UNIVERSITY OF WUPPERTAL
BERGISCHE UNIVERSITÄT WUPPERTAL

EUROPÄISCHE WIRTSCHAFT
UND
INTERNATIONALE MAKROÖKONOMIK

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# Structural Change, Specialization and Growth in EU 25

Diskussionsbeitrag 173
Discussion Paper 173

*Europäische Wirtschaft und Internationale Wirtschaftsbeziehungen*
*European Economy and International Economic Relations*
**ISSN 1430-5445**

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January 2010

*Herausgeber/Editor: Prof. Dr. Paul J.J. Welfens, Jean Monnet Chair in European Economic Integration*

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JEL classification: C23, O47, O52, R10
Key words: RCA, Output Growth, Sektoral Output Analysis

**Summary:** Based on the OECD's classification of goods, we take a closer look at EU 15 countries and EU accession countries in terms of the dynamics of sectoral output growth – with due emphasis on the distinction between labor-intensive and science-intensive products. Sectoral output dynamics are explained by the (modified) revealed comparative advantage (RCA), specialization in terms of input intensity, the growth rate of RCA, past sectoral output dynamics and per capita output. In addition, we consider the development of nominal sectoral output development. Considerable differences between EU 15 and EU 10 countries were found, which point to different production regimes in leading EU countries and the Eastern European accession countries, respectively. This panel-based bottom-up approach to output growth suggests that structural change will affect the responsiveness of the supply side considerably.

**Zusammenfassung:** Basierend auf der OECD Güter Klassifikation betrachten wir die Länder der ehemaligen EU15 und die Beitrittsländer der erste EU Osterweiterungsrunde hinsichtlich der Dynamik des sektoralen Output Wachstums – mit kritischer Würdigung der Unterschiede zwischen arbeits- und wissensintensiven Gütern. Die sektorale Output Entwicklung wird durch Spezialisierung im Sinn von komparativen Vorteilen (RCA), Spezialisierung in Bezug auf die Input – Intensität, die Veränderungsrate der komparativen Vorteile, die vergangene sektorale Output Entwicklung sowie die Entwicklung des Pro-Kopf-Outputs beschrieben. Zusätzlich betrachten wir auch die Entwicklung des nominalen sektoralen Outputs. Es lassen sich signifikante Unterschiede zwischen den Staaten der EU 15 und den Beitrittsländern feststellen, welche auf unterschiedliche Produktionsformen in den beiden Gruppen hinweisen. Dieser Panel-basierte Bottom-Up Ansatz zur Erklärung des Output-Wachstums zeigt, dass Strukturwandel die Reagibilität der Angebotsseite erheblich beeinflussen wird.

We gratefully acknowledge comments by Andre Jungmittag and Dora Borbély, EIIW at the University of Wuppertal. This paper has benefited from discussions at the Brussels conference in the EU-financed project "Changes in Industrial Competitiveness as a Factor of Integration: Identifying Challenges of the Enlarged Single European Market" (HPSE-CT-2002-00148); the usual disclaimer applies.

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# 1. Introduction

Competition in goods and factor markets will normally lead to a resource allocation, which is efficient in a static and a dynamic sense. Dynamic efficiency refers to Schumpeterian competition and process or product innovations. Product innovations should go along with a rise in prices fetched in national and international markets – the latter implies a rise in real export unit values (strictly speaking: relative to a benchmark). Cutting costs through process innovations will raise profitability. Since relative factor endowment affects relative factor prices, one may expect that specialization of production and exports will be in line with factor endowment. Such endowment is to some extent exogenous– e.g. in the case of rich natural resources of certain countries; to some extent, it is due to demographic dynamics, as well as to endogenous innovation dynamics or growth-enhancing government policies.

In open economies, the pressure for specialization will result in an export and import pattern, which is characterized by different relative sectoral export positions, ones that can be measured by standard revealed comparative advantages or by modified RCAs. Standard RCA measures, which put the focus on the sectoral export-import ratio, as compared to the aggregate export-import ratio, imply some problems in the case of current account imbalances, thus the standard RCA has to be corrected for adequately; however, in a system of flexible exchange rates, capital flow dynamics might indeed shape the current account development. Therefore, it is useful to use a relative export performance indicator, which is not affected by current account imbalances: The indicator to be considered is the modified RCA indicator, which basically stands for the sectoral export ratio of country i compared to the sectoral export ratio of all other countries in the same relevant market. Subsequently, we will use modified RCAs and put the focus on the relative sectoral export position of a country i in the EU 15 single market. Thus, the approach follows BORBÉLY (2006), whose empirical analysis has explained RCA dynamics and export unit values in Hungary, the Czech Republic and Poland, as well as in EU cohesion countries. Her approach is also taken up here, in terms of the OECD-based distinction between labor-intensive production and science-intensive industrial production; the broad taxonomy of the OECD – covering several sectors, as shown in the appendix for the case of Germany and France - is indeed quite useful as it allows to put the focus on relative factor endowment. The basic challenge is to come up with a bottom-up explanation of sectoral growth and to highlight differences between two key types of sectors in the EU: For the sake of simplicity, we boil down the multi-sector distinction of the OECD to just two sectors, and thus consider labor-intensive sectors on the one hand, and on the other hand, focus on science-intensive goods plus differentiated goods (e.g. such as electronics), which often stand for innovative differentiated products.

There are several approaches for explaining specialization dynamics, one major strand of analysis puts the emphasis on the link between specialization and per capita income – within a standard neoclassical model per capita income will, of course, reflect capital intensity and thus, cross-country variance of specialization indicators should go parallel with per capita income variance. However, there is no uniform view in the literature with respect to the link between sectoral specialization and per capita income. The traditional literature on Schumpeterian dynamics has suggested that prospects for productivity growth should differ across production activities because of the difference in innovation opportunities (SCHUMPETER, 1934; NELSON/WINTER, 1982). Part of the endogenous growth approaches emphasizes the crucial role of knowledge-intensive production and their linkages in the economy for the growth of productivity (ROMER, 1990; GROSSMAN/HELPMAN, 1991). KRUGMAN (1987) has suggested that specialization is a positive function of per capita income and some of the findings of AMITI (1999) do indeed suggest such a pattern to be relevant to Western Europe. However, with international outsourcing dynamics and offshoring becoming increasingly important in Europe and in Asia since the 1990s, it is not surprising that export specialization in industry is increasing.

BENEDICTIS/GALLEGATI/TAMBERI (2009) consider sectoral export diversification. The semi-parametric empirical analysis indicates that countries have a tendency to diversify – the key finding is that, controlling for countries' heterogeneity, sectoral export diversification will increase with income. With regards to sectoral export dynamics of Eastern Europe, the empirical findings of BORBÉLY (2006) indicate that import specialization is crucial for export specialization; therefore, international fragmentation of the production process plays a role in export specialization. Similarily, SRHOLEC (2007) has focused on newly industrialized countries' high-tech exports in electronics and finds that high-tech exports of the South are largely reflecting fragmentation of production; while indigenous technological capabilities are linked with export performance in electronics, the empirical evidence suggests that it is mainly the propensity to import electronics components that accounts for by far the largest proportion of cross-country differences in the specialization of electronics exports. MANI (2000) looked at the rise of developing countries' high-tech exports and finds that only few newly industrialized Asian countries have strong patenting activities, namely Korea and Taiwan – thus, high-tech exports could indeed be, to some extent, a statistical artifact. SRHOLEC (2006) has investigated the role of international production sharing for exports of high-technology products; the main finding was that many exporting countries enjoyed a fast growth of high-tech exports, however, there was only a modest gain in the upgrade of local technological capabilities. With respect to eastern European accession countries, similar issues might be expected to some extent, but it is also clear that human capital formation in these EU countries are a relatively good in international comparison.

