeed increase if covered distances rise. In order to discuss potential increases of distances, again the role of modern logistic concepts will be scrutinized closely.

3.1 Impacts on transport distances caused by the logistic system

To carry commodities between the nodes of the production system and the nodes of distribution and transport logistics systems, vehicles are needed.

Whilst the flow of commodities could be represented in form of directed edges (flashes) in space and time, the major share of vehicles operates in form of closed loops. Take, for example, regular round trips of airplanes or the trucks on the road, where drivers more or less regularly return to their family. A classification of tour patterns is given by Liedtke and Schepperle (2004).

Figure 4: Clusters of typical tour patterns



Source: Liedtke and Schepperle, 2004

These tour types can shortly described in the following way:

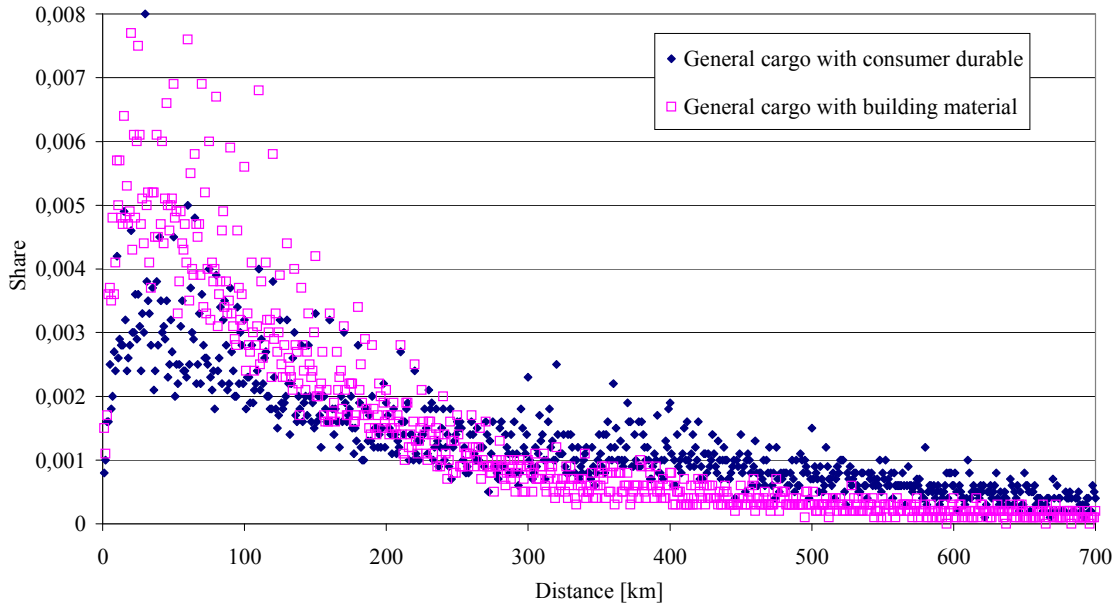
- Regional distribution: A rather small or medium lorry successively unloads or loads goods on a short or medium trip.
- Trucking tours: Irregular sequences of full and empty running trips.
- Shuttle tours (even, uneven).
- Consolidation: Sequences of loading and unloading sequences, long distances, large lorry.

- Tri-/quadrangle tours (e.g. company A in Region 1 - company B in Region 2 - company C in Region 2 - company D in region 1).

In some cases, a correlation between distribution systems and tour types can be found. For instance, the delivery from regional distribution centers to shops is conducted in form of distribution tours whilst cross-border transports are most likely direct transports ("Quadrangular tours") or consolidated full load transports ("shuttle tours") between transportation network nodes. In contrast, it could be expected that durables starting from the manufacturer be transported in form of full truckload shipments to the wholesaler's distribution centers.

The methodological tools for setting up such a relationship based on empirical findings, additional expert inputs and entropy-maximizing algorithms is described by Liedtke and Schepperle (2003). The detailed results are presented by Babani et al. (2006) and Liedtke (2006). The results are trip length distributions for each step of supply chains. Figure 5 gives an example.

Figure 5: Trip-length distribution of full-load trips with durables on board



Source: Liedtke (2006)

Thereby, the findings can be combined with information on transport performance by commodity groups as given in federal transport statistics (DIW, 2002). This opens the door to analyzing the transportation performance related to the final demand.

3.2 Transport performance related to final demand

The assignment of transport performance to the diverse categories of final demand follows the approach applied for DMI and transport volume. In order to calculate transport performance coefficients, statistics on ton-kilometers by commodity groups are taken into account (DIW, 2002). These statistics allow for a separation of the following commodities: products from 1) agriculture and forestry, 2) food and animal feed, 3) products from coal mining, 4) crude petroleum and products of crude petroleum, 5) ores, 6) ferrous and steel products, 7) minerals and building materials, 8) fertilizers and 9) chemical products. Furthermore a tenth miscellaneous category, including vehicles and machines is given. The transport performance of the first nine groups, which refers to about 75% of the total transport performance, can easily be assigned to the consuming production branches. The remaining ton-kilometers related to the tenth group have been distributed according the shares of the transport volumes.

Finally, the direct and indirect ton-kilometers necessary to satisfy consumers' needs can be estimated according equation (5):

$$tp^{dom} = tp \cdot B^{dom} \cdot Y^{dom} \tag{4}$$

tp: Row vector (n elements) of transport volume coefficients. The vector results from the division of incoming transport (measured in ton-kilometers) related to n (=71) branches' by the corresponding production values.

Table 4 shows the assignment of ton-kilometers to the diverse categories of final demand. Furthermore, transport distances that result from the division of transport performance by DMI are given.

Table 4

Transport performance and DMI necessary to satisfy final demand in million tkm and million tons per year, transport distances in km, Germany, 2000, (domestic production)

	Consumption of food	Other private consumption	Public consumption	Investments	Export	Total
DMI (in mill. tons)	153 *9.3%*	416 *25.2%*	90 *5.5%*	579 *35.1%*	411 *24.9%*	1 650 *100.0%*
Transport performance (in mill. tkm)	60 523 *12.4%*	104 907 *21.5%*	21 863 *4.5%*	157 634 *32.3%*	143 673 *29.4%*	488 600 *100.0%*
Reporting: *distances in km*	*394*	*252*	*243*	*272*	*350*	*296*

Transport performance does not account for sea shipping but refers to road, rail and inland waterway transport in Germany (no matter if the haulier is German or not). Furthermore, imports are only considered, if they enter the production process but not if they are delivered directly to the consumers.

The covered distances give an idea about the average distance covered by one ton of material input to satisfy consumers' needs on its way alongside the EPCD chain. Distance is particularly high in the case of (direct and indirect) inputs to food production and to exports. However, the high re-loading factor related to food production points to a higher number of trips necessary to satisfy demand for food. Thus, the average trip distance is probably higher in the case of exports.[4]

Due to decreasing or at least constant DMI, transport performance will only grow, if re-loading factors or average distances rise. With regard to the loading factors some changes might occur in the future. However, expected changes hardly justify to expect significant growth rates for a longer period (section 2.3). Thus, it all depends on average distances. Since the study at hand does not account for kilometers driven abroad (in order to satisfy demand for domestic products), the question cannot fully be answered here. However, considering logistic concepts might give a first insight into future trends.

4 Conclusions

The main points made in this paper fall into two parts: The first part is devoted to the development of a model that links DMI and freight volumes by combining material flow with input-output analysis. Concerning the production process, it can be shown that transport volumes are a fairly constant multiple (*re-loading factor*) of DMI depending, on the one hand, on the number of production stages and, on the other hand, the combustion of energy sources.

The application of input-output analysis allows for a good estimation of transport volumes that come along with the production of goods. However, volumes related to the distribution of these goods can hardly be projected from physical or monetary input-output tables.

The presented study overcomes this shortcoming by additionally taking into account detailed information on freight markets and logistic concepts. In so doing, *revised re-loading factors* can be identified. Although the revised calculations result in higher factors, they still seem to be rather constant over time. Since DMI is expected to continue the decreasing trend in the

[4] Note that the re-loading factor is also determined by the combustion of energy sources. Thus it does not reflect the average but rather the minimum number of trips necessary to satisfy demand for the corresponding category.

near future (for the German economy), transport volumes can be considered to stagnate in the near future. Thus, it can be concluded, that significant growth rates of transport performance must derive from rising distances. Indeed, international transport might continue to gain in importance. However, first empirical findings suggest that the introduction of the HGV toll in Germany clearly slows down this process. As a consequence thereof, limits to growth might soon be experienced in the case of road freight transport in Germany.

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Spatial and sectoral analysis of productivity-wage dissimilarities in Romania

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Abstract
Labour productivity and wages are two major determinants of the economic activity and their connection is a constant concern for the economists, as well as for employers and policy-makers. This paper is aiming to measure to which extent is the variation of productivity consistent with the distribution of wages, employing two patterns of comparison: by region and by economic branch. For this purpose, we developed a revised form of the coefficient of structural changes, in order to determine the regional/ sectoral dissimilarities between productivity and wage.

Key words: labour productivity, wage, disparities, Romania

JEL classification: J31, R23

1. Introduction

This paper explores the inter-region and inter-sector labour productivity and wage variation employing transversal data sets for 2000 and 2005. The main idea is to determine the dissimilarities between labour productivity and wage, both by regions and by main economic branches. For this purpose, we developed a modified form of the

coefficient of structural changes (Kazineț, 1955, Tövissi, 1979), in order to enable comparisons between qualitative variables such as labour productivity and wage.

This paper is structured as follows. Section 2 outlines the two major economic lines of thought that provide explanations for the relations between labour productivity and wages. Section 3 briefly describes the methodology used to work on our spatial and sectoral data. Sections 4 and 5 focus on the results of the regional and sectoral analysis of productivity - wage dissimilarities. Section 6 provides some concluding remarks on the topic.

2. Theoretical background

The labour economics literature displays two main approaches to the connection between labour productivity and wages. In neo-classical theory the level of wages is supposed to be determined by the marginal productivity of labour. Firms are activating on a competitive market and the level of wages is established exogenously on the labour market, like other prices in the economy.

From the standpoint of the profit maximizing goal, the decision to hire an additional unit of labour is entirely based upon its effect on the profits. Considering the wage as the cost of hiring one more worker and the revenue as the marginal productivity of the unit of labour, in order to maximize profit, the firm demands each factor of production until the marginal productivity falls equal to the real price of that factor (Mankiw 2003, p. 46-48).

This judgement establishes a clear link between wage and the average productivity of labour: the economic sector with bigger labour productivity would also have higher wages. Increases in labour productivity in one economic sector would magnify the demand for labour, thus producing an increase in wages, at least on the short run. In the long run, this wage surplus is difficult to maintain, since more workers will be attracted

by the sector offering higher wages, thus increasing the supply of labour and exercising upon the wages a downward pressure that can bring them back to the average wage. Considering the supply of labour is mobile, from a theoretical point of view the long run effect will be the convergence of wages between sectors, together with an increase in employment in the higher productivity sector, owing to migration of workers.

There is empirical evidence to support this theory derived from the standard neo-classical model. A research for Sweden and Finland, over 1950-2000 period, found that the dispersion (by economic sector) of labour productivity and wages develops in the same direction for the most of the period (Svanlund, 2007), Finland better fitting the neo-classical theory.

Some authors consider this neo-classical theory about the relationship between labour productivity and wage is wrong (Bruce, 2002, Huizinga, 2004). First, they say there isn't necessary a correspondence between output per worker and revenue per worker because, if decline in the demand for the output of a certain sector occurs, market prices will have to reduce too, thus causing a decrease in the revenue per worker, despite any presumable productivity gains. A higher labour productivity may produce a price reduction because it determines the increase of the total output of the sector and, by the laws of supply and demand, when supply rise, the price fall. This decline in prices furthermore produces a reduction in revenue per worker. The agricultural sector of the developed countries represents such an example, the farm incomes being under permanent downward pressure despite constant productivity improvements.

Second, even if revenue per worker actually increase in the higher productivity sector, the consequent higher level of wages may not be sustainable on the long run because the increasing labour supply generated by the workers migrating from lower wage sectors puts a downward pressure on wages.

To sum up, there may be only partial, time-limited connection between labor productivity and wages from the sectoral point of view. Empirical evidence supports these assertions. An example is a research employing statistical data covering 1961-1995 period for Canada, that discovered that regardless of an industry's growth in relative multifactor productivity, relative wages remained unchanged Bruce (2002). Another made in Nederland's showed that a wage push only temporary raises labour productivity in the short run, but it is inefficient in the long run (Huizinga, 2004). Therefore, the author concludes that it is probably best not to use wage policy at all as a tool to influence productivity, but it is very effective as a tool against unemployment.

3. Methodology

The aim of this paper is to measure the dissimilarities between labour productivity and wage variations from the standpoint of their regional and sectoral values, as compared with the national average. We started from the coefficient of structural changes (Kazineț, 1955, Tövissi, 1979) that measures the average variation in the structure of a population over a period of time using the quadratic mean of the absolute differences between the present (t) and the previous (o) shares owned by the elements (i) of this population:

$$CS = \sqrt{\frac{\sum_{i=1}^{n}\left(\frac{x_i^t}{\sum_{i=1}^{n} x_i^t} - \frac{x_i^0}{\sum_{i=1}^{n} x_i^0}\right)^2}{n}} \qquad (1)$$

We developed the formula for a coefficient of dissimilarities (CD) that enables comparisons between the structures of two different variables. For qualitative variables, such as wage and labour productivity, instead of the share of each unit i ($\frac{x_i^t}{\sum_{i=1}^{n} x_i^t}$) we employ the ratio between the value of the variable for unit i and the arithmetic mean, as in the formula below:

$$CD = \sqrt{\frac{\sum_{i=1}^{n}\left(\frac{P_i}{P_m} - \frac{W_i}{W_m}\right)^2}{n}} \qquad (2)$$

where:

$\frac{P_i}{P_m}$ is the ratio between region/sector "i" productivity and the national average;

$\frac{W_i}{W_m}$ is the ratio between the average monthly wage in region/sector "i" and the national average monthly wage;

n – number of regions/sectors.

This indicator measures the overall dissimilarities between the spatial/sectoral distributions of wages and labour productivity and its values lays between 0 and $\sqrt{2n}$. For example, when territorial inequalities of labour productivity perfectly mirror the ones of wages, that is for each region *i* the position it holds against productivity national average is exactly the same as for the wage, there is no discrepancy between the two distributions and the coefficient of dissimilarities is zero. On the opposite, when the regional labour productivity hierarchy is totally different from the one of wages (e.g., the region with the highest wage has the smaller labour productivity) the dissimilarities reach their maximum level: $CD = \sqrt{2n}$, where n stands for the number of regions. Romania has eight development regions, so the regional CD may vary between 0 and 4. Taking into account that we employed 12 main branches for our sectoral analysis, in this case CD may vary between 0 and 4.9.

4. Regional productivity-wage dissimilarities

In this paper we first investigate the relationship between wage dispersion and labour productivity dispersion in the Romanian development regions. Absolute values of labour productivity and wage presented in the table 1 show little regional variation. In 2000, the territorial coefficient of variation for wages was 13.35% against the 16.31% variation of labour productivity. In 2005 the coefficient of variation for labour productivity recorded a sharp reduction, falling to 3.96%, but the wages variation slightly increased to 14.06%.

Table 1. Regional productivity-wage dissimilarities

Regions (*i*)	2000				2005			
	Labour productivity *(GDP/person in thou RON current prices)*	**Wage** *(RON /person current prices)*	$\frac{P_i}{P_m}$	$\frac{W_i}{W_m}$	**Labour productivity** *(GDP/person in thou RON current prices)*	**Wage** *(RON/ person, current prices)*	$\frac{P_i}{P_m}$	$\frac{W_i}{W_m}$
0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
North-East	15.2208	185	0.8754	0.8645	60.6997	663	0.9606	0.8887
South-East	16.4368	217	0.9454	1.0140	62.4436	702	0.9883	0.9410
South	15.8948	208	0.9142	0.9720	64.9609	716	1.0282	0.9598
South-West	17.4566	226	1.0040	1.0561	65.3714	734	1.0347	0.9839
West	15.9466	204	0.9172	0.9533	61.1393	718	0.9677	0.9625
North-West	16.4948	191	0.9487	0.8925	61.0493	679	0.9663	0.9102
Center	16.2320	197	0.9336	0.9206	61.1211	661	0.9674	0.8860
Bucharest	23.9761	275	1.3790	1.2850	67.1918	977	1.0635	1.3096

Source: Romanian Statistical Yearbook 2006, Labour cost survey and authors' calculations

These divergent evolutions of labour productivity and wages explain the increase in the dissimilarities between the territorial distribution of their values since 2000:

$CD_{2000} = 0.0551$ or 5.51%

$CD_{2005} = 0.1031$ or 10.31%.