In order to take a closer look at eastern European countries' sectoral dynamics, it is useful to adopt the OECD methodology for distinguishing between various patterns of specialization. The analysis presented covers the EU 25. Therefore, it seems adequate to avoid focus on the early post-transformation period, thus the time period covered is 1993-2005. While it may be argued that all Eastern European accession countries have experienced sustained output growth, it is rather unclear which sector dynamics were behind the aggregate dynamics. The traditional literature (BLACK, 1996); suggests that low-income transition countries should mainly specialize in labor-intensive production in a first stage of economic catch-up and only in a later stage – after a strong increase of capital intensity, to which foreign direct investment might contribute – will there be structural change in favor of a broader role of knowledge-intensive production. One should emphasize that the traditional Heckscher-Ohlin approach does not consider the role of foreign direct investment, one that plays a particular role in Eastern European countries' economic catch-up. High foreign direct investment inflows were recorded in many Eastern European accession candidate countries in the decade after 1994. Sectoral specialization might not only largely reflect the impact of trade and import competition, respectively, but may also reflect FDI inflows as well; moreover, product upgrading typically goes along with FDI inflows, therefore, there should be a positive revenue effect for the firms and the sectors concerned.

As regards aggregate growth accounting for Western Europe, JUNGMITTAG (2006) has shown that specialization in general does not contribute to growth, only high-technology specialization contributes directly to growth. Besides capital formation and technology as procured by patents, he also finds diffusion – related to trade – to play a considerable role in growth. However, the knowledge about the role of industrial growth in various sectors is scarcer – except for the well-known growth-enhancing role of information and communication technology production (for the US see e.g. WELFENS/WESKE, 2006; for Eastern Europe: VAN ARK/PIATKOWSKI, 2004). We will try to shed some light on this issue for both the EU 15 and the first 10 Eastern European EU accession countries. Since a distinction between science-based sectors (plus differentiated products that are knowledge-intensive) and labor-intensive plus resource-intensive sectors will be made, we can also highlight the role of Schumpeterian transition dynamics, namely to what extent different factors explain output growth in science- and knowledge-intensive sectors, as opposed to labor-intensive industries. Moreover, as regards the EU 15 countries versus the EU 10 Eastern European countries, one might anticipate that Marshallian agglomeration externalities and the associated specialization will play a relatively big role in accession countries; by contrast, the high-income countries in Western Europe should benefit from Jacobs externalities in many industrial sectors; that is from diversification benefits, which become more important as industrial production shifts towards more complex products and product innovations, respectively.

The relative position in the EU 15 export markets, which represent the bulk of international markets for exporters from accession countries, as well as the EU 15 countries themselves, can be assessed through the modified RCA. Part of the change in RCAs in the various sectors will be related to supply-side factors, but there will also be impulses from the demand side. With regards to per capita income, the various income elasticities – referring to different types of goods – imply that there will be demand-driven structural change over time. At the same time, one may consider the impact of higher per capita income and higher GDP, respectively, on the composition of output in general and on the growth of output in scale- and knowledge-intensive sectors (bigger markets will facilitate the recovery of R&D expenditures). While the role of per capita income will be considered here, the role of scale economies will not be analyzed.

Comparing the EU 15 and the EU 10 brings out considerable differences with respect to the role of some of the variables. At the bottom line, one may emphasize that specialization generally matters, while the role of per capita income is somewhat unclear and the link between RCA developments and output growth is non-linear. Section 2 is devoted to basic theoretical considerations about structural change and output growth. Section 3 presents the regression analysis. The final section gives some policy conclusions that refer to the EU 15 countries and the EU accession countries, respectively.

## 2. Structural Change and Growth: Interdependent Perspectives

As a useful standard approach to structural change, which goes back to the 1960s, one may refer to the analysis of CHENERY (CHENERY; 1960; CHENERY/TAYLOR, 1968). CHENERY and other researchers with a focus on the structural dynamics of Newly Industrialized Countries have tried to identify normal developments of sectoral patterns: Per capita income was considered to be a major driver of sectoral development patterns, not least because income elasticities for various goods, and hence, sectoral demands differ. Some economists would draw policy recommendations for a catching-up in poor countries, the idea was to identify optimal structural change – with causation running from structural dynamics to per capita output; others considered the CHENERY approach as a mainly descriptive perspective, which at best could serve as a useful benchmark for comparisons across countries (see the discussion in HEILEMANN/DÖHRN; 2005).

In a nutshell, the CHENERY approach assumes that structural change is shaped by two factors: So-called universal factors, which can be identified across a large number of countries provided that adequate international cross-section analysis is conducted. A second aspect concerns specific national factors of the respective country, such as climate/geography, endowment with natural resources, legal framework, national policy etc. (CHENERY/TAYLOR, 1968). Universal factors can be identified through empirical analysis– in line with CHENERY's ideas – while respective factors may be detected through the estimation of sectoral growth functions. Such an approach can be understood as a reduced form of a simplified model, in which the domestic production of the respective sector is driven by domestic final demand, intermediate demand and exports. Sectoral shares of real domestic demand are determined by y – considered as exogenous – and the size of the population, which is a proxy for scale economies. Moreover, endowment variables – such as natural resources or ICT capital –can also be included in the sectoral growth function.

Hence, the approach can be stated as:

(1) $V_{ij} = V_{ij}\ (y_j, L_j, R_{ij})$

with $V_{ij}$: value added in sector i in country j;
$y_j$: per capita income in country j;
$L_j$: population in country j;
$R_{ij}$: resources for sector i in j (e.g. use of energy or employment of scientists).

A standard specification (with positive elasticities for the input factors) is:

(2) $V_{ij} = y_i^{\alpha}\ L_j^{\varphi}\ R_{ij}^{\psi}$

From a theoretical point, one may argue that this reflects a specific production function in combination with implicit technology dynamics related to the country's per capita income level for each sector; alternatively, the variable $y_i$ may be understood to reflect both the general technology level – which in turn is related to per capita income – and demand-side dynamics related to per capital real income. This approach does not consider the role of trade for sectoral or aggregate growth unless there is an indirect trade link, which is based on an import or export function related to per capita income.

Assuming constant elasticities and taking logarithms allows for a focus on value-added sectoral shares: the share of a sector is analyzed in total valued added ($V_{ij}/V_j$). In addition to the above variables, one may include other variables such as lagged sectoral output, which could reflect a partial adjustment mechanism. In order to consider the case of variable elasticities, one may consider including per capita income with both a linear and a quadratic term (see e.g. DÖHRN/HEILEMANN, 2003 for the case of EU accession countries). From this perspective, the CHENERY approach has turned out to be useful for industrialized transition countries too, however, alternative or complementary analytical elements could also be useful. E.g. since information and communication technology has become a broadly used common-purpose technology in OECD countries and in leading NICs, there is an enhanced ability among firms to organize value-added chains along flexible geographical lines.

Since sectoral technology spillovers matter, the structure of industry and the innovation systems of the respective countries should be important elements contributing to aggregate real GDP. As transition countries are catching up over time, in terms of productivity and technological sophistication, it is to be found that sectoral specialization will affect overall sectoral output growth (BORBÉLY, 2006; WELFENS, 2008). Catching-up means, however, that opportunities for further easy industrial growth – based on diffusion of knowledge, rising trade intensities and effects of full trade liberalization in EU countries will reduce. Moreover, the increasing role of outsourcing and services production, respectively, will reduce the prospects for sustained growth in industrial output.