The level of this indicator is near the lower limit of its variation range, proving that the regional distributions of wages and labour productivity are highly connected.

The ratio between the maximum and the minimum wage by regions was 1.49 in 2000 and 1.47 in 2005. For labour productivity, these ratios were 1.58 and 1.10 respectively.

The evolution of the coefficient of dissimilarities shows a big increase in productivity-wage regional differentials in 2000-2005 period. Although it almost doubled, the regional productivity-wage dissimilarities are still very low, especially if compared with the ones by economic sectors.

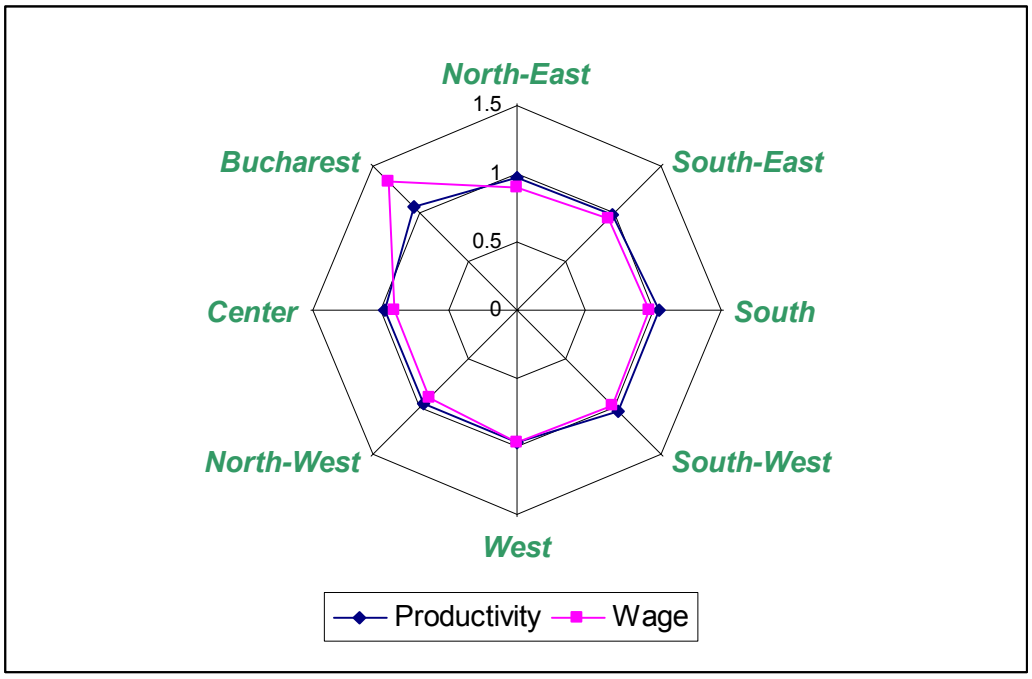

Figure 1. Regional productivity-wage dissimilarities in 2005

5. Productivity-wage dissimilarities by main branches of economy

In the second part of our empirical study we are testing whether differential levels of labour productivity across economic sectors are reflected in their relative wages. Starting from the wage and labour productivity levels of 12 main branches of the economy in 2000 and 2005 (table 2) we measure the overall dissimilitude between the distribution of these two indicators by using relation (1), where $\frac{P_i}{P_m}$ is the ratio between the productivity of branch "i" and the national average and $\frac{W_i}{W_m}$ represents the ratio between the monthly average wage in branch "i" and the national monthly average wage.

Firstly we measure labour productivity as gross value added /employee, by dividing the gross value added in each branch by its number of employees (table 2). Fundamental problems of labour productivity measurement by this formula arise in agriculture, hunting and sylviculture, where the employees are only a small part of the employed population.

These leads to an unrealistic high value of labour productivity, as the gross value added is created by all the population employed in agriculture and the employees hold a smaller share of the employed population, as compared to other sectors of the economy. When labour productivity is measured as gross value added per person employed (table 3), the value of labour productivity in agriculture sharply decreases.

The overall differences between labour productivity and wage distributions of values by branches are far bigger than the regional ones. The coefficient of dissimilarities is:

$CD_{2000} = 1.1370$ or 113.70%

$CD_{2005} = 0.9240$ or 92.40%.

Although the differences between sectoral distribution of wages and labour productivity are significant, considering the full range of variation of this indicator (from 0 to 4.9), there is still considerable productivity-wage connection.

Table 2. Dissimilarities between labour productivity (gross value added/employee) and wage by main economic branches

Branches (*i*)	2000				2005			
	Labour productivity *(Gross value added/person in thou RON current prices)*	**Wage** *(RON/ person, current prices)*	$\frac{P_i}{P_m}$	$\frac{W_i}{W_m}$	**Labour productivity** *(Gross value added/person in thou RON current prices)*	**Wage** *(RON/ person, current prices)*	$\frac{P_i}{P_m}$	$\frac{W_i}{W_m}$
0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Agriculture, hunting and sylviculture	45.40*	164	2.8844	0.7664	169.25*	438	2.9533	0.7312
Fishing and pisciculture	1.00	135	0.0635	0.6308	5.23	361	0.0913	0.6027
Industry	11.72	223	0.7445	1.0421	41.48	658	0.7237	1.0985
Construction	12.43	186	0.7899	0.8692	52.56	558	0.9171	0.9316
Trade	14.50	150	0.9213	0.7009	42.88	458	0.7482	0.7646

Hotels and restaurants	22.67	138	1.4402	0.6449	67.75	425	1.1821	0.7095
Transport, storage and communications	21.72	284	1.3797	1.3271	92.74	795	1.6182	1.3272
Financial intermediations	17.41	526	1.1064	2.4579	81.51	842	1.4222	1.4057
Real estate and other services	58.97	216	3.7466	1.0093	150.76	461	2.6305	0.7696
Public administration and defense	23.38	304	1.4853	1.4206	105.93	550	1.8483	0.9182
Education	5.71	205	0.3631	0.9579	26.06	515	0.4548	0.8598
Health and social assistance	5.17	177	0.3284	0.8271	23.59	443	0.4117	0.7396

Source: Romanian Statistical Yearbook 2006, Labour cost survey and authors' calculations

* *This unusually high value is due to the low share of employees in the total population employed in agriculture.*

If agriculture, hunting and sylviculture and real estate are excluded because of their extreme values which distort the results, the level of the coefficient of dissimilarities decreases to 54.27% for 2000, respectively 39.24% for 2005.

Better results are obtained by measuring labour productivity as gross value added per person employed (table 3).

Table 3. Dissimilarities between labour productivity (gross value added/person employed) and wage by main economic branches

Branches (*i*)	**2000**				**2005**			
	Labour productivity *(Gross value added/person in thou RON current prices)*	**Wage** *(RON/ person, current prices)*	$\frac{P_i}{P_m}$	$\frac{W_i}{W_m}$	**Labour productivity** *(Gross value added/person in thou RON current prices)*	**Wage** *(RON/ person, current prices)*	$\frac{P_i}{P_m}$	$\frac{W_i}{W_m}$
0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Agriculture, hunting and sylviculture	2.49	164	0.3025	0.7664	9.115	438	0.3006	0.7312
Fishing and	0.6	135	0.0728	0.6308	3.925	361	0.1295	0.6027

pisciculture								
Industry	10.95	223	1.3287	1.0421	35.15	658	1.1593	1.0985
Construction	11.13	186	1.3502	0.8692	39.5	558	1.3029	0.9316
Trade	10.61	150	1.2876	0.7009	27.97	458	0.9223	0.7646
Hotels and restaurants	20.48	138	2.484	0.6449	45.84	425	1.512	0.7095
Transport, storage and communications	19.18	284	2.3265	1.3271	70.78	795	2.3343	1.3272
Financial intermediations	16.71	526	2.0269	2.4579	69.73	842	2.2999	1.4057
Real estate and other services	38.52	216	4.6726	1.0093	93.73	461	3.0915	0.7696
Public administration and defense	23.54	304	2.8554	1.4206	102.3	550	3.3725	0.9182
Education	5.53	205	0.6703	0.9579	23.09	515	0.7617	0.8598
Health and social assistance	4.62	177	0.5609	0.8271	20.47	443	0.6751	0.7396

Source: Romanian Statistical Yearbook 2006, Labour cost survey and authors' calculations

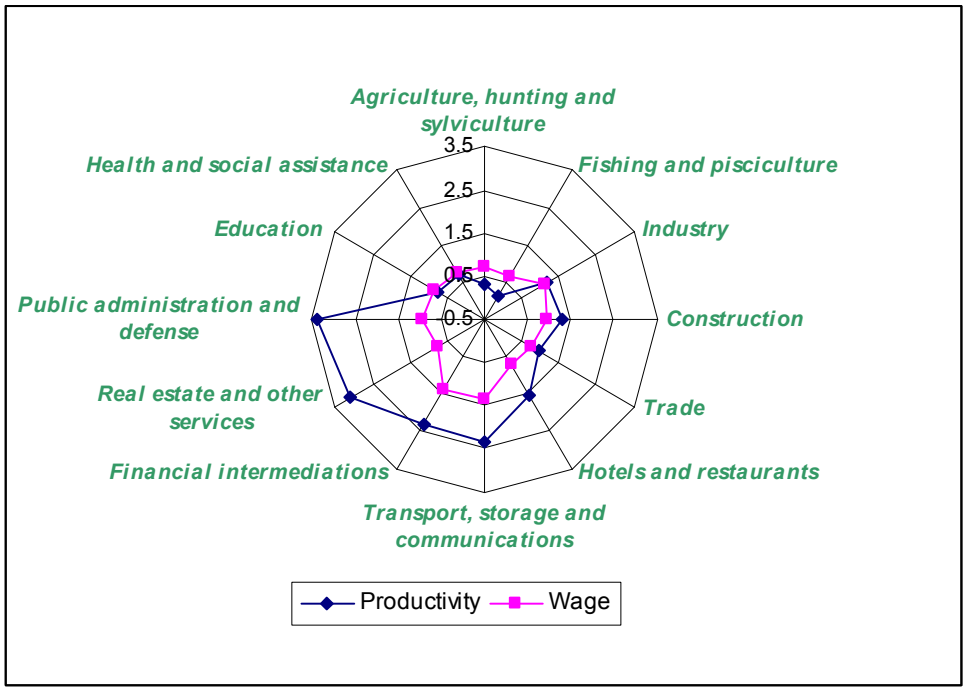

Figure 2. Sectoral productivity-wage dissimilarities in 2005

The ratio between the maximum and the minimum wage by branch was 3.90 in 2000 and decreased to 2.33 in 2005. For labour productivity, these ratios were 64.20 and 26.06 respectively. Based on this reduction of the distances between the extreme values of the distributions, the overall dissimilitude coefficient also decreased in 2000-2005 period:

$$CD_{2000} = 1.3349$$

$$CD_{2005} = 1.0978.$$

The values of the coefficient of dissimilarities are relatively low, showing a significant connection between labour productivity and wages from the sectoral point of view.

6. Final remarks

The relation between labour productivity and wages is an issue of great interest for economists. Against the neo-classical theoretical belief upon the strong connection between labour productivity and wages, empirical evidence reveals important differences in their variation.

In this paper we investigated the cross-section relation between the dispersion of wages and productivity in Romania, both by regions and by economic activity. We found insignificant differences between the territorial variations of those two variables. However, the distribution of labour productivity across economic branches is in a much bigger dissonance with the sectoral distribution of wages. There is a tendency favoring the reduction of these differences in time, mainly due to a faster increase of labour productivity in the less favored branches of the economy, thus reducing the gap.

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The Role of Regional Competition for Demography and Regional Disparities in Germany

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Abstract

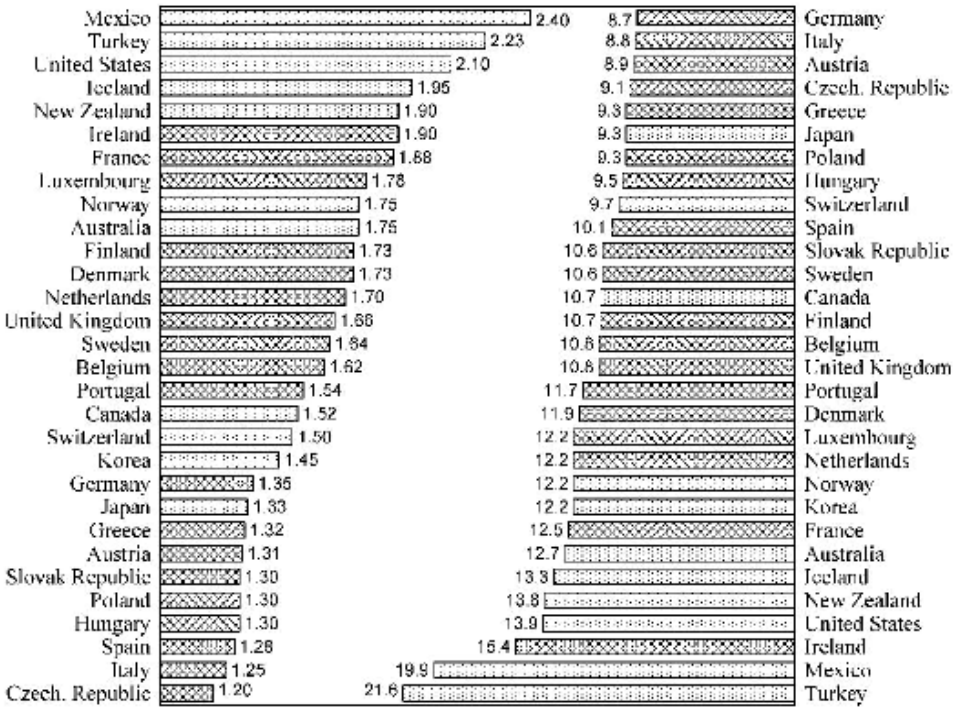
The demographic development in Germany has severe consequences on the economic and social development of the country. The aging and decreasing of the population are certainly the most considered aspects of the demographic change. We consider additionally the competition between regions for inhabitants, which can be observed in Germany and aggravates the country's demographic situation. Indicators such as the natural population-development, the fertility rate, the sex ratio, the migration, etc. are varying significantly from region to region. Very strong regional differences in these indicators are observable between East and West Germany, as well as between North and South Germany. High-qualified persons are recruited by other regions for the purpose to built higher location advantages. This intensified competition leads to very big regional differences that some regions cannot successfully face. The consideration, that a cooperation of regions instead their competition

would yield success regarding the demographic problem, which is stronger through the national migration, is very important. We consider in our model two utility-maximizing German regions that pursue a policy of attracting young inhabitants through different policy measures.Therefore, we construct an oligopoly model that picture the competition situation. A Prisoner's dilemma results, where each region has the incentive to attract inhabitants from the other region, despite that cooperation between both regions would lead to higher welfare, better allocation of the factors and less government spending.

I. Introduction

The population in Germany and in the most developed countries is expected to decrease in the next 40 years. The demographic problems are a consequence of the low fertility, the increasing life expectancy as well as of the internal migration. The low fertility rates combined with the increasing life expectancy, which is leading to population aging, are generating a lot of economical and structural changes which the German society have to face.

Figure 1 depicts an international comparison of several OECD countries in 2002. Considering the fertility rates Germany is located somewhere in the middle of the ranking. A closer look, especially on the birth rates per 1.000 inhabitants reverses this picture and gives insights to the structural problem of Germany. This measure is defined as the number of births occurring per 1.000 inhabitants during a year, whereas fertility is defined as the average number of births per woman, assuming that the age-specific fertility rates of this year remains unchanged throughout the life of a woman. The number of women of childbearing potential is quite small, which results from the low number of births that the country experienced in the 1970s (Sinn 2005). Therefore a drastically change in the outlook of Germanys demographic development appears unlikely.



Source: Sinn 2005.

Figure 1. Fertility rates (left side) and birth rates per 1.000 inhabitants (right side) in several OECD countries in 2002.

The natural demographic development is aggravated by internal migration which leads to major regional disparities in Germany. Considering that many young people, especially young women aged 18 to 29, are migrating from East Germany to West Germany, many consequences can be already observed. Counties in the eastern part of the country are facing already the demographic problems, which are predicted for the south-western part of the republic in 20 years. The internal migration is aggravating the situation, because it delays the demographic changes in some regions (the regions with positive net migration), which leads to an inappropriate way of facing the problem in these regions. On the other side, the internal migration induces an amplified impact on demography in regions with negative net migration. Competition for population arises. Regions are trying to attract inhabitants through different measures and economic incentives. A situation with high expenditures for attracting population and a suboptimal allocation of inhabitants emerges. Regions can hardly face this competition so that regional disparities arise.

The purpose of this paper is to show that despite strong competition, there are situations where regions have no incentive to react on policy measures of the competing region. A change of the own policy measures as a reaction on policy changes of other regions will lead to an inferior result. Considering two utility maximizing counties, as well as a minimum population which is needed for using efficiently existing infrastructure and the regional

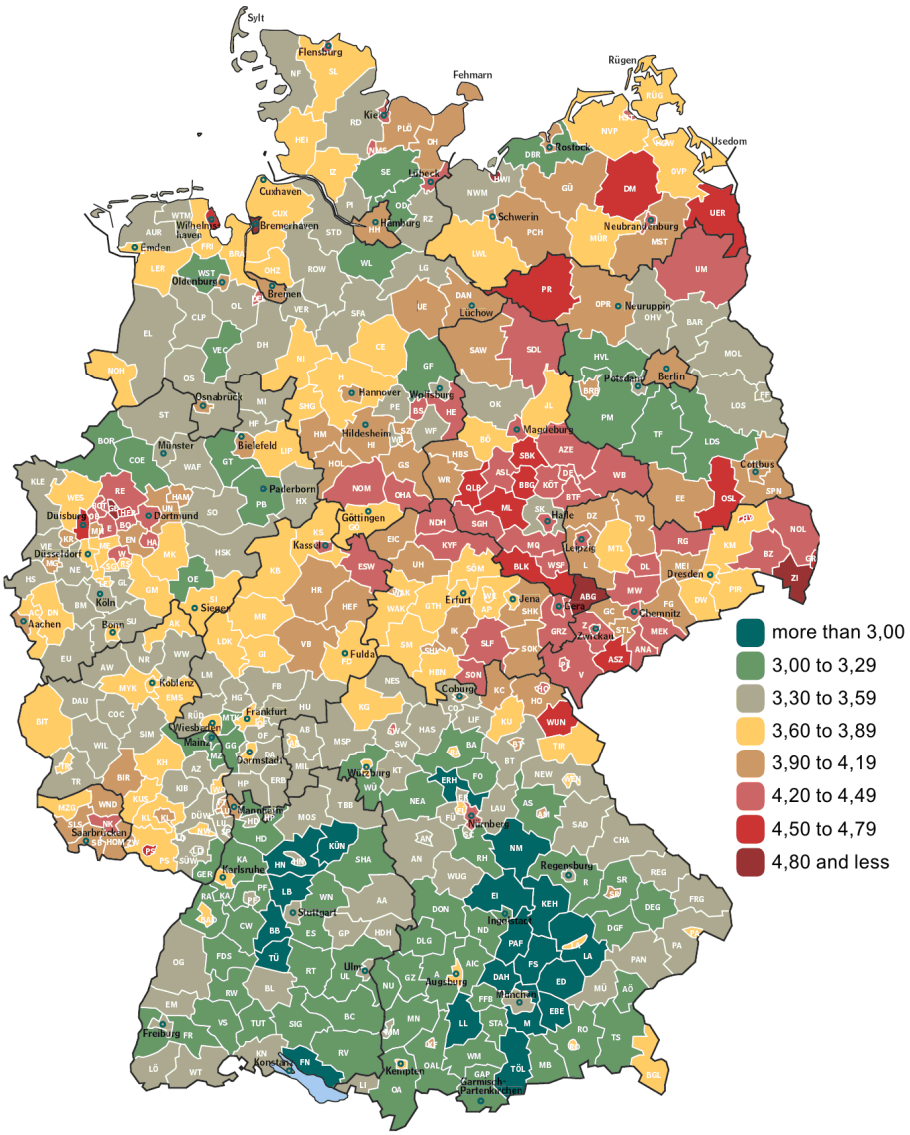
competition for inhabitants, there are some reaction alternatives for each region that depend on the demographic situation of each region.

II. Population-structure and requests for the population-politics in Germany

The demographic change in Germany represents an economic problem. The aging of the population causes in the first place a structural change of the German society because of the decreasing of the labor force participation. In the year 2030, the share of the people aged 60 years or older of the population is amounted to approximately 35 percent and consequently almost double so high as the share of the persons aged 20 years and younger (Lehr 2003; Birg 1987). This means that a smaller group of employed people have to face an increasing number of older people who needs pensions, special care or other services. Labor force participation declines with increasing age of population. Globally the number of people aged 60 years or older is expected to triple until 2050. The ratio of older people to the population is in developed countries 20%, but an increase to 32% until 2050 is expected (United Nations, 2005). A clear decrease of the population is expected in Germany in the year 2040 with the death of the baby-boom generation of the 1960s (Börsch-Supan, Ludwig, Sommer 2003). According to all scenarios there will be a population decrease of 6 million people in Germany, i.e. a population of 77 million or less inhabitants instead of 83 millions is expected.

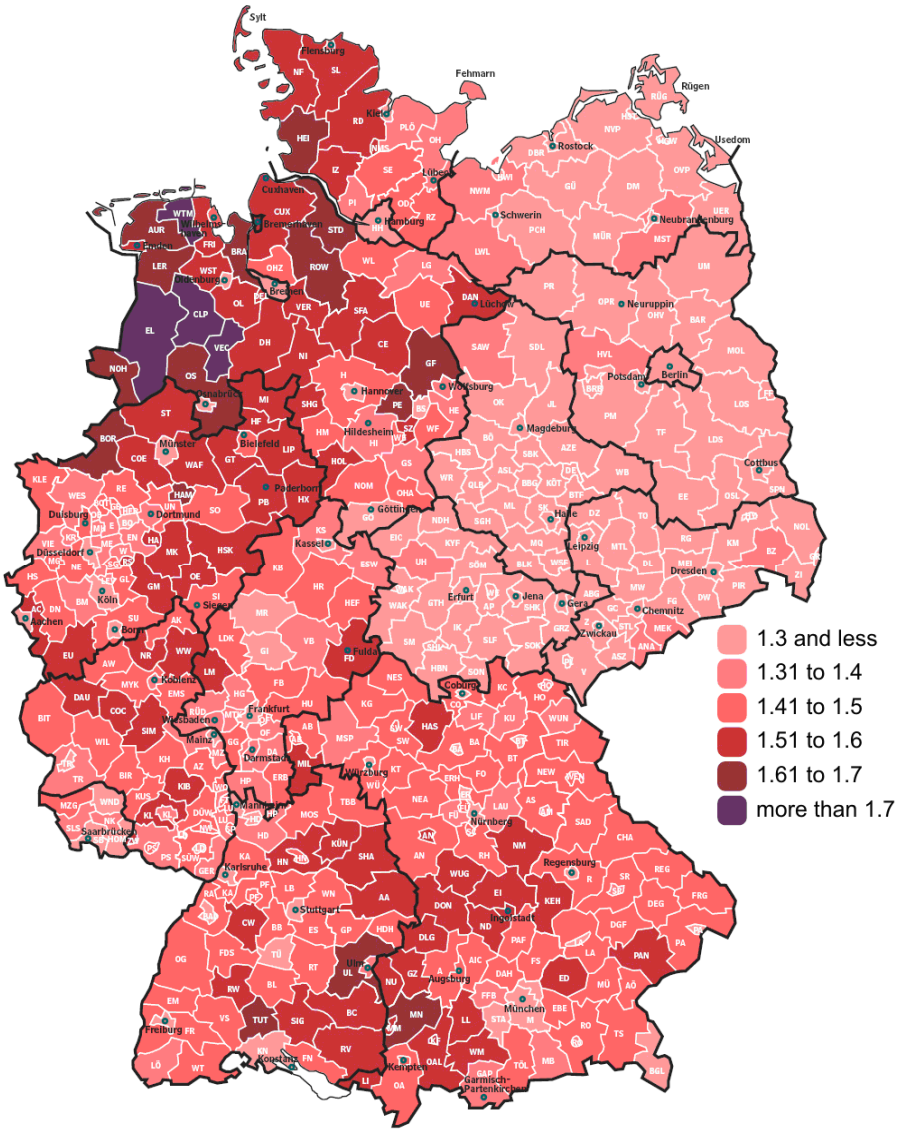
Indicators such as the natural population-development (relationship of the births to the death-cases), the fertility (number of children per woman), the sex ratio (the ratio of women to men) and the share of persons aged 20 and younger to the total population as well as the migration describe the evaluation of the demographic development. In Germany, there are very strong regional differences in these indicators. Germany's reunification entailed massive migration-streams between East- (New Federal States) and West Germany. The demographic situation in Germany is pictured in figure 2 (the best mark for a region is 1, the worst one is 6, but there are only 19 counties aside from Munich and Stuttgart which have a better grade than 3) (Kröhnert, van Olst, Klingholz 2004). The differences between east west and north south are well defined.

Every third woman in Germany remains childless. These circumstances are no longer enough for securing a stability of the population. (Kröhnert, van Olst, Klingholz 2004). The fertility rates in Germany are shown in figure 2.



Source: Kröhnert, van Olst, Klingholz 2004

Figure 2. Survey of the demographic situation in all German counties.



Source: Kröhnert, van Olst, Klingholz 2004

Figure 3. Fertility rates in Germany.

Decreasing fertility rates exists in most of the developed countries. This can be observed by considering the average total fertility rate for the OECD countries which decreased by 1.3 in 30 years (1960 the fertility rate was 2.9 children per woman, by the end of the 1990s decreased the same rate to 1.6) (Adserá 2003). Considering the world fertility level, which is about 2.65 children per woman (also declining), it can be concluded that fertility decline in developed countries like Germany has been the rule (United Nations 2005; Birg 2005). The primary consequence of decreasing fertility rates and increasing life expectancy is

population aging. Besides the population aging, the internal migrations of young people between east and west will have very negative effects for some German regions. The consequences of this population decline will be of economic, social as well as psychological nature. The prognoses for the year 2030 are through the announcement of the declining population, the continuous decrease of the fertility and further migrations, not optimistic. The expected number of 200,000 international migrants in terms of annual averages for the period 2005-2050 is not really the solution of the problem, considering the fact, that migrants are not mainly moving in regions, which are strongly affected by demographic problems (United Nations 2005). They are going to regions with communities of several nations, such as cities without strong population decline (Detig, Feng, Friedrich 2002).

In the foreground of the political discussion, are the effects of the population aging and the decline of social aid systems, such as health-, pension-, and nursing insurance. Above all those social insurances, only the pay-as-you-go systems are affected. The public pension system which takes the form of a full pay-as-you-go system, i.e. pension tax revenues from employees are financing the pension benefits of the people who are retired, is in Germany affected by the aging of the population. The demographic problems are putting growing pressures on pay-as-you-go systems of social security (Bryant 2004). Benefit payments made to an increasing number of elderly retirees will exceed system tax revenues. The pensions are hard to finance under these circumstances because a smaller number of employees will have to face a growing number of retirees (Birg 2003). This means for the public pension system in Germany concretely an increase of the employees' contributions by 100% or a decrease of the pension payments for retirees by 50%, if the public pension system remains the same. The public health insurance is also affected by the population aging. The governments have to face increasing demand for health-services, i.e. higher expenditures, and a decreasing number of contribution payers, caused by the lower labor force participation. The rise of the expenditures in the health sector can be explained by two factors: first of all there is the population aging which accounts for this rise and secondly it is empirical underlined that the per capita expenditures for heath services increases with rising age, i.e. older people need more health care than younger people (Birg 2002). The per capita health expenditures for an older person are eight times higher than the expenditures for a person aged 20 years (Ministerium für Gesundheit und Soziales NRW 1994).

Through the decrease of the number of persons in the employable age caused by the population aging, a shortage of the labor force emerges. Scenarios in which the female labor

force participation rate is similar to the male labor force participation rate, the retirement age is higher and the unemployment rate is 5%, predict for the long term that there will be 8 million less employed people compared to the year 2000, despite the increased employment rate (Börsch-Supan, Ludwig, Sommer 2003). The risen importance of capital results from the shortage of the factor labor. This capital-intensification is explained on the one hand through the substitution of the factor labor with capital and on the other hand through capital investments abroad in the form of foreign direct investments (FDI). The FDI could secure that the unchanged consumption-demand can be satisfied by imports (Börsch-Supan, Ludwig, Sommer 2003). High capital flows in foreign countries with big economic potential caused by increased labor force participation can not be prevented (Kinsella, Phillip 2005).

The population aging in Germany is also important for explaining changes in consumption demand caused by a postponement of individual preferences. The demand for health and nursing services is rising while the demand for education decreases because of smaller fertility rates. In East Germany the phenomenon of empty apartments can be observed. The decreasing number of young families could explain this situation.

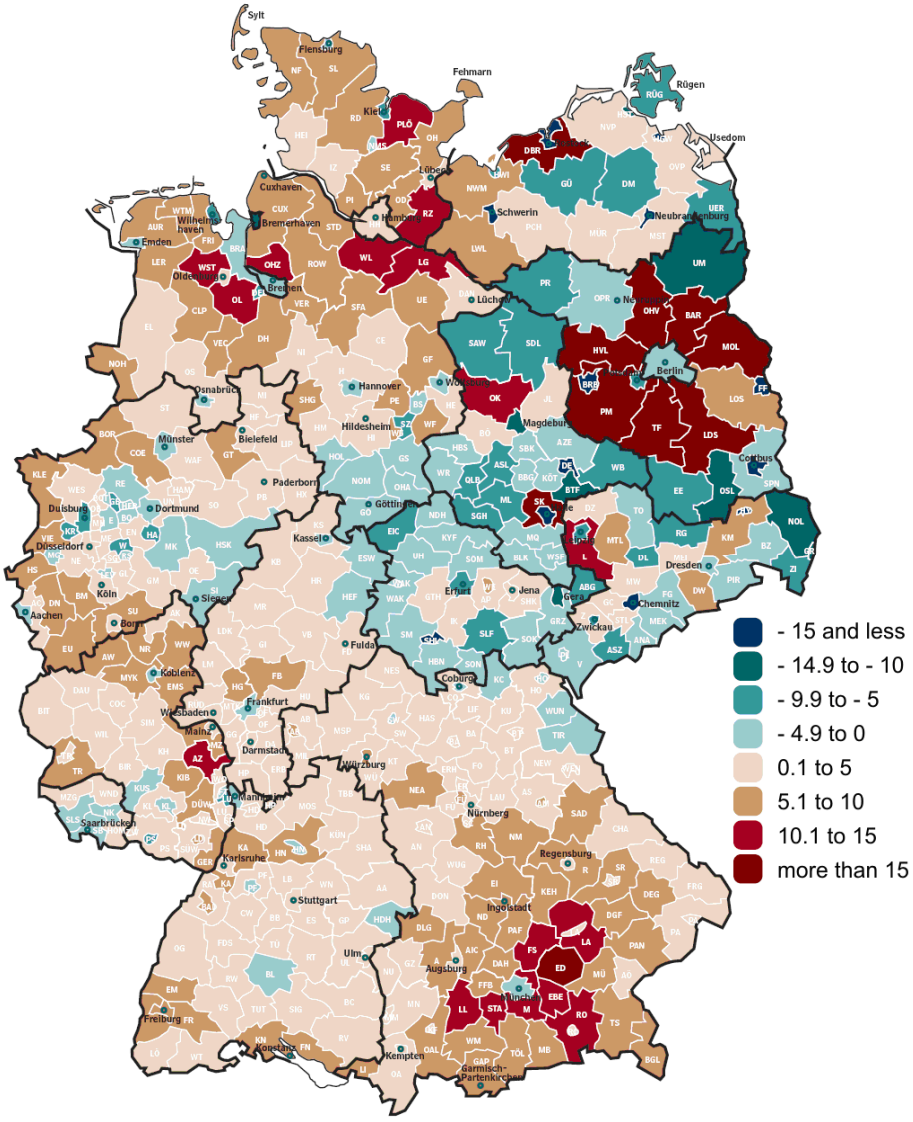
The counties in Germany are also strongly affected by the demographic development. The discussion about the introduction of a demographic component for the better calculation of the fiscal equalization started in some counties affected by decreasing population and constant or rising financial needs.