While explaining the dynamics of sectoral output within a panel data approach is a straightforward exercise, the issue of explaining nominal sectoral output growth should also be raise, which, of course, also includes the price vector on the left-hand side. We are basically interested in understanding the role of relative export unit values (sectoral export unit value relative to the export unit value of US firms in the EU). From a theoretical perspective, it might be expected that an improved lagged relative export unit value is a proxy for higher future profits, and therefore, output growth should be affected positively. On the other hand, it may be argued that relative export unit values of firms in small open economies are basically shaped by US price dynamics, and hence, should not affect the output growth in the EU 15 or in the Eastern European EU countries. At the same time nominal output dynamics are positively affected by relative sectoral export unit values, this points to the fact that absolute export unit values can be raised; this could either reflect an improved market position of firms in the EU 15 single market or it could reflect quality upgrading, or even both.

## 2.1 Trade Specialization, Aggregate Demand and Growth

Following the ideas behind Ricardian specialization, the revealed comparative advantage indicator of Balassa (RCA) is a standard indicator for assessing the competitiveness of a sector in a given country. The RCA compares the sectoral export-import ratio to the export-import ratio of the whole economy. An alternative is given by the following formula:

(3) $$RCA_j = \frac{x_j / \sum_{j=1}^{n} x_j}{m_j / \sum_{j=1}^{n} m_j}$$ with $x_j$ being the exports in sector j and $m_j$ being the imports

While this RCA is good for comparing specialization across different sectors in a single country, a slightly different approach is more appropriate if we are interested in comparing specialization across different countries. For this instance, we introduce some kind of modified RCA – indicator that compares the sectoral export shares in country c to the sectoral export shares in the whole observed market. In our case, the observed market will be the EU 15 market. The decisions to limit ourselves to this market are manifold. One of the main reasons is the amount of data available in the 1990s. The actors on this market are the EU 25 countries, with Belgium and Luxembourg being counted as a single state.

Explicitly formulated, the modified version of the RCA (BALASSA (1965), BORBÉLY) is given as follows:

$$(4) \qquad RCA_{c,j} = \tanh yp\left(\ln\left(\frac{x_{c,j}/\sum_{j=1}^{n} x_{c,j}}{x_{EU15,j}/\sum_{j=1}^{n} x_{EU15,j}}\right)\right)$$

with $x_{c,j}$ being the exports of country c and sector j

If the modified RCA exceeds unity, the respective country has a revealed comparative advantage in that sector. The main advantage of using modified RCA is that it is robust to the changes in the current account position, while the first RCA is not. Furthermore, the modified RCA offers more consistent results, as only exports are used– however small they may be – but differences in measuring imports and exports will not be used. Moreover, we can directly use the modified RCA in a macroeconomic context, as it will be shown in a simple setup with two goods and two countries. Furthermore, in contrast to the standard RCA indicator, the modified one takes the comments made by HOEN/OOSTERHAVEN (2006) on the inappropriateness of the standard indicator into account, which is sensitive to current account imbalances and raises other methodological problems.

## 2.2 Macroeconomic Demand Perspective and Modified RCA

As a complementary approach to demand-oriented analysis of structural change within an implicit three country-approach, we may focus on the uses of the equation of GDP in country I, where X' and X" represent exports of two sectors.

$$(5) \qquad Y = C + I + G + X' + X'' - J$$

Exports of country I and country II (* variables) are assumed to go exclusively to country III, which is assumed to be a large economy, while country I and country II are both small. Dividing this by the overall real exports X, while assuming that $C = cY$, $I = hY$, $G = \gamma Y$ and imports $J = jY$, we have:

$$(6) \qquad (1 - c - h - \gamma + j)Y/X = [X'/X] + [X''/X]$$

$$(7) \qquad (1 - c - h - \gamma + j)Y/X = [X'/X]/[X'^*/X^*]\ X^*/X'^* + (MRCA'')X''^*/X^*$$

We define $MRCA' = [X'/X]/[X'^*/X^*]$, $\alpha'^* := X'^*/X^*$ and MRCA" and $\alpha''^*$ correspondingly.

$$(8) \qquad (1 - c - h - \gamma + j)Y/X = (MRCA')\alpha'^* + \alpha''^*\ (MRCA'')$$

For ease of exposition we assume that $\alpha'^* = 1 - \alpha''^*$

(9) $(1 - c - h - \gamma + j)Y/X = \alpha'^* (MRCA' - MRCA'') + MRCA''$

(10) $(1 - c - h - \gamma + j)(Y/X)/MRCA'' = \alpha'^* [(MRCA' - MRCA'')/MRCA''] + 1$

If $[(MRCA' - MRCA'')/MRCA'']$ and $[-c - h - \gamma + j]$ are both close to zero, the following approximation will hold after taking their logarithms:

(11) $-c - h - \gamma + j + \ln Y - \ln X \approx \alpha'^* [(MRCA' - MRCA'')/MRCA''] + \ln(MRCA'')$

Assuming that we have constant parameters c, h, j and γ, we get the following equation by differentiating with respect to time (with g denoting growth rates):

(12) $g_Y \approx g_X + \{g_{MRCA''} + \alpha'^* d[(MRCA' - MRCA'')/MRCA'']/dt\}$

The growth rate of real income is thus determined by the sum of overall export growth plus the change in competitiveness, as indicated by the term {...}. Note that for the simple case of an economy with two export sectors, it can be observed that MRCA' and MRCA" will have opposite signs, but the growth rates of the MRCAs are unrestricted with respect to the sign. The aggregate growth rate, thus, will be positively influenced by the sectoral export dynamics if $g_{MRCA'}$ exceeds that of $g_{MRCA''}$ in the case that the latter is positive; in any case, the term […] must be positive if there is to be a positive impact from sectoral specialization. From a macro demand side perspective, the bracket term {…} is the export composition contribution to economic growth.

Note that if overall exports X are proportionate to aggregate output in country III (Y**), then X=xY** and we can replace lnX by lnx + lnY**, and therefore, $g_X$ by $g_Y$**. As long as there is a composition effect of exports on output growth, country I and country III will not have the same growth rate. From a supply-side perspective one may consider a growth model in an open economy (see WELFENS, 2008) with a production function in which labor-saving knowledge is determined by trade and exports, respectively.

# 3. Descriptive Analysis

The data we use for this analysis comes from three major sources. While the production and the production growth data come from Eurostat, as well as the OECD STAN database, the set was extended by linear interpolation for missing values in parts of the data series. Where missing values occurred at the beginning or the end of the time series, linear extrapolation was used. By using this method we accept that the results might be slightly biased in favor of constant growth rates. This is only a problem from a theoretical point of view, but has no real effect on the main results, as it can be seen through a closer inspection of the data. The third source we use for our analysis of data is the COMEXT database. As the first step, the data is converted to match the NACE classification[1]. After that, several personal calculations are used to obtain different indicators at the desired level of aggregation (RCAs [read: modified RCA], the growth rates of the RCAs, the export unit values EUVs and the Specialization index).

It should be mentioned that we restrict ourselves to the EU 25 countries and the manufacturing sectors in this paper. The period covered here refers to the years from 1993 to 2005. This period is shortened by the fact that averages are calculated, as well as the fact that up to three lags are used. Therefore, the actual timeline dates from 1997 to 2004, leading to eight observed years, which is sufficient for a panel data analysis, if a large number of cross-sections are observed. The number of cross-sections differs, which we discuss in greater detail in section 4.