In principle there are two categories of policy measures for demographic problems, on the one hand the support of fertility measures (support of families with more than 3 children, offer of incentives for giving birth to children) and on the other hand the international migration (integration services for migrants). According to calculations of the United Nations concerning migration as policy measure for demographic problems, Germany would have to receive 188 million migrants until the year 2050 to be able to prevent the population aging (United Nations 2000). This number of necessary migrants arises from the consideration that the population aging is only stopped until the migrants are getting old by themselves. Considered by this calculation is also the fertility rate of the migrants which is situated by 1.9 children per woman and hence lower than the necessary fertility rate of 2.1 children per woman which is needed for population rejuvenation (Birg 2002). Most problematical about international migration is that many migrants are migrating in the German social systems and not into labor. The number of the inhabitants with migration background doubled between 1970 and 2002. At the beginning of the 1970s there lived 3 million migrants in Germany, in

2002 there were 7.4 millions. It is very important to remark that the number of employed migrants during the same period 1970-2002 remained almost the same (there were 1.8 million employed migrants at the beginning of the 1970s and 1.9 in 2002) (Beckstein 2005). On the other hand, the support of measures for rising fertility alone won't bring better results than the migration solution, except the fertility rate will rise till 3.8 children per women (Birg 2002). Such a high fertility rate is not conceivable considering the increasing female labor participation rates, the bad childcare infrastructure and the structural changes in families and society.

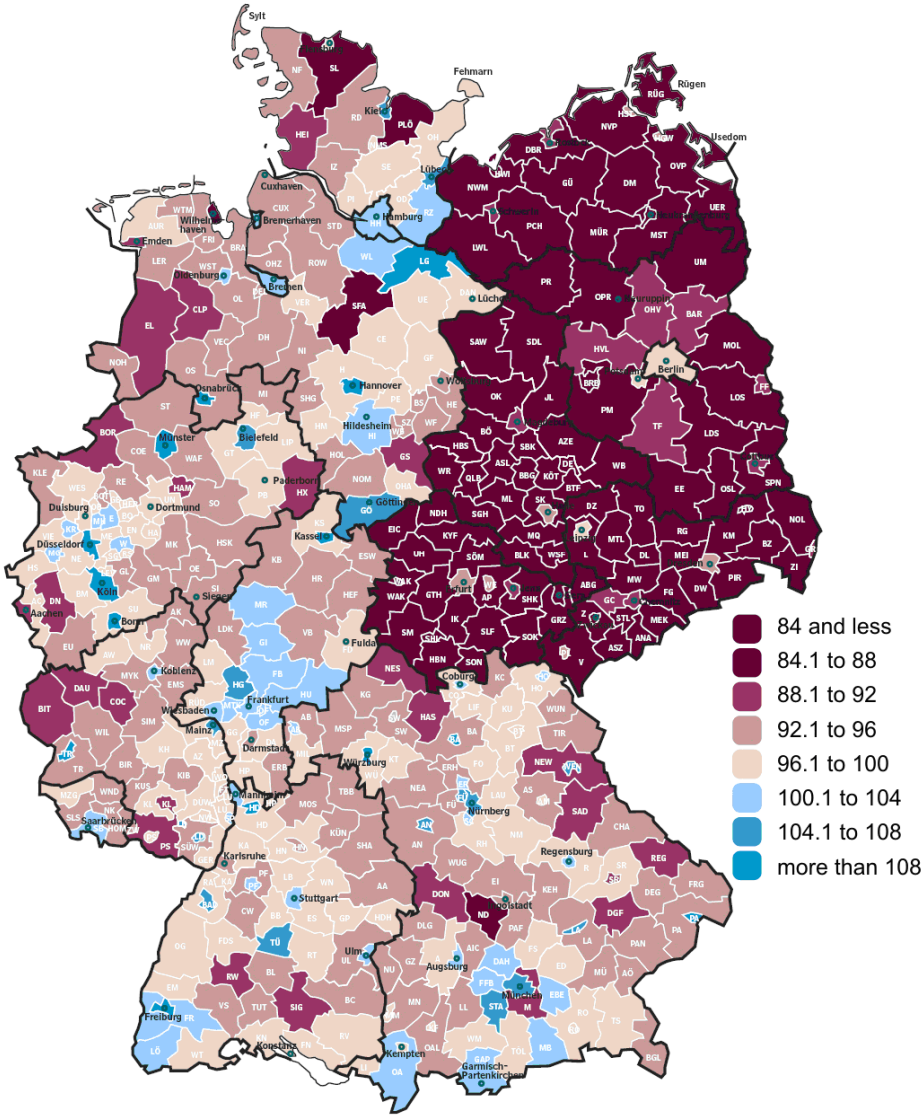
III. Regional Disparities and Regional Competition for Population

In Germany, a strong competition for inhabitants between regions can be observed. Regions recruit high-qualified persons for the purpose to built higher location advantages. This intensified competition leads to very big regional differences that some regions cannot successfully face. A big migration between rural areas and the conurbations has been observed (Bundesministerium für Familie, Senioren, Frauen und Jugend 2005). There are regions in the New Federal States where the rate of the migration balance per 1.000 inhabitants is –15, i.e. per 1.000 inhabitants there are 15 persons more that move out from this region than persons which migrate in this region. The situation of this migration is shown in figure 4. The east's professionally underprivileged young women migration can be observed in poor regions. The result of this migration for these regions is a very low sex ratio, i.e. the probability for a growing number of births decreases also. There are regions in East Germany, with a ratio of 80 women aged between 18 and 29 years to 100 men in the same age-class, while the number of women in the west of the country excesses partially the number of men (Kröhnert, van Olst, Klingholz 2004).



Source: Kröhnert, van Olst, Klingholz 2004

Figure 4. The ratio of women aged between 18 – 29 to men in the same age class and the rate of migration balance per 1000 inhabitants.



Source: Kröhnert, van Olst, Klingholz 2004

Figure 5. The ratio of women aged between 18 and 29 years to 100 men in the same age-cohort.

The same regional differences also concern the fertility. The differences between East and West Germany are quite big. However, the average number of children per woman of 1.37 in Germany (1.2 in the east and 1.41 in the west), is for both regions very low.

As a consequence counties try to attract population to counteract these trends. The underlying conflict regions face if they independently set their optimal population policy can be described in the well-known Prisoner's Dilemma (Mas-Colell, Whinston, Green 1995). The matrix in figure 6 illustrates this game with the two symmetric regions *i* and *j* as players deciding simultaneous which strategy, a low level of expenditures, r_l, or a high level of

expenditures, r_h, to choose. The pay-offs for each region consist in the difference between the monetary utility the region capitalizes from their level of population and the spending for attracting population. The population level is not only influenced by the region's actual level of expenditures, but also by the competing region's expenditures. Therefore we assume $P_{hl} > P_{ll} = P_{hh} > P_{lh}$. The first letter of the index describes the policy of this region, *l* (low) or *h* (high), and the second the spending level of the competing region.

Region *i*, Region *j*	Low level of expenditures	High level of expenditures
Low level of expenditures	$U(P_{ll}) - r_l$, $U(P_{ll}) - r_l$	$U(P_{lh}) - r_l$, $U(P_{hl}) - r_h$
High level of expenditures	$U(P_{hl}) - r_h$, $U(P_{lh}) - r_l$	$U(P_{hh}) - r_h$, $U(P_{hh}) - r_h$

Source: Own model.

Figure 6. Matrix of Prisoner's Dilemma.

If one region has a higher spending level than the other one, it will attract most internal migrants. If both choose the same expenditure level they will equally split the available migrants. However, their utility will be lower if their expenditure level is higher. Since we assume that the additional migrants will monetary outweigh the higher expenditure in case of a higher level of this region, both regions have the (strict) dominant strategy to choose a high level of spending – depending on the policy effectiveness –, although both are better off in the case with a low level of expenditures (Pareto). The typical Prisoner's Dilemma emerges. In the latter analysis we show that this dilemma not necessarily prevails. It is not a strictly dominant strategy to increase in any case the level to expenditures if the competing region does so (or lower it if the other region lowers their level, too). An important parameter is the effectiveness of policy.

We start our analysis with a general idea of the underlying utility function of the regions and then specify it more in terms of their basic characteristics. In its most general form the utility function of region *i* is defined as

$$U_i = U\left(P, P_i^*\right). \tag{1}$$

The utility depends positively on the actual number of inhabitants of the region, $\partial U_i / \partial P > 0$. However the critical population level, *P**, is very important for the analysis. This constant describes the minimal number of population necessary for sustaining the current level of infrastructure. For example in the case of water supply a minimal water flow is

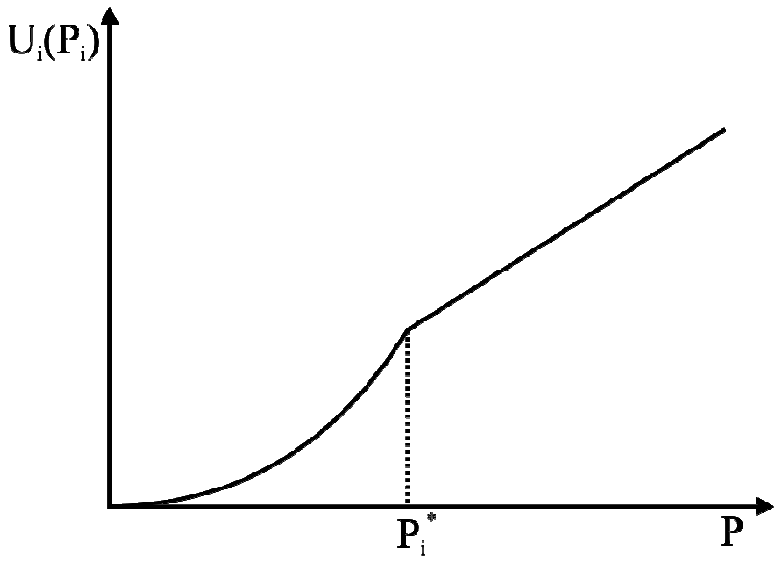
necessary to prevent that pipes block or germs spread. Table 1 illustrates the limited flexibility of some infrastructures. The upkeep of a certain population level to ensure a sufficient utilization helps to avoid costly investments.

System	Adaptability	Operational Measures	Investive Measures (Adaptation, Closedown, Dismantling)
Electrical Energy	+	change of switch conditions	cables, transformer stations
Gas	+ / –	network change, change of pressure stage	lines, pressure control facilities
District Heating	– –	change of operation mode	routes, heat transfer stations, reduction from a four-line to a two-line system
Drinking Water	– –	network change, pipe network flushing, change of pressure stage	lines, cross-section reduction, containers, pressure-boost stations
Wastewater	–	sewer cleaning	cross-section reduction, spill structures

Source: Herz, Werner, Marschke 2002

Table 1. Adaptability of several supply and disposal systems to demographic changes.

Therefore P^* is a very important concept politicians have to look at when deciding the optimal level of expenditures. If the actual level of inhabitants is below P^* each additional citizen will raise the utility of the region by a high amount, if the actual population level approaches the critical level. However, if the actual population is e.g. near zero, each additional citizen won't have any strong increase in utility, therefore $\partial^2 U_i / \partial P^2 \big|_{P<P_i^*} > 0$. On the other hand, if the critical level is reached each additional citizen will increase utility but not as much as the previous citizens, $\partial^2 U_i / \partial P^2 \big|_{P>P_i^*} \leq 0$. Figure 7 makes this consideration clear. In fact, if population increases further there will be another critical value when the maximal capacity of the present infrastructure is reached. In this case the slope of the utility function is ambiguous: either utility decreases or increases depending if the positive marginal utility of an additional citizen exceeds or falls below marginal cost of infrastructure building. Since infrastructure cannot be built continuously, there surely is a decline in utility after the maximal capacity is reached, increasing after further immigration.



Source: Own model.

Figure 7. Utility function of a region with respect to critical level of population.

According to our analysis so far, there are three options for reacting for any region if population declines:

i. Deconstruction of present infrastructure to lower the necessary level of population

ii. Emergence or increase of expenditures for the purpose of attracting population to this region (in this case rather monetary incentives like tax holidays, subsidies, job services etc. than infrastructure expenditures are considered since investments in infrastructure would in fact increase the critical level of population)

iii. Laissez-faire

The most appropriate attempt against population decline depends on the region's position on the utility curve (see figure 7). Between two competing regions there are three types of competition depending on the relative position of the region on the utility curve. The following table 2 shows our considerations for region *i* and *j* without loss of generality:

Type of conflict	**Region *i***	**Region *j***
Strong competition	$P_i < P_i^*$	$P_j < P_j^*$
Medium competition	$P_i > P_i^*$	$P_j < P_j^*$
Weak competition	$P_i > P_i^*$	$P_j > P_j^*$

Source: Own model.

Table 2. Types of competition.

If we specify (1) more, we get

$$U_i = U\left[P_i\left(n_i, M_i, S\left(r_i, r_j\right)\right), P_i^*\left(\overline{I}_i, R_i - r_i\right), G\left(R_i\right)\right]. \quad (2)$$

The variables are:

P present level of population

n natural rate of growth (difference between birth rate and mortality rate)

M natural migration (difference between immigration and emigration)

r_i expenditures aiming at attracting population

R_i total expenditures for population policy (R_i – r_i expenditures for deconstruction of infrastructure; in order to keep the analysis as simple as possible this variable is not taken into consideration further on, consequently $r_i = R_i$)

G function of expenditures including administrative costs

P^* critical level of population needed to maintain present level of infrastructure

P_i^0 Population at time 0

I existing infrastructure

α effectiveness of own population policy

β effectiveness of the population policy of the competing region on population development of own region (this parameter is evidently influenced by distance, preferences and other location factors)

Since the main focus of our paper is on competition and attracting population we do not consider option (i), deconstruction of infrastructure. This decision is made particularly due to the fact that expenditures for deconstructing infrastructure are sunk costs and therefore will not increase the utility of the region in the long run. Such deconstruction could be necessary in case of global demographic change. An extreme scenario like this anyway is hardly probable for the near future up to fifty years. Considering expenditures for attracting population equaling total expenditures, $r_i = R_i$, and excluding administrative costs we get:

$$U_i = U\left[P_i^0\left(1+n_i\right)+M_i, P_i^*\left(\overline{I}_i\right), \alpha r_i, \beta r_j\right]. \tag{3}$$

This utility function is characterized by the following facts: An increase in the initial population, the natural rate of growth as well as the natural migration will raise population and utility, therefore the first order conditions are given by $\partial U_i/\partial P_i^0 > 0$, $\partial U_i/\partial n_i > 0$ and $\partial U_i/\partial M_i > 0$. However, an increase in the level of expenditures of the competing region or a higher level of existing infrastructure decreases utility, therefore the first order conditions are given by $\partial U_i/\partial r_j < 0$ and $\partial U_i/\partial \overline{I}_i < 0$. A high expenditure level of the competing region has a direct impact on the population behavior as people are attracted to the corresponding region. The second condition acts indirectly by raising the necessary level of population needed to maintain the present level of infrastructure. The policy effectiveness parameters, α and β, have unambiguously opposite effects on utility, $\partial U_i/\partial \alpha > 0$ and $\partial U_i/\partial \beta < 0$. On the one hand the strategic variable of a region, r_i, ceteris paribus increases utility due to recruiting population to this region. On the other hand r_i causes utility decrease because the population measures cause expenditures. In order to calculate the optimal level of expenditures, the first as well as the second order conditions have to be fulfilled, $\partial U_i/\partial r_i = 0$ and $\partial^2 U_i/\partial r_i^2 < 0$. Solving for r_i with respect to r_j the following reaction function is figured out:

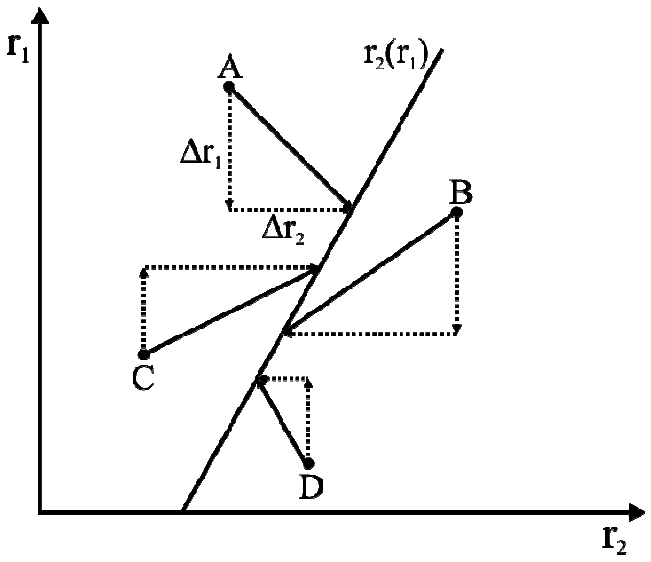
$$r_i\left(r_j\right) = f\left[P_i^0\left(1+n_i\right), M_i, \beta r_j, P_i^*\left(\overline{I}_i\right)\right], \tag{4}$$

for $i, j = 1,2$ and $i \neq j$. In order to describe the strategic situation adequately some basic assumptions are needed. First, both regions are distinguishable from each other regarding the possible migrating citizens, i.e. the two regions offer a kind of differentiated good. Second, since every politician has to legitimate its provided budget, both regions try to spend as few as possible. Third, utility functions are sufficiently specified. As a final point, the structure and the rule of the game, the pay-offs as well as the strategies are common knowledge to both regions. As they decide simultaneously respectively without the ability to observe the actions of the competing region imperfect information prevails. In the further analysis we introduce incomplete information about the cost structure of one region is introduced.

The approach discussed here is mainly based on Krelle (1961) and Ott (1972)[1]. The following figure 8 shows the reaction function of region 2 described in equation (4). A

[1] For further discussion see also Krelle (1963).

decrease in the level of expenditures of region 1 is considered on the first place. Starting from point A (left to the reaction function), region 2 increases its level, whereas starting from point B (right to the reaction function), region 2 will also decrease its expenditures. Furthermore we consider the effects of an increase in the expenditure level of region 1 on the expenditure level of region 2. Again in case of starting at the left side of the reaction function in point C for instance, region 2 will also increase its expenditures. Analogous, starting at the right side of the function in point D, region 2 will decrease its expenditures. From this analysis it results that the reaction of increasing or decreasing expenditures depends on the area where the initial expenditure combination is located. It makes no difference if region 1 increases or decreases its expenditure level, region 2 will always raise its expenditures, if the initial point is located left to the reaction function and will always lower its expenditures if the initial point is located to the right side of the reaction function.



Source: Ott 1972 and own model.

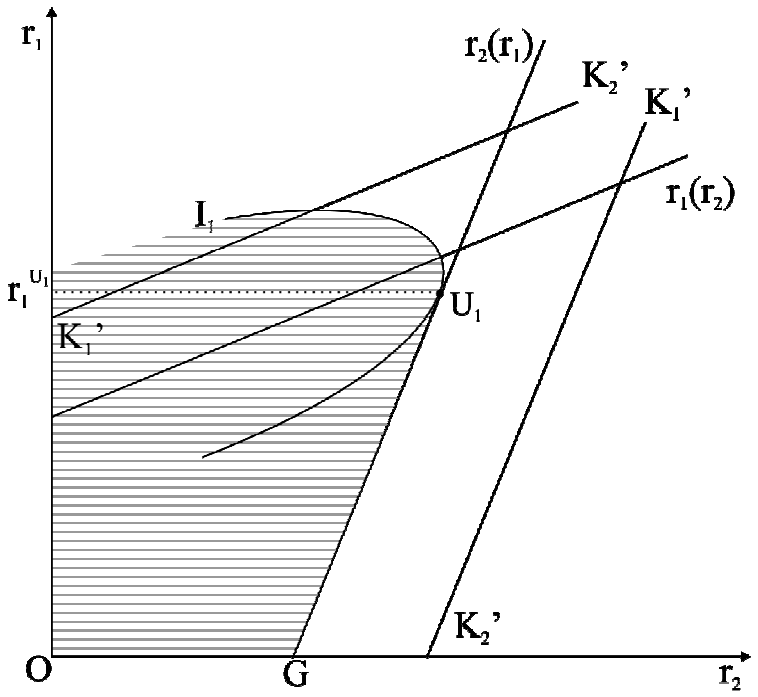
Figure 8. Reactions of region 2 to deviations of region 1 from several initial $r_1 r_2$ -combinations.

The interesting question that arises from this consideration is if a certain point or area exists, representing such a combination of r_1 and r_j where region 1 has no interest in changing its expenditure level, considering the reactions of region 2 to any decision of region 1. The most convenient approach would be identifying the Nash-equilibrium of this Cournot-like game, the point where both reaction functions cross. However, the latter analysis shows

that in a certain small area equilibriums emerge. In this case none of the regions has any incentive of undertaking any actions.

IV. Optimal Population Policy

Figure 9 illustrates the equilibrium area of region 1 with respect to any decrease in the level of expenditures, OGU_1I_1. It is straightforward to prove this prediction. On the right side of $r_2(r_1)$ and above U_1I_1 region 1 can be in a favorable position, if it decreases its expenditure level, taking into consideration that region 2 will react and will raise its expenditure level, too. In the best case the highest indifference curve I_1 can be reached.

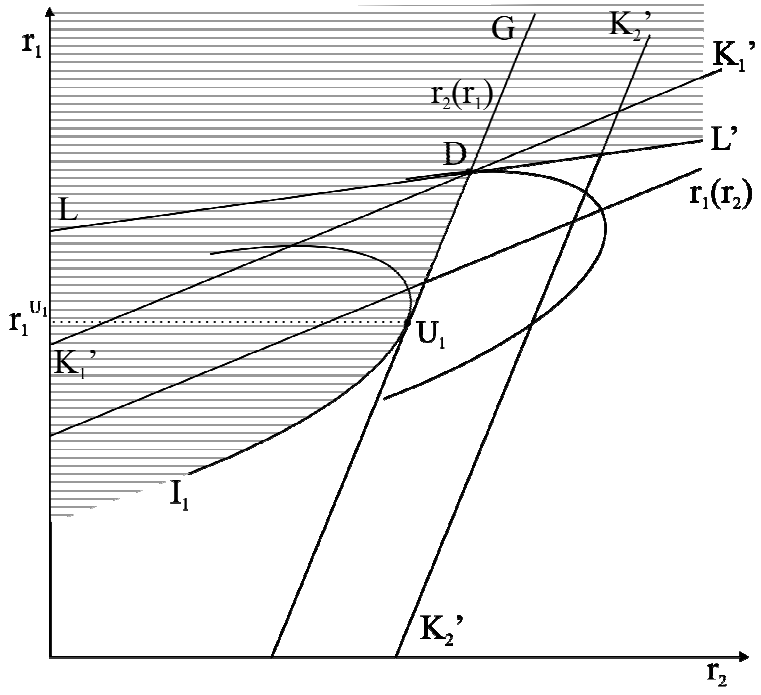


Source: Ott 1972 and own model.

Figure 9. Equilibrium area of region 1 with respect to expenditure decreases.

Since there is the assumption that lower expenditures are better, the nearer an indifference curve is to the origin of the according reaction function, the higher is the utility of the considered region. To the left of $r_2(r_1)$ and below U_1I_1 any decrease in the expenditure level will be accompanied by an increase of expenditures of the competing region 2 and will lower

the utility level of region 1. In the best case, if the initial $r_1 r_2$-combination was located on $U_1 I_1$ and expenditures were lowered to $r_1^{U_1}$, utility would remain unchanged. Outside the marked area, e.g. to the right of $r_2(r_1)$, any expenditure decrease will lead to a higher utility level of region 1. Some special features are also depicted in the upper and the following figures. The curve $K_i' K_i'$, where $i = 1,2$, describes the highest reachable indifference curve for any given value of r_j. Therefore the indifference curves bend away from the point of intersection. The point U_1 is called the ***Stackelberg asymmetry solution point*** (Stackelberg 1948). In this situation region 1 is in the independent position ("leader") and region 2 in the dependent one ("follower").

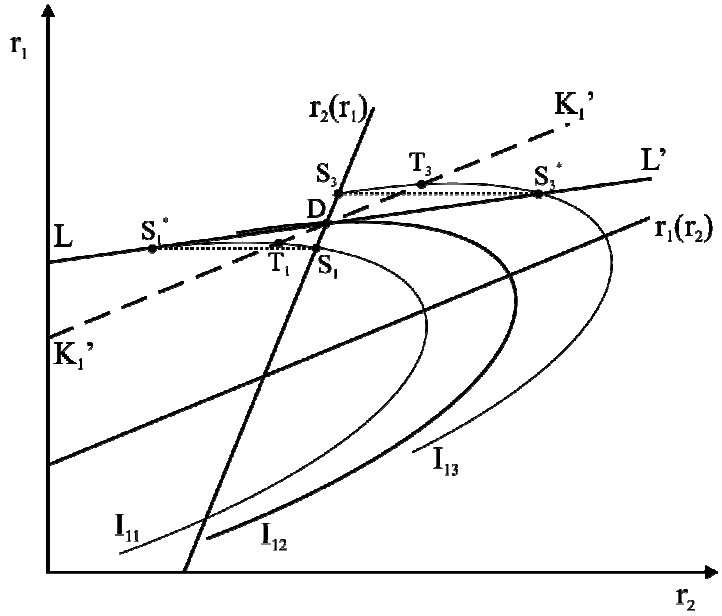


Source: Ott 1972 and own model.

Figure 10. Equilibrium area of region 1 with respect to expenditure increases.

Figure 10 shows the equilibrium area of region 1 with respect to any raises in the expenditure level, namely the marked area above $I_1 U_1 DL'$. The proof of this statement is more complex than in the previous case. On the right side of $r_2(r_1)$ and below DL' any increase in the level of expenditures contributes to the region achievement of a higher indifference curve. On the left side of $r_2(r_1)$ and above $U_1 I_1$ any increase in the expenditure level of region 1 will be accompanied by a raise in the expenditure level of region 2 so that a lower utility level of

region 1 will be reached. Again in the best case, if the initial $r_1 r_2$-combination was located on $U_1 I_1$ and expenditures were increased to $r_1^{U_1}$, only the location on the same indifference curve would change and utility would remain constant. Any combination of expenditure levels on the right side of $r_2(r_1)$ and above DL' will lower the utility of region 1. Figure 11 shows how LL' is constructed.

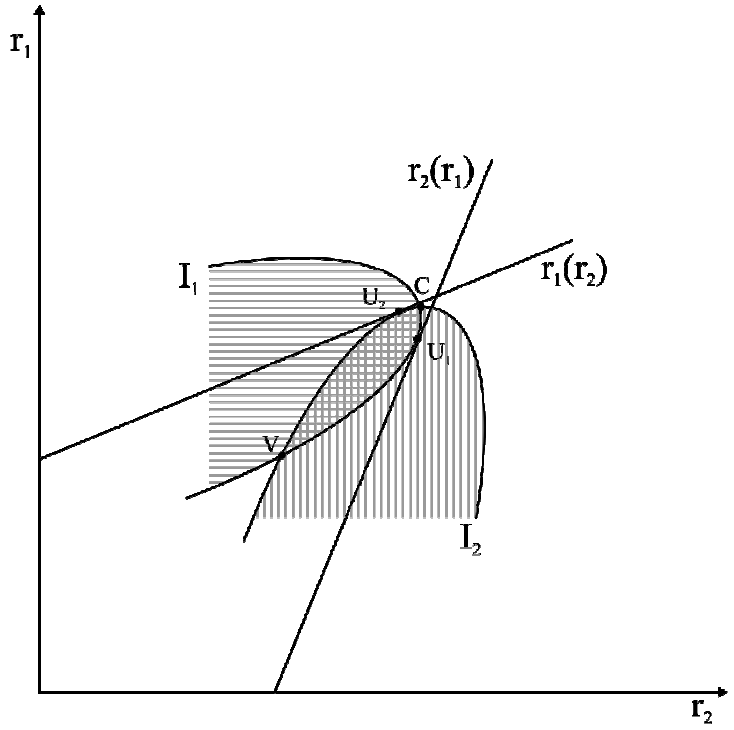


Source: Ott 1972 and own model.

Figure 11. Construction of LL'.

T_1 is the intersection point between $K_1'K_1'$ and the indifference curve I_{11}. Therefore T_1 represents the highest possible utility, that can be reached for the according expenditure level of region 2 (r_2). I_{11} is chosen so that T_1 is located on the left side of the reaction function $r_2(r_1)$. The upper intersection point of I_{11} and $r_2(r_1)$ is denoted with S_1. If a parallel to the r_2-axis is drawn through S_1, the according point S_1^* can be constructed. The indifference curve I_{12} is chosen to have the special characteristic $T_2 = S_2 = S_2^* = D$. Analogously I_{13} is constructed to get an intersection point T_3 at the right side of $r_2(r_1)$. In this case S_3 is located left to T_3 and S_3^* right to the intersection point. The intuition of this approach is given in the following. An assumption can be made that the initial expenditure combination is located between S_1^* and S_1 on I_{11}, in $T_2 = S_2 = S_2^* = D$ on I_{12} or between S_3

and S_3^* on I_{13}. If region 1 increases its expenditure level from such located initial points and region 2 reacts according to $r_2(r_1)$, region 1 would merely be at a disadvantage. Therefore the line LDL' that connects all S^* describes the lower limit for the section DL'.



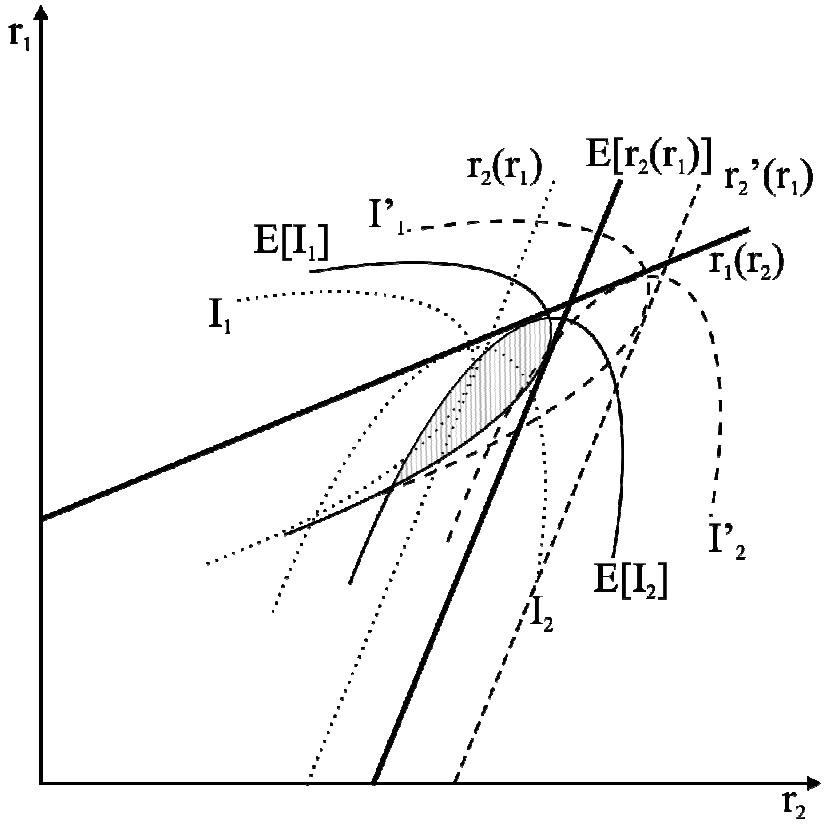
Source: Ott 1972 and own model.

Figure 12. Equilibrium area of both regions with respect to expenditure in- and decreases.