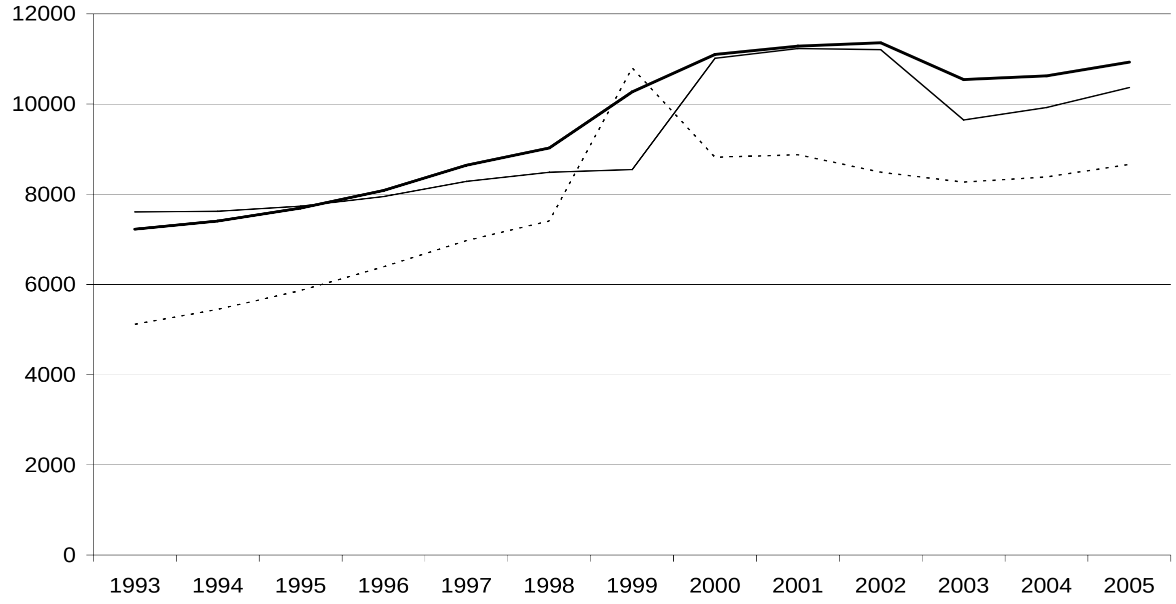
To motivate some of the later aspects of chapter 4 we will take a look at Figure 3.1, which shows that the absolute levels of production in the EU 10 and the EU 15 countries follow distinctively different paths. While the path of the EU 15 countries is constantly rising, the path of the EU 10 countries follows a more cyclical pattern, which is also relevant when observing the EU 25 levels. Therefore, it is adequate to analyze the EU 10 and the EU 15 countries separately so that more detailed answers can be found[2]. An interesting aspect is the fact that in recent years, the EU 10 countries show a tendency to lag behind the EU 25 countries.

**Figure 1: Average production across all 22 sectors**


[1] The conversion uses a matching table that relates the „Combined Nomenclature“ – CN classification to the NACE classification. The matching table was introduced as part of an EU financed project on “Changes in industrial competitiveness as a Factor of Integration: Identifying Challenges of the Enlarged Single European Market” (HPSE-CT-2002-00148)

[2] A different structure in the levels of production output implies that the dependent variable in an econometric model depends especially on the observed country group. The two standard solutions are the introduction of a binary country group index variable or the splitting of the underlying data set. We decide in favor of the second solution.

**Figure 2: Average production across all EU 25 countries**




Source: OECD STAN Database

An analogy to Figure 3.1 and Figure 3.2 shows the average level of production for two sector groups. Before talking about this figure in detail, it should, again, be mentioned that this paper takes up the OECD sector classification. This classification puts the 22 sectors (recycling excluded) of the manufacturing industry in 5 main sector sets: Labor intensive, Resource intensive, Scale Intensive, Science Intensive Industries and Differentiated Goods. For our analysis we define labor-intensive industries as low-tech industries and science-based and differentiated goods industries as high-tech industries. Therefore, L describes the sector group consisting of the labor-intensive industries, while S&D describes the sector group of the science-based and differentiated goods industry. A detailed description of the OECD classification, as well as an assignment of which sector belongs to which group, can be found in (BORBÉLY 2006).

With respect to Fig. 2, it can be mentioned that except for the change in 1999, the only difference in the two groupings lies mainly in the level of production. It should, therefore, be expected that regressions for the two groups should provide similar results or that differences are rather in the levels than in the structure.

# 4. Empirical Analysis

Next we turn to the empirical analysis for sectoral output growth on the basis of a panel data approach, where we consider the following subgroups for 1993-2005 in the country sample:

- All 25 EU countries (EU27 without Romania and Bulgaria)
- EU 15 countries
- EU 10 countries, which are the Eastern European accession countries of 2004.

We consider sectoral data on the left-hand side of the equation and sectoral data on the right-hand side, except for per capita income growth, for which we use country data.

In terms of sectors we make a distinction between:

- labor-intensive sectors (where we follow the OECD definition)
- science-intensive and differentiated goods sectors
- all sectors together

Furthermore, we differentiate by the way in which specialization is measured. On the one hand, we consider nominal specialization indicators (all RCA related indicators) and on the other hand, we consider real specialization indicators based on physical units.

The data used, as described in **the section above,** will not be included in the regression model as raw data. Instead, we first calculate three-year averages to smooth the data. The idea behind this is the fact that sectoral data concerning specialization can be relatively unstable if a sector is dominated by only a small number of firms; **large annual swings in international trade can also distort the picture**. Averaged data are, thus, much more suitable to counter these instabilities than raw data are. We decide on three-year averages, because they offer a good effect of smoothing, while still leaving us with enough observations to be made.

As mentioned above, we decided to use a panel regression approach. The choice is due to the nature of the data. The data has three dimensions; a time-dimension (denoted by the index t), a country-dimension and a sectoral-dimension. As methods for three dimensional panel estimations are not available (at least to the knowledge of the authors), we combine the last two dimensions into a country-sector-cross-section (denoted by the index i). Therefore, we are able to apply established panel data estimators.

Before going on, we present the first regression model that includes the aforementioned variables:

(33)
$$\log(prod_{i,t}) = c + \beta_1 \log(mrca_{i,t}) + \beta_2 spezdummy_{i,t} + \beta_3 exgrow_{i,t} + \beta_4 mrcagrow_{i,t} + \beta_5 releuv_{i,t} + \beta_6 gdppc_{i,t} + \mu$$

After applying a two-stage panel estimator to the model, we tested for fixed-effects. Since they presented a significant problem, we decided to use the first differences instead.

(34)
$$\left[\log\left(prod_{i,t}\right)-\log\left(prod_{i,t-1}\right)\right] = c + \beta_1\left[\log\left(mrca_{i,t}\right)-\log\left(mrca_{i,t-1}\right)\right] + \beta_2 spezdummy + \beta_3\left[exgrow_{i,t}-exgrow_{i,t-1}\right] + \beta_4\left[mrcagrow_{i,t}-mrcagrow_{i,t-1}\right] + \beta_5\left[releuv_{i,t-1}-releuv_{i,t-2}\right] + \beta_6\left[\log\left(prod_{i,t-1}\right)-\log\left(prod_{i,t-2}\right)\right] + \beta_7\left[gdppc_{i,t-1}-gdppc_{i,t-2}\right] + \mu$$
T

he result of this step is that, aside from the fact that the results are more consistent, the model itself can be interpreted in analogy to the theoretical model given in equation (8). In addition to equation (8) we have introduced a variable lagged production (one period time lag). We introduce this variable, as the level of production achieved will affect future production output – not least because adjustment/reallocation costs can be considerable in specialized industries and in sectors with high sunk costs in R&D. Furthermore, extensive testing has shown that a lag of one year gives a fairly good fit. The rest of the chapter will be used to present and discuss the results of two-stage OLS regressions for several subgroups, as defined above.

Though, before going on, some comments need to be made. While a Durbin-Watson statistic is given in all results, this value does not give the panel-specific Durbin-Watson statistic, as introduced by BHARGAVA and FRANZINI (1982); although, the BHARGAVA and FRANZINI statistic would not change a lot concerning the conclusions with respect to autocorrelation. We have to accept that the regression results for several subgroups point in the direction of autocorrelation in the residuals. Using the BHARGAVA and FRANZINI statistic would only strengthen this result, as the statistic uses rather tight upper and lower bounds. The following tables do not consider the autocorrelation problem, but the following regression tables do, namely in the sense that there is no autocorrelation problem in the respective subsets of data (and all tables are shown in the appendix).

**Table 1: Regression Results for nominal data**

| Variables | All sectors | | | Labor-intensive | | | Science-based | | |
|---|---|---|---|---|---|---|---|---|---|
| | EU 25 | EU 15 | EU 10 | EU 25 | EU 15 | EU 10 | EU 25 | EU 15 | EU 10 |
| C | *** | - | - | - | - | ** | * | - | - |
| $\log(mrca_{i,t})$ | *** | *** | *** | *** | - | *** | *** | *** | * |
| $spezdummy_{i,t}$ | ** | ** | - | *** | ** | - | - | - | - |
| $exgrow_{i,t}$ | *** | *** | *** | *** | - | ** | - | ** | - |
| $mrcagrow_{i,t}$ | *** | *** | *** | - | - | - | - | *** | - |
| $releuv_{i,t-1}$ | - | *** | - | - | - | - | - | - | - |
| $\log(prod_{i,t-1})$ | *** | *** | *** | *** | *** | *** | *** | *** | *** |
| $gdppc_{i,t-1}$ | * | *** | - | - | - | * | - | ** | - |

**Table 2: Regression Results for real data**

| Variables | All sectors | | | Labor-intensive | | | Science-based | | |
|---|---|---|---|---|---|---|---|---|---|
| | EU 25 | EU 15 | EU 10 | EU 25 | EU 15 | EU 10 | EU 25 | EU 15 | EU 10 |
| C | *** | - | - | - | - | - | ** | - | - |
| $\log(mrca_{i,t})$ | ** | - | *** | * | - | *** | - | - | - |
| $spezdummy_{i,t}$ | * | ** | - | ** | ** | - | - | - | - |
| $exgrow_{i,t}$ | - | - | - | - | - | - | - | ** | - |
| $mrcagrow_{i,t}$ | *** | - | *** | - | - | ** | *** | - | ** |
| $releuv_{i,t-1}$ | - | - | - | - | - | - | - | - | - |
| $\log(prod_{i,t-1})$ | *** | *** | *** | *** | *** | *** | *** | *** | *** |
| $gdppc_{i,t-1}$ | ** | *** | - | * | - | - | - | - | - |

When looking at regression analysis results with two cross-tables, we can see for which sectors what variables (in first differences) are significant. The asterisks (*) define the level of significance, as described above. A grey background signifies a positive sign of the corresponding parameter, while a white background signifies a negative sign. (The full regression results can be found in the appendix.) Additionally, it suffices to say that almost all regressions yield acceptable results as the R-squared values are usually in the range from 0.45 to 0.60. Two exceptions are the cases for the EU 15 in all sectors, which only gives a R-squared of 0.27, whereas the EU 25 with only the labor-intensive sectors results in a R-squared of about 0.73.

The following table shows an example of the results gained from the regression in all EU 25 countries in the areas of science-based and differentiated goods.

**Table 3: Regression results for the EU 25 and science-based and differentiated goods (real data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/10/07 Time: 02:20
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 117
Total pool (balanced) observations: 936
Instrument list: c (log(mrcar?)-log(mrcar?(-1))) spezdummy? (exgrow?-exgrow?(-1)) (mrcargrow?-mrcargrow?(-1)) (releuv?(-1)-releuv?(-2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.018726 | 0.008248 | 2.270434 | 0.0234 |
| LOG(MRCAR?)-LOG(MRCAR?(-1)) | 0.006680 | 0.011995 | 0.556897 | 0.5777 |
| SPEZDUMMY? | -0.000684 | 0.009482 | -0.072113 | 0.9425 |
| EXGROW?-EXGROW?(-1) | -0.000235 | 0.000815 | -0.288313 | 0.7732 |
| MRCARGROW?-MRCARGROW?(-1) | -3.53E-05 | 1.26E-05 | -2.805312 | 0.0051 |
| RELEUV?(-1)-RELEUV?(-2) | -0.002428 | 0.011462 | -0.211844 | 0.8323 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.699744 | 0.035403 | 19.76514 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | -1.80E-05 | 1.47E-05 | -1.219338 | 0.2230 |

| | | | |
|---|---|---|---|
| R-squared | 0.528994 | Mean dependent var | 0.069471 |
| Adjusted R-squared | 0.525441 | S.D. dependent var | 0.200933 |
| S.E. of regression | 0.138419 | Sum squared resid | 17.78039 |
| Durbin-Watson stat | 1.813439 | Instrument rank | 8.000000 |

Before we discuss results for distinct parameters, we will start by giving a short interpretation of the insights gained from the two cross-tables. Generally, it can be said that the results based on nominal data are more consistent than those based on real (volume) data. Therefore, at first, we will only refer to the first cross-table.

A first look directly shows that the lagged production levels generally have a highly significant positive influence on the actual sectoral production levels, which validates the assumptions made here. This is backed up by the results for real RCAs, which yield the same results.

Similar results can be found when looking at the modified RCAs that have been logarithmically derived. While two instances exist where the parameter cannot be assumed to be significant, in the other cases, we get a highly significant strictly positive parameter. Even the two exceptions can be explained. They indicate that specialization in low-tech industries in the EU 15 has no impact on the production levels, while in the EU 10, the specialization in high-tech industries has only a very modest effect; low technology stands for modest specialization and low sunk costs, therefore, it should be expected that volume adjustment can be made at short notice and previous production volumes do not imply implicit commitment to future production along the same line of specialization. An explanation for this phenomenon can be found in the fact that specialization in the EU 15 is more on high technology, while in the EU 10 it is more on low technology.

This aspect is strengthened by the fact that GDP per capita positively affects production in the science-based sectors of the EU 15, while it negatively affects the production in labor-intensive industries in the EU 10. In addition to this, the specialization indicator also only affects the EU 15 countries. This effect is either insignificant or positive. It is especially positive for the low-technology sectors. Taking a look at the other variables, it may be argued that export growth only matters for the EU 15 in high technology sectors. This is based on the fact that the EU 15 is an exporter of mainly high technology goods. Exports in high technology sectors are often needed to recover high R&D fixed costs through large international sales volumes. Therefore, a rise in exports lifts the overall volume in the corresponding sectors.