The presented Figure 12 merges both segments: The equilibrium areas for expenditure increases and decreases as well as the analogous consideration for region 2. VU_1CU_2 represents the equilibrium area where no region has an incentive to change its level of expenditures. If the initial expenditure combination is located in this area (by accident or because of historical reasons – the cause of such a situation does not need to be investigated here), the most recommendable choice of action for each region is to undertake nothing, i.e. option (iii). The lowest level of expenditure combinations, where this consideration is applicable, is V and the highest one is C.

However, one question emerges: What would happen, if region 1 for instance has hardly knowledge of decisive items like infrastructure, migration or population development of region 2? In this case region 1 is not aware of the type of region 2, i.e. the location of its reaction function. In order to define this situation as easily as possible, the assumption can be made that region 2 can be either a “normal expenditure” or a “high expenditure” region,

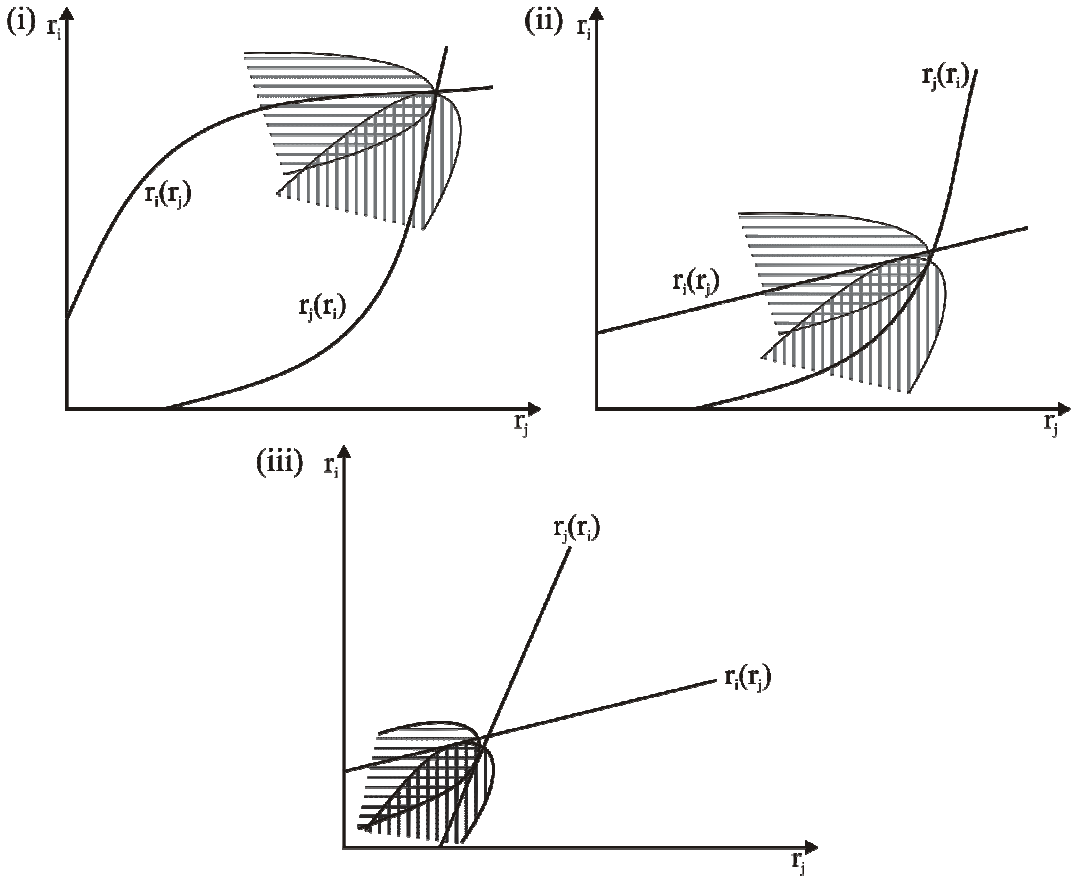
which will spend at any level of r_1 more than the normal type. This situation is depicted in figure 13.



Source: Own model.

Figure 13. Incomplete information about region 2.

If region 1 has no information about the expenditure structure of region 2, it should consider the expected location of the reaction function of region 2. The resulting equilibrium area is marked in figure 13. On the one hand if region 2 has a normal expenditure level, the resulting expenditures tend to be too high (in fact a small area may exist where both equilibrium areas coincide). On the other hand if region 2 has a high expenditure level, the emerging expenditure levels tend to be too low. If region 1 presumes a special type of region 2, it runs the risk of being wrong. The more unlikely the emergence of one type of region 2 respectively the more similar these kinds are, the larger is the concordance between expected and actual equilibrium area. However, region 2 knows that region 1 doesn't have information about its actual type, therefore has to consider this aspect and the resulting (expected) equilibrium area remains stable.



Source: Own model.

Figure 14. Three cases: (i) strong competition, (ii) medium competition and (iii) weak competition.

Figure 14 shows the three possible cases described in table 1. Case (i) depicts the situation when both regions face each other in a strong competition and at the same time both need additional population to reach the critical population level, P^*. Therefore they will spend a huge amount of money until the necessary migrants are attracted. After they succeeded in doing so, the regions become more passive and reduce their marginal expenditures when both face an equilibrium area of high expenditures. Case (ii) depicts a medium level of competition when one region's initial population is larger than its critical population level and therefore the region has a reduced incentive to attract further migrants. However region *j* has still such an incentive. Finally, case (iii) depicts weak competition since both do not necessarily need further population. Expenditure levels in cases (i) and (iii) are symmetric – either high or low, since both regions are quite symmetric (both either need or do not need further population). In contrast to this in case (ii) spending levels are different – in the equilibrium area region *j* always expends more than region *i*.

V. Conclusion

Population decline and aging is a severe problem Germany among other developed countries has to face in the near future. As a consequence many economic, social as well as psychological problems occur. Economic consequences may be problematic for the pay-as-you-go pension systems, since less young people have to bear the contributions needed to pay the pensions to the retirees. Since medical progress takes place, allowing people to live longer, costs of the public health insurance will also raise dramatically. Economic growth will be directly affected through reduced workforce. Therefore the capital intensity will rise leading to an increase in FDI but also to an increased dependency on imports, since consumption-demand remains unchanged. Two categories of policy measures are suggested: support of fertility measures and international migration. These measures, however, will evoke other problems, e.g. immigration into social security systems. Therefore it is not astonishing that German regions face a strong competition for inhabitants. Especially regions in East Germany loose many inhabitants to western regions.

In our analytical framework we considered the need of regions for a critical population level, required to maintain the existing infrastructure. According to the relative positions of two competing regions with respect to the critical population level three different levels of competition can be identified. However, each region has three possible strategies so as to face the demographic problems: deconstruct present infrastructure, increase expenditures for population recruiting or laissez-faire. Our analysis showed that in fact an equilibrium area exists where no region has an incentive to deviate. According to the type of competition expenditures in this area are symmetrically or asymmetrically.

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Intelligent Region Management = Intelligent Absorption of EU funds

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Biographical note

Cornelius Pylak obtained Ph.D. (2006) in economics in the field of management (doctoral thesis: "Less developed region management model"), Doctoral Study Programme Diploma (2004), Management Analyst Post-Graduate Diploma (2003) and MA (MSc) in Marketing Management (2001). He works in Lublin University of Technology as a lecturer.
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Abstract

Effective institutions and public administration is a key factor in designing and implementing the growth policy and the economic and social development. Effective institutional and administrative potential is also vital for good region management. Organisation of the system influences deeply the efficiency and effectiveness of the structural aid and simultaneously the level and quality of resources used, what has huge impact on the development and competitiveness of Polish less developed regions.

The paper presents the model of EU structural funds implementing, which would help to transpose Polish less-developed regions (their administration) into intelligent regions – implementing European Funds in a pro-developmental way (not pro-social), focusing on strategic synergy projects realisation based on proper timetable, adjusted to specific regional

factors (enhancing regional investment attractiveness), enabling individual approach to major developmental projects (increasing their effectiveness) and absorbing less financial sources on good purposes (not more – on bad purposes)

Key words:
Less developed region, region management, European Union funds, R58 – Regional Development Policy

Introduction

An ability to gain and optimally absorb external financial resources for regional and local activities is driven mainly by the efficiency of territorial autonomy units – i.e. ability to elaborate proper projects, concentrate partners and manage public initiatives in an effective way.

Effective institutions and public administration is a key factor in designing and implementing the growth policy and the economic and social development. Effective institutional and administrative potential is also vital for good region management. Organisation of the system influences deeply the efficiency and effectiveness of the structural aid and simultaneously the level and quality of resources used, what has huge impact on the development and competitiveness of Polish less developed regions.

When we take into account the institutional system of EU funds (acting within the public organisations), we have to emphasise the conditions described for public management issue. We have to think about dynamic changes of implementing system structures and processes, what would enable accelerating convergence of Polish regions (by EU funds destined on strategic synergy projects – SSP). It is the public administration to be the causative factor of strategic synergy projects creating (by diffusing the knowledge to the projector and initiating creating of self-government partnerships) and of monitoring the implementation of the resources in a strategic and innovative way.

Processes existing within the region management system should be therefore conductive for self-learning, because as we take into account less developed regions, there is often only one real competitive advantage: ability of the regional management system to learn faster than in more developed regions. Thus there could begin the process of transforming such less

developed region into the intelligent – self-learning region, possessing the strategic reacting ability.

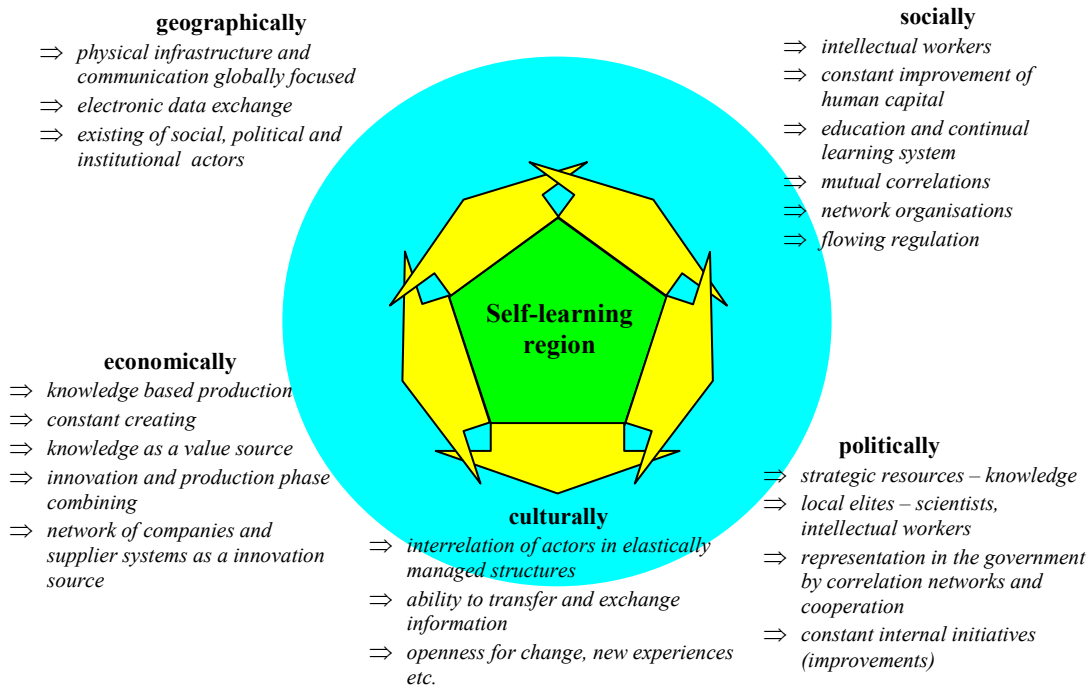


Fig 1. **Features of the self-learning region.**

Source: *Pylak, C., Less developed region management, Współczesne Zarządzanie No. 2/2006, pp. 144-153; Florida, R., Toward the Learning Region, Futures 1995 vol. 27, No. 5, p. 533, Ache, P., Vision and creativity – challenge for city regions, Futures Vol. 32/2000, pp. 435-449.*

Literature relevance

The concept of the model arises from various research conducted and described in the literature, mainly from the last D. Barker research (CEEN Consulting GmbH, 2005), where there has been institutional systems from less developed regions of new member states examined (but not in Poland). The results indicated plenty of shortcomings in the field of:

- Governance: general lack of provision of policy direction; ambiguity in legal requirements; inability to incorporate stakeholder needs into the planning process; perception of no 'added value' from leadership
- Management practices: low involvement of staff in decision-making; non-transparent recruitment; streamlining of procedure manuals; low functionality of supporting infrastructure

- Financial resources: poor cash-flow and budget management; weak internal audit function
- Service delivery: low recognition / estimation of sectoral expertise; need for better branding of the agencies

- Human resources: reactive implementation of HR development; non-competitive salaries; perception of low equity; non-transparent assessment and reward criteria/ criteria for promotion
- External Resources: low efficiency in sourcing data; internal perception of poor PR; low engagement of private sector resources
- Monitoring of projects & programmes: lack of experience of monitoring staff in pre-accession instruments; inadequacy of monitoring indicators; poor estimation of efficacy of IT systems; low opinion of quality and clarity of monitoring and reporting system
- Programme management: inadequacy of staff numbers at IBs and MA; poor application forms and evaluation grids
- Administrative capacity for formulation: inadequate involvement in programme preparation/ very low knowledge of procedures for programme formulation; almost none of the staff has experience in pre-accession instruments (at any part of the programming cycle)
- Management and Control of Programmes: expenditure forecasting not efficient/ functional; unclear risk analysis procedures

To conclude the purpose of the model creation, firstly, so far there isn't implemented an intelligent management model of the less developed region referring to EU funds and thus there isn't shown any modelling process of transposition such region into intelligently managed region.

Secondly, nowadays in Poland and in entire EU, all the regions are still creating or testing new systems of implementing new, changed structural policy in the programming period 2007-2013. This causes difficulties in acquiring publications and reports referring to this theme (for example ex-post evaluations would be available in 2008). The quintessence of EU structural policy is elaborated in the "Third report on economic and social cohesion". In Poland we can indicate expertises and reports prepared in 2005 for National Development Programme 2007-2013 and also on-going evaluations from the 2006-2007 period.

Thirdly, currently there are not available concrete tools enabling transposition of public management in less developed regions (like Polish) into intelligently managed regions implementing EU funds successfully. However, there are a few tools for institutional potential assessment in entire public administration (Institutional Development Programme – PRI) and in institutions implementing structural funds in new member states (Barker), there are not entirely adjusted to our research needs because of the lack of transposition paths indicating.