Incidentally, we have to point out a problem in the model using real data. Here, the influence of the export growth is negative, which would imply that production rises if exports drop. Since research has shown that exports are production enhancing, it is reasonable to assume that the model with nominal data is, at least in this aspect, more reliable. The somewhat contradictory sign of the growth rate of the modified RCAs might be explained by the fact that RCAs only have relatively small growth rates, which, in some cases, only follow a long-term growth path. Thus, we can offer an interesting range of empirical findings. In the next step, we want to proceed and take a look at some distinct analyses for single-sector country pairings.

Taking a look at all sectors and all 25 countries shows that modified RCA has a significant positive impact on sectoral output growth. The specialization dummy also has a positive impact. Current export growth is insignificant, so it may be argued that sector output growth in manufacturing is independent from the sales split with respect to home markets and foreign markets. The growth rate of modified RCA has a negative significant impact, the rise of the MRCA growth rate suggests that due to the decline in marginal products of factor inputs or due to falling prospects in international demand growth, sectoral output growth falls once that specialization has become strong. Relative export unit values are insignificant. Lagged sectoral output has a positive impact; therefore, there is certain persistence in growth dynamics in the industry. Lagged per capita GDP has a negative impact on sectoral output growth, which may be interpreted to reflect the logic of economic convergence: The higher the overall per capita real income is, the more difficult sustained growth in all sectors of industry will become – and indeed one should expect a transition towards rising growth rates in the service sectors.

In the EU 15, which stands for a broad variety of industrial sectors in high-income countries, we only find these three significant variables:

- the specialization dummy
- the past production
- per capita income; here it has a positive significant sign which suggests that high-income countries are specialized in goods with positive income elasticities.

In the EU 10 countries modified revealed comparative advantage contributes positively to sectoral output growth, which suggests that sectoral reallocation of input factors – quite important in the fast-growing accession countries - has indeed contributed to the growth of industrial output. The growth rate of modified RCA has a negative impact, while lagged production has a positive impact. Other variables are insignificant.

As regards labor-intensive sectors in the EU 25, we find that the modified RCA, as well as the specialization dummy and past production, have a significant positive impact. Per capita income has a negative impact – but is only weakly significant - which suggests that labor-intensive production will come under pressure for adjustment in the context of overall economic growth. R-squared is rather modest. With respect to science-intensive output growth, the growth rate of modified RCA has a negative impact, while lagged production has a positive impact for the EU 25.

In the EU 15 countries the RCA is insignificant, whereas the specialization dummy is significant, which suggests that output growth is not so much shaped by the respective position in the EU 15 market, but rather by specialization. Lagged production is significant, but the Durbin Watson is low, which suggests there is a problem with the specification.

As regards the EU 10, in the case of labor-intensive goods, the modified RCA is highly significant, while the specialization dummy is not. With regards to the latter, we may argue that those industries are rather footloose - compared to labor-intensive production in EU 15 – since specialization is not a significant influence on sectoral output growth. Past production is highly significant and the growth rate of the modified RCA has a negative impact.

As regards science-intensive output growth in the EU 15 countries, the statistics tests are satisfactory. The specialization dummy is not significant, while the export growth variable has a positive impact. The latter suggests that export success is a driver of output growth in science-intensive production, possibly due to the fact that R&D expenditures can be recovered in large growing international markets. Past production has a positive significant impact.

# 5. Conclusions and Policy Implications

The main conclusions are concerned with the importance of the modified RCA and specialization in general. It was shown that not only do both factors influence the level of GDP per capita, but they also have a positive influence at the same time. This is partly in line with the theoretical analysis in the second section. In contrast to JUNGMITTAG (2006) – he refers to EU 15 countries (actually to EU 13) - it was not possible to show that specialization in high technology goods alone leads to a higher GDP per capita. Instead, it could be shown that specialization in itself - no matter in which sector - leads to positive growth effects. The same is true for the level of specialization. The highly significant coefficients for the MRCA lead to the conclusion that if a country is highly specialized in a sector and has gained a strong position in the EU 15 market, this position leads to further positive growth effects.

The findings concerning the export growth and the export unit values were less conclusive. If we take the insights gained from the analysis of the nominal data as the more reliable ones, it can be argued that a higher export growth only has positive growth effects in the EU 15 but not in the EU 10 countries. Exactly the opposite is true for the export unit values which only have positive growth effects in the EU 10 countries and not in the EU 15; this phenomenon might reflect the fact that EU 10 markets are more price elastic since there is less overall specialization in high technology; by contrast, Western European countries are partly strongly specialized in high-technology manufacturing production, where the demand e.g. for intermediate imports (and intra-EU 15 exports) will be less price sensitive than in standardized low-technology goods. If one interprets the export growth as a quantity indicator and the export unit values as quality indicators, it can be said that it is economically more important for the accession countries to build a base of quality exports before this export base is enlarged.

From those insights, it can be seen that it is important to foster specialization in a country with low or modest per capita income. Thus, one may argue in favor of a policy that fosters specialization to a fairly high degree in a way that a strong comparative advantage is built over the relevant market: This, of course, calls for strong competition policies and incentives in favor of Schumpeterian dynamics (read innovation in new products) that can fetch higher prices in international markets and process innovations that raise profits and, therefore, the ability to finance future innovations. It is important to support high technology specialization; this statement can be made despite the lack of detailed analysis in this paper of the spillover effects of high technology specialization. Furthermore, the government in the EU 10 countries should focus on policies that raise export quality. This could happen by implementing and enforcing EU competition policies and nurturing export growth in high-income countries, which offer competitive markets for high quality products. Adequate emphasis should also be given to policies against product piracy and copyright; patent acceptance in general. Future research will highlight the theoretical approaches presented here in more detail – with more sectors and more countries. We conclude that the EU single-market obviously generates incentives for structural specialization and output dynamics that are largely in line with modern economic analysis. Of particular interest are the partly distinct results for low-technology industries and high-technology sectors, respectively. We thus, conclude that more research on Schumpeterian dynamics within the EU will be useful.

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# Appendix

## Regression Results

### Table 4: Regression results for the EU 25 and all sectors (real data for RCAs)

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/10/07 Time: 02:13
Sample: 1997 2004
Included observations: 8
Cross-sections included: 499
Total pool (unbalanced) observations: 3962
Instrument list: c (log(mrcar?)-log(mrcar?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcargrow?-mrcargrow?(-1)) (releuv?(-1)-releuv?( -2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.018724 | 0.003701 | 5.058775 | 0.0000 |
| LOG(MRCAR?)-LOG(MRCAR?(-1)) | 0.011138 | 0.004430 | 2.514232 | 0.0120 |
| SPEZDUMMY? | 0.007446 | 0.003907 | 1.905512 | 0.0568 |
| EXGROW?-EXGROW?(-1) | -2.20E-05 | 4.09E-05 | -0.537190 | 0.5912 |
| MRCARGROW?-MRCARGROW?(-1) | -2.95E-06 | 1.08E-06 | -2.743715 | 0.0061 |
| RELEUV?(-1)-RELEUV?(-2) | 0.001730 | 0.002186 | 0.791342 | 0.4288 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.582849 | 0.019656 | 29.65210 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | -1.26E-05 | 6.28E-06 | -2.000976 | 0.0455 |

| | | | |
|---|---|---|---|
| R-squared | 0.417847 | Mean dependent var | 0.052386 |
| Adjusted R-squared | 0.416816 | S.D. dependent var | 0.156783 |
| S.E. of regression | 0.119730 | Sum squared resid | 56.68120 |
| Durbin-Watson stat | 1.669121 | Instrument rank | 8.000000 |

### Table 5: Regression results for the EU 25 and all sectors (nominal data for RCAs)

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/10/07 Time: 02:11
Sample: 1997 2004
Included observations: 8
Cross-sections included: 499
Total pool (unbalanced) observations: 3965
Instrument list: c (log(mrca?)-log(mrca?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcagrow?-mrcagrow?(-1)) (releuv?(-1)-releuv?(-2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.017554 | 0.003680 | 4.770630 | 0.0000 |
| LOG(MRCA?)-LOG(MRCA?(-1)) | 0.059133 | 0.008974 | 6.589366 | 0.0000 |
| SPEZDUMMY? | 0.008195 | 0.003889 | 2.107062 | 0.0352 |
| EXGROW?-EXGROW?(-1) | -0.001491 | 0.000259 | -5.753646 | 0.0000 |
| MRCAGROW?-MRCAGROW?(-1) | 0.001062 | 0.000201 | 5.285726 | 0.0000 |
| RELEUV?(-1)-RELEUV?(-2) | 0.002343 | 0.002160 | 1.084503 | 0.2782 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.577070 | 0.019700 | 29.29306 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | -1.08E-05 | 6.26E-06 | -1.718954 | 0.0857 |

| | | | |
|---|---|---|---|
| R-squared | 0.423539 | Mean dependent var | 0.052363 |
| Adjusted R-squared | 0.422519 | S.D. dependent var | 0.156733 |
| S.E. of regression | 0.119105 | Sum squared resid | 56.13412 |
| Durbin-Watson stat | 1.669247 | Instrument rank | 8.000000 |

**Table 6: Regression results for the EU 15 and all sectors (real data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/10/07 Time: 02:14
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 300
Total pool (unbalanced) observations: 2398
Instrument list: c (log(mrcar?)-log(mrcar?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcargrow?-mrcargrow?(-1)) (releuv?(-1)-releuv?( -2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.004562 | 0.004032 | 1.131388 | 0.2580 |
| LOG(MRCAR?)-LOG(MRCAR?(-1)) | -0.000930 | 0.004510 | -0.206264 | 0.8366 |
| SPEZDUMMY? | 0.009909 | 0.004190 | 2.364732 | 0.0181 |
| EXGROW?-EXGROW?(-1) | 0.005746 | 0.004924 | 1.166871 | 0.2434 |
| MRCARGROW?-MRCARGROW?(-1) | 1.55E-06 | 1.23E-05 | 0.126393 | 0.8994 |
| RELEUV?(-1)-RELEUV?(-2) | 0.000229 | 0.002223 | 0.102828 | 0.9181 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.309749 | 0.031171 | 9.937225 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | 1.68E-05 | 6.15E-06 | 2.725548 | 0.0065 |

| | | | |
|---|---|---|---|
| R-squared | 0.262405 | Mean dependent var | 0.026739 |
| Adjusted R-squared | 0.260245 | S.D. dependent var | 0.115274 |
| S.E. of regression | 0.099146 | Sum squared resid | 23.49340 |
| Durbin-Watson stat | 1.361070 | Instrument rank | 8.000000 |

**Table 7: Regression results for the EU 15 and all sectors (nominal data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/10/07 Time: 02:15
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 300
Total pool (balanced) observations: 2400
Instrument list: c (log(mrca?)-log(mrca?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcagrow?-mrcagrow?(-1)) (releuv?(-1)-releuv?(-2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.002864 | 0.004021 | 0.712166 | 0.4764 |
| LOG(MRCA?)-LOG(MRCA?(-1)) | 0.092135 | 0.017632 | 5.225560 | 0.0000 |
| SPEZDUMMY? | 0.009664 | 0.004145 | 2.331302 | 0.0198 |
| EXGROW?-EXGROW?(-1) | 0.104654 | 0.023091 | 4.532186 | 0.0000 |
| MRCAGROW?-MRCAGROW?(-1) | -0.124029 | 0.027675 | -4.481581 | 0.0000 |
| RELEUV?(-1)-RELEUV?(-2) | 0.006447 | 0.002346 | 2.748426 | 0.0060 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.314531 | 0.030929 | 10.16954 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | 2.24E-05 | 6.17E-06 | 3.631754 | 0.0003 |

| | | | |
|---|---|---|---|
| R-squared | 0.277159 | Mean dependent var | 0.026703 |
| Adjusted R-squared | 0.275044 | S.D. dependent var | 0.115235 |
| S.E. of regression | 0.098116 | Sum squared resid | 23.02705 |
| Durbin-Watson stat | 1.375736 | Instrument rank | 8.000000 |

**Table 8: Regression results for the EU 10 and all sectors (real data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/10/07 Time: 02:17
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 199
Total pool (unbalanced) observations: 1564
Instrument list: c (log(mrcar?)-log(mrcar?(-1))) spezdummy? (exgrow?
-exgrow?(-1)) (mrcargrow?-mrcargrow?(-1)) (releuv?(-1)-releuv?(
-2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.013781 | 0.010089 | 1.365988 | 0.1721 |
| LOG(MRCAR?)-LOG(MRCAR?(-1)) | 0.028356 | 0.009689 | 2.926648 | 0.0035 |
| SPEZDUMMY? | 0.003921 | 0.007569 | 0.517998 | 0.6045 |
| EXGROW?-EXGROW?(-1) | -2.74E-05 | 5.09E-05 | -0.539079 | 0.5899 |
| MRCARGROW?-MRCARGROW?(-1) | -3.74E-06 | 1.38E-06 | -2.715064 | 0.0067 |
| RELEUV?(-1)-RELEUV?(-2) | 0.002250 | 0.005146 | 0.437201 | 0.6620 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.680470 | 0.030912 | 22.01324 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | 2.43E-05 | 4.10E-05 | 0.592982 | 0.5533 |

| | | | |
|---|---|---|---|
| R-squared | 0.452055 | Mean dependent var | 0.091711 |
| Adjusted R-squared | 0.449590 | S.D. dependent var | 0.198390 |
| S.E. of regression | 0.147185 | Sum squared resid | 33.70813 |
| Durbin-Watson stat | 1.758510 | Instrument rank | 8.000000 |

**Table 9: Regression results for the EU 10 and all sectors (nominal data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/10/07 Time: 02:18
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 199
Total pool (unbalanced) observations: 1565
Instrument list: c (log(mrca?)-log(mrca?(-1))) spezdummy? (exgrow?
-exgrow?(-1)) (mrcagrow?-mrcagrow?(-1)) (releuv?(-1)-releuv?(-2))
(log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.016320 | 0.010024 | 1.628062 | 0.1037 |
| LOG(MRCA?)-LOG(MRCA?(-1)) | 0.050795 | 0.012480 | 4.070008 | 0.0000 |
| SPEZDUMMY? | 0.005895 | 0.007544 | 0.781418 | 0.4347 |
| EXGROW?-EXGROW?(-1) | -0.001459 | 0.000322 | -4.530711 | 0.0000 |
| MRCAGROW?-MRCAGROW?(-1) | 0.001050 | 0.000249 | 4.221664 | 0.0000 |
| RELEUV?(-1)-RELEUV?(-2) | -0.001803 | 0.005022 | -0.358958 | 0.7197 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.680257 | 0.030913 | 22.00546 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | 7.65E-06 | 4.06E-05 | 0.188699 | 0.8504 |

| | | | |
|---|---|---|---|
| R-squared | 0.457208 | Mean dependent var | 0.091712 |
| Adjusted R-squared | 0.454768 | S.D. dependent var | 0.198326 |
| S.E. of regression | 0.146444 | Sum squared resid | 33.39110 |
| Durbin-Watson stat | 1.767425 | Instrument rank | 8.000000 |