Less developed region management model

For the beginning and intensification of the transposition process of the less developed region into intelligent region, there is a vital need to create and implement the public management model. The less developed region management model will be based on three areas: structure of the model, processes of the model and reinforcement of the model:

1. Structure of the model – institutional system for development management and EU funds implementing;

2. Processes of the model – choosing and realising (efficiency, effectiveness, financing, monitoring, promotion) of the strategic synergy projects (SSP);

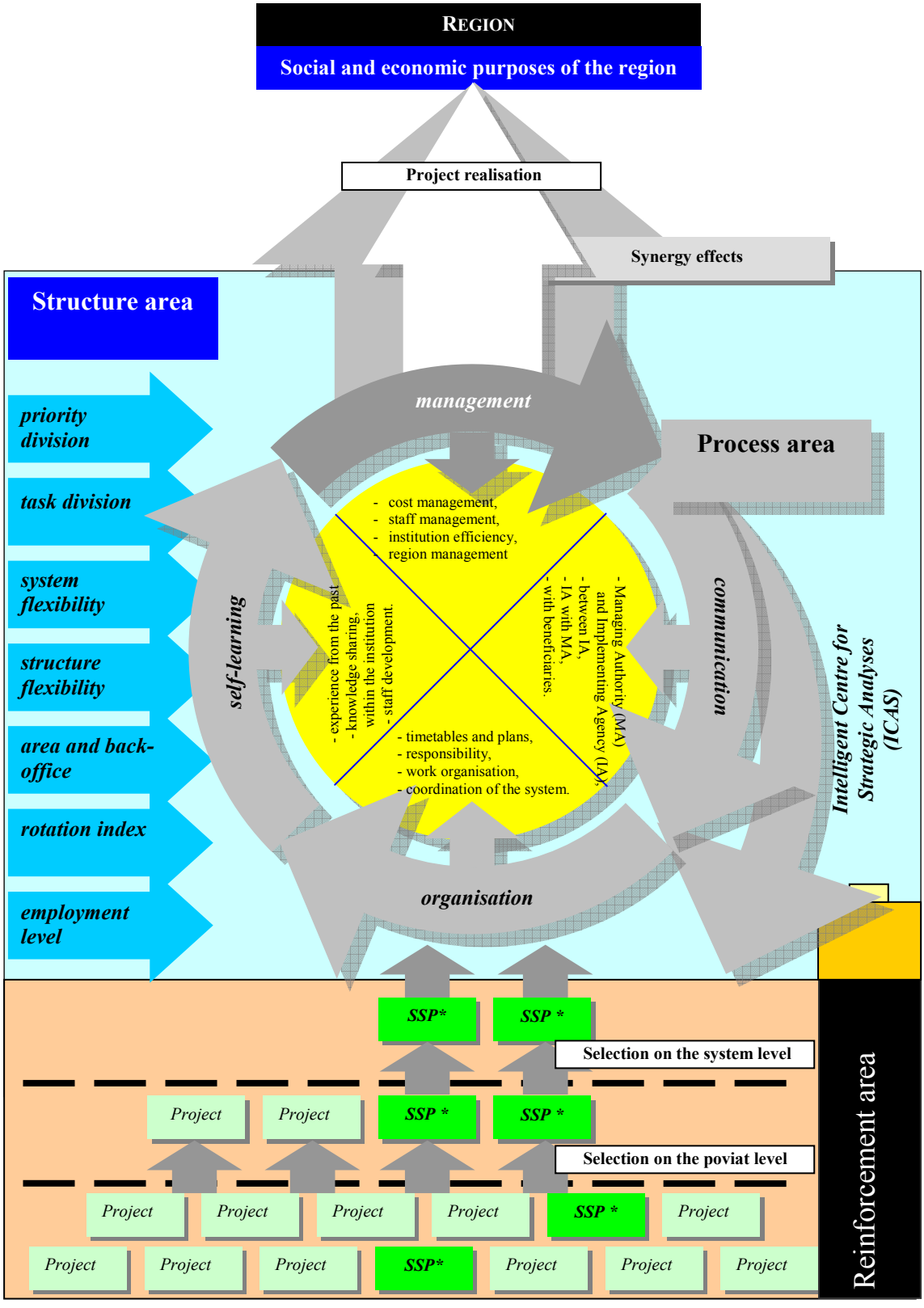
3. Reinforcement of the model – preparing of the strategic synergy projects by the new regional institution: Intelligent Centre for Strategic Analyses (ICAS);

When we look at the model, it is obvious that two first areas are controlled by the system and the latter is outside the direct control – system institutions do not prepare projects for their own, they can only influence projectors as a feedback by various instruments and tools.

In the reinforcement area there are mainly projectors preparing their individual projects. Firstly, when the model starts to exist, there will be plenty of projects which will not meet the strategy and synergy needs. Then, after some time, thanks to mutual communication and cooperation with the reinforcement area, the proportion will change for the strategic synergy projects. To prevent maximum assurance that proper projects are chosen, the model assumes two-step process of selection: one step at the poviat level and second – voivodship (system).

Next, chosen projects go to the structure area (with the permeated process area). The structure is partly a determinant of the process area criteria, because process parameters are often

depending on it. That is why, when model functioning is analysed, these two areas should be examined jointly.

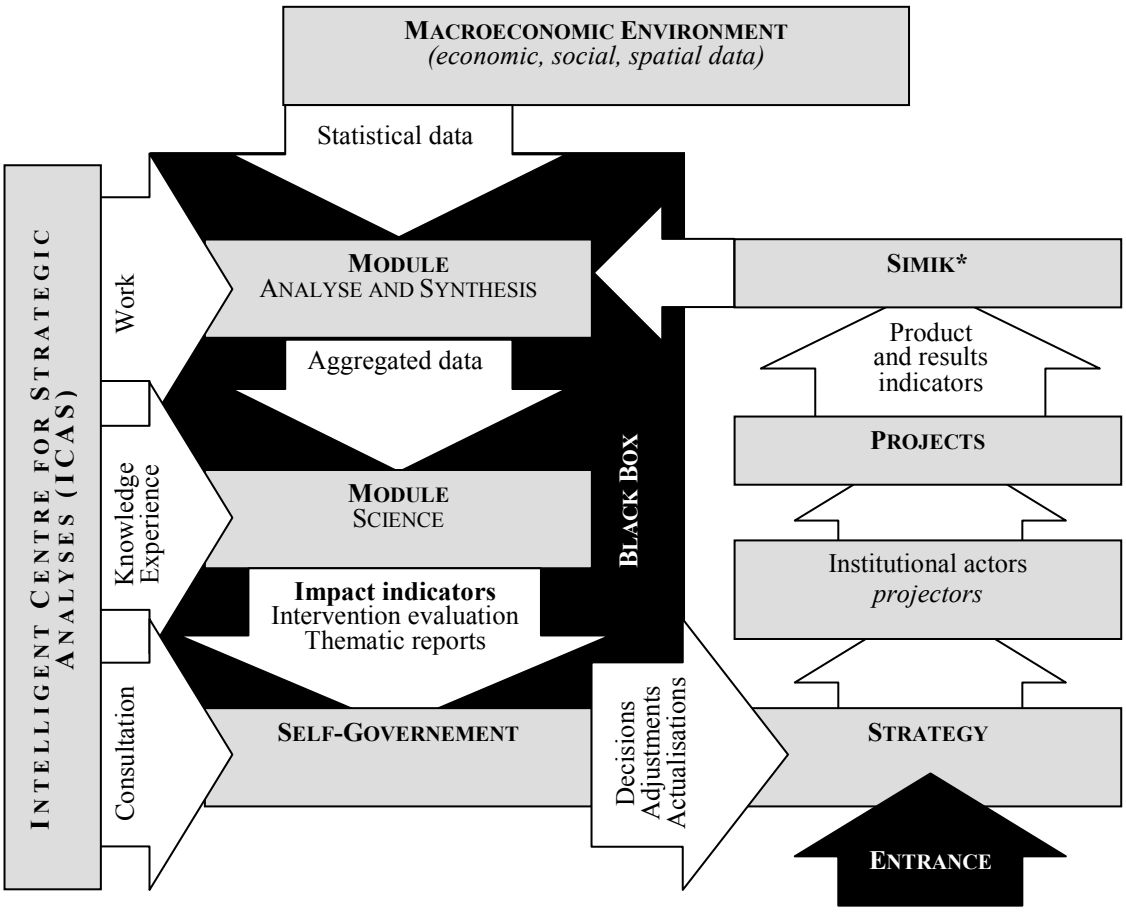


*SSP – strategic synergy project

Fig 2. **The concept of three-area model of the less developed region management.**
Source: *self-elaboration.*

Reinforcement of the less developed region management model has to be focused on creating real competitive advantage to the better developed regions, mainly in the field of faster learning and regional synergy creating. The following has to be taken into account:

- delivery of the strategic synergy projects to the system – based on the assessment of impact effectiveness of the programmes and gained results. Impact, beside of products and results, is the most strategic aspect of programming, referring to the mission and strategic goals, used during creation of strategies for companies, regions or states;
- selection of the strategic synergy projects – creating the proper system of selecting and assessing projects in a way that there are selected only or mostly strategic synergy projects;
- creating of the Intelligent Centre for Strategic Analyses (ICAS), which could be some kind of the region brain, effectively improving its ability to absorb reinforcement project stream, focusing on planning, preparing and implementing – in a intelligent way – information and knowledge about the project impact on the economy.



**SIMIK – *Informatics System for Monitoring and Financial Control of structural funds*

Fig 3. Learning process of the less developed region management model.

The process of the model learning will cover model structure and processes area and create the entire synergy. The learning process should be managed in ICAS, placed in Managing Authority and act as a flexible structure.

Policy implication of the model

The model is superior to what exist in the field, because it has practical and complex approach to improving and drifting to intelligent region management. The approach assumes:

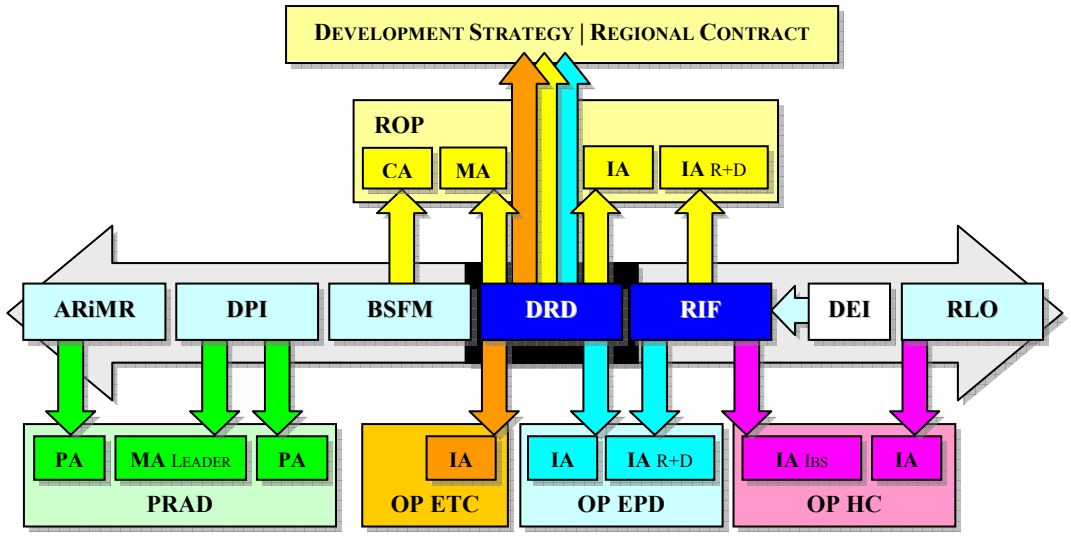
1. The diagnosis of the organisational potential, identification of the areas to enhance and the enhancing methods;
2. Creating of tools for self-assessment and self-improvement of the region management institutions;

Such approach is similar to the approach elaborated in the Institutional Development Programme (PRI), which is successfully implemented in Polish self-governments. Differences are: entire subject range, implementing way, and before others – the goal. Such approach would result in significant persistence, because institutions could use prepared tools in the future, improving different areas referring to quality, effectiveness, efficiency and transparency of their activities.

Additional advantage is the first diagnostic research in institutions implementing EU funds and getting them acquainted with the self-improving tool. Thus, institutions could only verify the development process of technical and economic potential in the future.

The purpose of given approach is though the diagnosis of the current state of the art and creating the tools, which (when there are conductive circumstances, actors interests and monitoring institutions determination) could become the catalyst for constant, cyclic improvement process of various institutions functioning. As we said above, the process is aimed in transposition of the less developed region into intelligent region.

* *Source: self-elaboration based on Pylak, C., The concept of the less developed region management model (lubelskie region case study) [in:] Bojar E., Regional and local development management in the aspect of European integration, Polihymnia publishing, Lublin 2005, pp. 160-171.*



Explanation

PA	Paying Authority
CA	Certifying Authority
MA	Managing Authority
IA	Implementing Agency
R+D	priorities | operations concerning entrepreneurship, innovation, research and development
IBS	priorities | operations concerning information based society
ARiMR	Agency for Restructuring and Modernisation of the Agriculture
DPI	Department for the Programme Implementation
BSFM	Bureau for the Structural Funds Management
DRD	Department for Regional Development
DEI	Department for Entrepreneurship and Innovation
RIF	Regional Financial Institution
RLO	Regional Labour Office
PRAD	Programme for Rural Area Development
OP ETC	Operational Programme for European Territorial Cooperation
OP EPD	Operational Programme for Eastern Poland Development
OP HC	Operational Programme for Human Capital

Fig 4. **The proposal of the less developed region management model scheme and processes.**

Source: *self elaboration based on National Strategic Reference Framework, pp. 96-100.*

Conclusions

In nearly every above mentioned descriptions, there are potential possibilities for using the model in preparing and realising Polish regions development policies. This approach has a pure practical and implementing sense. Let's indicate it once more:

Firstly, it can be used by regional authorities for improving the institutions responsible for region development and absorbing EU funds.

Secondly, diagnostic tool can be used for the assessment of current institutional potential.

Thirdly, self-improvement tool can be used for constant and systematic transposition of the regional institutions into intelligent ones promoting to create and realise strategic synergy projects and absorb EU funds in a pro-developing way adjusted to the specificity of the given region.

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National and Regional Women Entrepreneurs' Networks

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Biographical note

Mariana Dragusin (b.1961) - is Professor in the Department of Commerce at the Faculty of Commerce, Academy of Economic Studies from Bucharest (2003-2007). Since 1999 she is also vice-dean of the faculty and member of its Council. She graduated the same faculty in 1984 with excellent results and obtained her PhD in Economics in 1998 at the same university. Mrs.Dragusin attended several national (1996, 1991, 1986) and international training courses (Austria/ 2002; 1999; 1993; 1992). In 2005 she was accepted as Visiting Research Professor at Tampa University in Florida (U.S.A.).
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Her major fields of competence and interest are: Management, Commercial Management, Entrepreneurship and Leadership.

Abstract

Women Entrepreneurship tends to become worldwide a driving force both in terms of number and gross revenues, playing an increasing role in the process of wealth creation

and innovation. The dynamic networking phenomenon is helping to strengthen female entrepreneurship's positive impact. The network can offer psychological, managerial and financial support by providing information, innovative and adapted consultancy and technical assistance to women entrepreneurs and aspiring ones.

This paper outlines the main forms of networking and their impact, both at national and regional level, as instruments of economic development and as a response to business women's need of dealing with a highly complex and fluid environment.

***Motto**: It takes teamwork to make the dream work.*

Women's entrepreneurship is expanding all over the world. The growth of women's businesses is central to wealth creation, innovation and economic development in all countries. The movement of women into business ownership is an undeniable phenomenon. The growth rate in number of women owned firms is higher than the same rate for men in more and more countries. Statistics and many studies are providing a comprehensive image of the role played by women involved in entrepreneurial activity in the world economy. Women entrepreneurs are creating jobs, hope and opportunities in every community.

1. Woman and the entrepreneurial process in Romania

In Romania, a country with low entrepreneurial culture, the small business sector had to be practically recreated after decades of centralized economy. It is beyond doubt that the small business sector is vitally important for Romania and can be the driving engine toward prosperity. The statistical figures in the White Charter of Romanian SMEs ([1]), issued in 2006, confirms once again that this sector can be one of the main sources of growth that Romania should rely on as the new member of EU family.

The increasing number of SMEs, both men and female owned, reflects a favourable business environment in the country. The SMEs distribution by development regions is not homogenous and shows the highest concentration in the following regions: Bucharest - still having the highest weight, North-West and Centre. From the density indicator point of view, Bucharest is on the top of the list (48, 5 SMEs / 1000 inhabitants), opposed to the North-East region, ranked on the last position (18 SMEs / 1000 inhabitants). Bucharest takes the lead for turnover too. The distribution of entrepreneurs by level of

[1] xxx White Charter of Romanian SMEs – 2005, Tipogrup Press, Bucharest 2005

education shows that the percentage of those with higher education increased from 21, 2% (1995) to 42, 7% (2004). By region, Bucharest has the most educated entrepreneurs - 58%, followed by the North-East Region (45, 8%) and West Region (45, 2%).

Understanding and appreciating the social and economic impact of women entrepreneurs is a key to a more effective identification, preparation, and utilization of a most valued human resource sector of Romania which contributes to the vitality and well being of the economy. Women Entrepreneurship tends to become rapidly a force in the economic regional development. Women's weight in the total population amounts to 51,2% and their presence in the total active population represents 47,6%. As a consequence, women represent a readily available pool of potential entrepreneurs that each Romanian region can leverage to improve its economy. An inquiry of the Statistic National Institute outlines women presence in the small business sector: almost 38% of the total active SMEs were lead by women entrepreneurs in 2005. There are important regional differences as far as the weight of their enterprises in the total: higher in the North-West Region (42, 0%), West Region (38, 8%) and South-West Region (38, 6%). The South Region has the lowest weight (29%) of enterprises run by women. This situation is correlated not only with the overall distribution of SMEs but also with cultural features.

Men and women have in Romania, at least theoretically, equal opportunities to start their own businesses. In fact, entrepreneurship is viewed by many persons as more suitable for men than for females ([2]). The conservative, traditional approach according to which women should stay at home, raise children and reinforce traditional family values on a day by day basis is still wide spread. Recent findings ([3]) revealed that such gender stereotype of women as main householder is still strong. Even though, the businesswomen phenomenon is rising continuously.

[2] www.ele.ro / "Businesswomen un fenomen care ia amploare", 2005
[3] www.iccv.ro / Barometrul de opinie publica; 2004,

A recent study ([4]) revealed that, *in terms of personality,* businesswomen can fit, just like men, to a successful *profile* proving: high energy, courage, discipline, goal orientation, enthusiasm, innovation, persistence, passion, vision, client focus and wish to work hard. The Romanian woman-entrepreneur is, in most of the cases, married with children, educated (high school or faculty), devoted to her business and able to overcome barriers but not interested in politics. However, in contrast to men, women tend to be more flexible, balanced and tolerant, more realistic. Romanian businesswomen are mainly motivated by the need of independence (81, 1%), comparing to men who tend to be driven by the desire to be in control, to make things happen. Other motivator factors are: professional achievement (62, 2%), higher income (45, 6%), by necessity (unemployment) (2, 7%).

Women's businesses tend to be smaller and less expensive to operate than those of men. Even if, the largest share of women owned companies is in the service sector they tend to continuously expand into non-traditional industries. Anyway, Romanian women entrepreneurs are involved in a larger variety of economic sectors (other then retail, services) comparing to those of European Union or U.S.A., as a natural consequence of their active role played as employees in the former centralized economy ([5]).Factors in the start-up process of a business for male and female entrepreneurs are also different. Women's decision to become self-employed is complex. Women are more likely than men to shoulder family-related obligations.

Romanian businesswomen do not feel discriminated comparing to men. They also face immediate competition and tend to bear the full cost of their businesses. The majority of women entrepreneurs provide all the required start-up capital themselves.

More and more business women consider joining a professional women's association to find a support network for their ideas and work. This trend indicates that Romanian businesswomen are beginning to understand the importance of membership in

[4] xxx International Conference Women Entrepreneurship in Romania, Nov. 2006: C. Rotaru, Ph. D.
[5] xxx Amfiteatrul Economic, nr. 17/2006, p.

associations and how combining their efforts can have a great impact on local and central administration bodies.

2. Networking – an option for women entrepreneurs

One of the main globalisation's effects is the increasing dependency of the economic actors. *Networking is the response to the companies' need of dealing with a high complex and liquid environment*.

The network brings to its members the opportunity to share risks and uncertainty. Based on cooperation the network is a new dynamic form of organisation that allows each member to follow its own objectives. The enterprise developing internal and external networks has higher chances to increase its competitiveness.

Affiliation to associations, as forms of networking, plays an important role in women entrepreneurship's success. The creation of women networks facilitates the increase of their members' awareness. Usually it is assumed that if a woman knows at least one other entrepreneur, she will have some access to experience-based information about how to start and manage a business.

Women associations have the mission to help, counsel, teach, encourage and inspire women entrepreneurs. They also contribute, through their activities, to a higher visibility of businesswomen. A survey ([6]) pointed out noticeable differences by gender in participating in associations, namely a larger interest in the case of men comparing with women. On the top of their expectations to be met is placed the desire to gain more and reliable market information as well as information about legislation and technologies.
According to G.E.M.'s Report 2005 ([7]), the first cross-national assessment on women's entrepreneurial activity, **network development** and mentoring is one of the main key that **would enable the increased involvement of women in new venture creation.** Start-ups success is highly dependent not only on education and experience, but also on a

[6] www.nfwbo.org / "Health and needs of SMEs"; Survey Brochure, 2004
[7] xxx G.E.M.'s (Global Entrepreneurship Monitor) Report 2005 on Women and Entrepreneurship

better networking. Role models and social networks are an important source of both information and access to resources. In many cases, the networks women rely on operate quite differently from those dominated by men. As stated in the Report, women in low-income countries ([8]) like Romania, often have significantly smaller networks and less geographical mobility. As a result, they construct relatively personal but strong networks that allow them to partially substitute these personal network relationships for formal legal contracts. Thus the position of woman entrepreneur within larger structures can influence her ability to observe role models and acquire resources.

3. Networking – a dynamic process at national and regional level

As the main governmental body responsible for the small business sector in Romania, the Ministry for SMEs, Commerce, Tourism and Liberal Professions has important strategic priorities aiming to create a business environment favourable to establishing and development of SMEs. The "National Multi-Annual Programme for 2005-2008 for the development of entrepreneurial culture among manager women from the SMEs sector" is the first in Romania, entirely dedicated to women. The goal of this programme is to promote a system that facilitates women mobility on labour market and help them to get involved in private economic structures and also maintain the balance between family and work. The programme's primary objectives are to:

- develop the entrepreneurial spirit among women;
- raise the level of information about women entrepreneurship;
- stimulate self employment;
- raise the number of women entrepreneurs within the business community;
- create new start-ups;
- equal access to the knowledge based economy.

Thus stimulated by a favorable legal and institutional framework**, women entrepreneurs networking in Romania** *is at its beginning, but it numbers already a lot of national and local associations, focused on promoting women's access to the world of businesses.*

[8] The 34 nations participating in the G.E.M. study in 2004 were divided in three categories: the *high-income group*, including countries with per capita incomes exceeding 25 000 $; *the middle-income group*, including countries with per capita incomes between 10 000$ and 25 000 $; the *low-income group*, including countries with per capita incomes not exceeding 10 000 $.

The Romanian **networking process** among businesswomen is surprisingly **dynamic** and **wide**. In a relatively short period of time, 20 business women associations were founded all over the country (Table nr.1).

Tabel nr. 1 – Main Romanian Business Women Associations

NR.	NAME:	LOCATION	SITE
1.	COALITION OF WOMEN BUSINESS ASSOCIATIONS	Bucharest	www.cafa.ro
2.	ROMANIAN WOMEN ENTREPRENEURS ASSOCIATION	Bucharest	www.afir.ro (inactive)
3.	ASSOCIATION FOR WOMEN ENTREPRENEURSHIP	Bucharest	-
4.	WOMEN'S ASSOCIATION OF ROMANIA (1990)	Bucharest	**www.afr.ro**
5.	'PROWOMEN'ASSOCIATION	Bucharest	-
6.	F.A.C.T.S. WOMEN ASSOCIATION	Bucharest	-
7.	BUSINESS OPPORTUNITIES FOR WOMEN ASSOCIATION	Bucharest	**www.asoaf-bow.ro** EU project (sumar)
8.	ASSOCIATION OF BUSINEES WOMEN AND TOP MANAGERS IN BRASOV	Brasov	www.afafci.ro, www.feminavip.ro
9.	WOMEN NATIONAL ASSOCIATION FROM RURAL ENVIRONMENT	Brasov (Bran)	
10.	ROMANIAN ASSOCIATION FOR WOMAN PROMOTION	Timis	www.apr.dnttm.ro inactiv
11.	TIMIS WOMEN ENTREPRENEURS ASSOCIATION (1998)	Timis	**www.afmt.ro** active engl./ partial
12.	DOLJ WOMEN MANAGERS ASSOCIATION	Dolj	-
13.	RAMNICU VALCEA WOMEN MANAGERS ASSOCIATION	Valcea	
14.	GIURGIU BUSINESS OPPORTUNITIES FOR WOMEN ASSOCIATION	Giugiu	-
15.	CALARASI BUSINESS WOMEN ASSOCIATION	Calarasi	-
16.	GALATI WOMEN ENTREPRENEURS ASSOCIATION	Galati	-
17.	CONSTANTA BUSINESS OPPORTUNITIES FOR WOMEN ASSOCIATION	Constanta	-
18.	BIHOR WOMEN ENTREPRENEURS ASSOCIATION	Bihor	-
19.	CLUJ BUSINESS WOMEN ASSOCIATION	Cluj	-
20.	UNITED WOMEN ASSOCIATION FROM IASI	Iasi	-

As suggested by their name and their documents (7 of them on their sites too, some of them with English version), these associations aim to inspire women to raise the bar on their performance and achieve career and personal success.

Coalition of Business Women Associations in Romania (CAFA) ([9]), launched at the beginning of 2004, is a coalition of 17 associations, having a well defined statement of principles, a code of conduct and clear stated principles of action. The forth Women in Business' Conference, which took place last year and gathered more than 100 participants from all over the country, had on the agenda the topic of the economic environment's evolution and its impact on the women's firms.

Among *the most important activities* deployed by women associations are the following:

- monthly meetings which includes company presentations and debates of the latest developments in business, finance and legislation;
- exchange of experience with other women entrepreneurs from other counties and regions of Romania;
- business partnerships among women;
- business skill-building;
- promotion of members and their companies in local and national media;
- participation in national and international events, workshops, round tables, debates, press conferences.
- receive information about business and training opportunities, newsletters, studies, and reports concerning gender issues.
- help women to develop their entrepreneurial spirit
- aiming at contributing to the improvement of the business environment in Romania.

Each woman member of the association can bring its own contribution, express its opinion and come up with new issues to be discussed. This is an efficient way to expand members' knowledge, become more self-confident, more open-minded.

The regional distribution of women association (Table nr. 2) is relatively homogenous, except for Bucharest. This situation reflects the efforts to enhance women's potential in

[9] xxx www.cafa.ro

each region. The largest number of associations is concentrated in Bucharest (35%), region accounting the highest number of SMEs and women entrepreneurs.

Table nr. 2 – Distribution by Regions of Romanian Business Women Associations

NR	DEVELOPMENT REGION	Number of associations
1.	***BUCHAREST REGION :***	7
2.	***CENTER REGION*** **-**Brasov (Brasov county)**;** - Bran (Brasov county)**;**	2
3.	***WEST REGION*** **-** Timisoara (Timis county)**;**	2
4.	***SOUTH-WEST REGION*:** - Craiova (Dolj County) - Ramnicu Valcea (Valcea county)	2
5.	***SOUTH REGION*:** - Giurgiu (Giurgiu county) - Calarasi (Calarasi county)	2
6.	**SOUTH-EAST :** - Constanta (Constanta county) - Galati (Galati county)	2
7.	**NORTH-WEST :** - Oradea (Bihor county) - Cluj-Napoca (Cluj county)	2
8.	**NORTH-EAST** : - Iasi (Iasi county)	1
	TOTAL	**20**

These associations are acting like important vectors for raising women' awareness and enhance regional levels of entrepreneurial behaviour. Along with other professional networks, like - Career Justice Women Association, University Graduated Women Association; Equal Opportunities for Women Foundation, "IF" Association for Women, Roma Women Association of Romania, Partner ship for Equality Centre etc. - are important entities promoting and managing innovative actions in the field of regional and local development.

Conclusions

Women entrepreneurship is becoming an important development factor both at national and regional level.

Women's businesses low weight in the total number of SMEs compared to women's weight in the total active population reveals an important unexplored pull of potential entrepreneurs. Networks development is one of the most effective options that can raise women's involvement in new venture creation. Findings suggest that the networking process in Romania, even if at its beginning, is surprisingly dynamic and wide and counts 20 associations. Their regional distribution homogenous (except for Bucharest) is reflecting the efforts to enhance women's potential in each region.

Implementing specific programs along with achieving a higher visibility of the existing associations can raise women's awareness about entrepreneurship and provide them with role models and networking possibilities.

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BOOK REVIEW

Roberta Capello, *Regional Economics*, Routledge, 2006

by Daniela-Luminita Constantin, Academy of Economic Studies of Bucharest

Regional Economics, published by Routledge, 2006 is authored by Roberta Capello, Professor of Regional and Urban Economics at Politecnico di Milano, one of the most distinguished representatives of the world's new generation of regional scientists. She has got her PhD from the Free University of Amsterdam (1993), with Professor Peter Nijkamp as scientific supervisor. Professor Roberto Camagni from Politecnico di Milano, another great regional scientist, has also played an important role in her career development. She has published a large number of books, articles and has been involved in many research projects in Italy and abroad. Roberta Capello is an outstanding member of the regional science international community, with key positions in the councils of Italian Regional Science Association, European Regional Science Association and Regional Science Association International. At present she is the first ever woman – president of Regional Science Association International.

Roberta Capello is, at the same time, an academic who invests lots of dedication and enthusiasm in the work with her students. The present book is a peremptory proof in this respect. It is, undoubtedly, a great textbook on regional economics, a very useful tool for students. Moreover, it is an extremely valuable book for the worldwide regional scientists, academics interested in the exchange of recent ideas, new ways of teaching regional economics. As a result of an original and inspired combination and synthesis between the traditional theories and models and the most recent, modern ones, pointing

out new ideas and further developments in regional science, this book is a new landmark of the international literature dedicated to regional economics.

One of the most important arguments is that, starting from the basic statement "space matters in economic activities", the book proposes and is organized around four perspectives which make it possible to take space explicitly into consideration. Each of them opens the door for addressing various theories of a special relevance to regional economics.

Thus, **Part 1** approaches the traditional location theory by means of *physical-metric space*, definable in terms of physical distance and transportation costs. The issues referring to agglomeration, accessibility and hierarchy are discussed in relation with well-known models such as those of Hotelling (for the interdependency in location choices), von Thünen (for the location of agricultural activities), Alonso (the urban location of firms), Christaller (the geographical approach to hierarchy of urban systems), Lösch (the economic approach to the same question). New models such as general equilibrium models and those describing networks are also discussed.

Part 2 concentrates on the regional growth theories employing the conception of *uniform-abstract space*. Unlike the physical-metric space, which is continuous in its value, the uniform-abstract space is discrete and allows the geographical space to be divided into regions as "areas of limited physical-geographical size (…) considered to be internally uniform and therefore synthesizable into a vector of aggregate characteristics of a social-economic-demographic nature…" (p.5). This conception has been adopted by the neoclassical growth theory, the export-base theory, and the interregional trade theory as fertile seedbed for addressing major questions such as: stages of development and disparities, industrial structure and regional growth, interregional relations, balance of payments and local growth, factor endowment and regional growth, factor mobility, absolute versus comparative advantage in regional growth, etc.

In **Part 3** the *diversified-relational space* conception provides the background for the distinctive elements of the local development theories, which discuss the determinants of territorial competitiveness from the viewpoint of the exogenous, respectively endogenous microeconomic factors. The "maximum cross-fertilization between location theory and development theory" (p.7) which is supported by the interpretation of space as diversified-relational points out the generative development analysis, approaching the national growth rate as the sum of the growth rates recorded by individual regions. It is opposed to the competitive development envisaged by various theories based on uniform-abstract space.

Finally, **Part 4** focuses on *diversified-stylized* space theories of growth. These are the most recent theories and display as distinctive feature the emphasis on increasing returns in macroeconomic growth models. They refer in particular to the models of new economic geography and endogenous growth, based on the assumption that productive activities concentrate around particular 'poles' of development, generating inequalities in terms of level and growth rate of income within the same region.

These four distinctive perspectives create another original feature of the book: it abandons the distinction between theories of convergence and divergence and brings instead a variety of interpretations of growth, from those associating this process with employment creation to theories which consider growth in relation with individual well-being and models and theories whose policy objective is to identify the determinants of the real competitiveness of a economic system as well as its constancy in time.

In order to make this richness of concepts, theories, models accessible to the students, each of the 11 chapters structured into the four parts mentioned above contains examples from all over the world, linking theoretical approaches and models to reality, as well as very helpful conclusions and review questions, followed by selected readings on empirical findings.

With its huge number of bibliographical references, the whole book reveals a truly encyclopaedical personality, covering all significant moments in the history of regional science. It was published exactly fifty years after *Location and Space Economy* (1956) written by Walter Isard, the founding father of regional science.

The book has already got a large recognition and appreciation in the international arena: two giants of today's regional science, Masahisa Fujita and Peter Nijkamp, who have written the foreword and, respectively, the postscript to Roberta Capello's book, refer to it with impressive words such as "fascinating book" (M.Fujita, p.XV), "landmark in the history of regional science and regional economics" (P. Nijkamp, p.256), expressing the belief that it will exert "a great influence on the intellectual mindset of new generations of regional economists" (P.Nijkamp, p257).

I thank Roberta Capello for offering to me the privilege of writing this book review and to include it in the first issue of the Romanian Journal of Regional Science. My wholehearted congratulations for her great achievement!