**Table 10: Regression results for the EU 25 and labor-intensive sectors (real data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/20/07 Time: 10:32
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 115
Total pool (unbalanced) observations: 911
Instrument list: c (log(mrcar?)-log(mrcar?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcargrow?-mrcargrow?(-1)) (releuv?(-1)-releuv?( -2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.000453 | 0.003748 | -0.120948 | 0.9038 |
| LOG(MRCAR?)-LOG(MRCAR?(-1)) | 0.007977 | 0.004240 | 1.881340 | 0.0602 |
| SPEZDUMMY? | 0.008929 | 0.003513 | 2.541326 | 0.0112 |
| EXGROW?-EXGROW?(-1) | -0.021644 | 0.013720 | -1.577504 | 0.1150 |
| MRCARGROW?-MRCARGROW?(-1) | 1.03E-05 | 9.63E-06 | 1.073937 | 0.2831 |
| RELEUV?(-1)-RELEUV?(-2) | 0.001489 | 0.012676 | 0.117449 | 0.9065 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.731409 | 0.021233 | 34.44669 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | -9.84E-06 | 5.93E-06 | -1.659500 | 0.0974 |

| | | | |
|---|---|---|---|
| R-squared | 0.729422 | Mean dependent var | 0.026895 |
| Adjusted R-squared | 0.727324 | S.D. dependent var | 0.093475 |
| S.E. of regression | 0.048811 | Sum squared resid | 2.151404 |
| Durbin-Watson stat | 1.098548 | Instrument rank | 8.000000 |

**Table 11: Regression results for the EU 25 and labor-intensive sectors (nominal data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/20/07 Time: 10:28
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 115
Total pool (unbalanced) observations: 913
Instrument list: c (log(mrca?)-log(mrca?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcagrow?-mrcagrow?(-1)) (releuv?(-1)-releuv?(-2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.001008 | 0.003704 | -0.272064 | 0.7856 |
| LOG(MRCA?)-LOG(MRCA?(-1)) | 0.111276 | 0.016536 | 6.729495 | 0.0000 |
| SPEZDUMMY? | 0.010807 | 0.003467 | 3.116971 | 0.0019 |
| EXGROW?-EXGROW?(-1) | -0.041501 | 0.015960 | -2.600254 | 0.0095 |
| MRCAGROW?-MRCAGROW?(-1) | -0.004040 | 0.021444 | -0.188379 | 0.8506 |
| RELEUV?(-1)-RELEUV?(-2) | -0.002679 | 0.012504 | -0.214259 | 0.8304 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.697095 | 0.022115 | 31.52111 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | -7.14E-06 | 5.85E-06 | -1.220402 | 0.2226 |

| | | | |
|---|---|---|---|
| R-squared | 0.736549 | Mean dependent var | 0.026802 |
| Adjusted R-squared | 0.734511 | S.D. dependent var | 0.093401 |
| S.E. of regression | 0.048126 | Sum squared resid | 2.096050 |
| Durbin-Watson stat | 1.096220 | Instrument rank | 8.000000 |

**Table 12: Regression results for the EU 25 and science-based and differentiated goods (real data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/10/07 Time: 02:20
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 117
Total pool (balanced) observations: 936
Instrument list: c (log(mrcar?)-log(mrcar?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcargrow?-mrcargrow?(-1)) (releuv?(-1)-releuv?( -2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.018726 | 0.008248 | 2.270434 | 0.0234 |
| LOG(MRCAR?)-LOG(MRCAR?(-1)) | 0.006680 | 0.011995 | 0.556897 | 0.5777 |
| SPEZDUMMY? | -0.000684 | 0.009482 | -0.072113 | 0.9425 |
| EXGROW?-EXGROW?(-1) | -0.000235 | 0.000815 | -0.288313 | 0.7732 |
| MRCARGROW?-MRCARGROW?(-1) | -3.53E-05 | 1.26E-05 | -2.805312 | 0.0051 |
| RELEUV?(-1)-RELEUV?(-2) | -0.002428 | 0.011462 | -0.211844 | 0.8323 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.699744 | 0.035403 | 19.76514 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | -1.80E-05 | 1.47E-05 | -1.219338 | 0.2230 |

| | | | |
|---|---|---|---|
| R-squared | 0.528994 | Mean dependent var | 0.069471 |
| Adjusted R-squared | 0.525441 | S.D. dependent var | 0.200933 |
| S.E. of regression | 0.138419 | Sum squared resid | 17.78039 |
| Durbin-Watson stat | 1.813439 | Instrument rank | 8.000000 |

**Table 13: Regression results for the EU 25 and science-based and differentiated goods (nominal data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/10/07 Time: 02:21
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 117
Total pool (balanced) observations: 936
Instrument list: c (log(mrca?)-log(mrca?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcagrow?-mrcagrow?(-1)) (releuv?(-1)-releuv?(-2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.014694 | 0.008239 | 1.783421 | 0.0748 |
| LOG(MRCA?)-LOG(MRCA?(-1)) | 0.144002 | 0.034059 | 4.227984 | 0.0000 |
| SPEZDUMMY? | -0.000780 | 0.009471 | -0.082388 | 0.9344 |
| EXGROW?-EXGROW?(-1) | 8.69E-05 | 0.006843 | 0.012706 | 0.9899 |
| MRCAGROW?-MRCAGROW?(-1) | -0.008644 | 0.026495 | -0.326248 | 0.7443 |
| RELEUV?(-1)-RELEUV?(-2) | -0.005588 | 0.011447 | -0.488168 | 0.6255 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.653971 | 0.037451 | 17.46212 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | -7.85E-06 | 1.49E-05 | -0.527414 | 0.5980 |

| | | | |
|---|---|---|---|
| R-squared | 0.529469 | Mean dependent var | 0.069471 |
| Adjusted R-squared | 0.525920 | S.D. dependent var | 0.200933 |
| S.E. of regression | 0.138349 | Sum squared resid | 17.76245 |
| Durbin-Watson stat | 1.730102 | Instrument rank | 8.000000 |

**Table 14: Regression results for the EU 15 and labor-intensive sectors (real data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/20/07 Time: 11:00
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 68
Total pool (unbalanced) observations: 542
Instrument list: c (log(mrcar?)-log(mrcar?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcargrow?-mrcargrow?(-1)) (releuv?(-1)-releuv?(-2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.005646 | 0.004158 | -1.357686 | 0.1751 |
| LOG(MRCAR?)-LOG(MRCAR?(-1)) | -0.001093 | 0.004093 | -0.267109 | 0.7895 |
| SPEZDUMMY? | 0.008300 | 0.004106 | 2.021300 | 0.0437 |
| EXGROW?-EXGROW?(-1) | -0.031443 | 0.032342 | -0.972178 | 0.3314 |
| MRCARGROW?-MRCARGROW?(-1) | 1.66E-06 | 8.97E-06 | 0.184752 | 0.8535 |
| RELEUV?(-1)-RELEUV?(-2) | -0.014573 | 0.012891 | -1.130533 | 0.2588 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.542962 | 0.034533 | 15.72318 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | -1.38E-06 | 6.06E-06 | -0.228084 | 0.8197 |

| | | | |
|---|---|---|---|
| R-squared | 0.563651 | Mean dependent var | 0.003067 |
| Adjusted R-squared | 0.557931 | S.D. dependent var | 0.066139 |
| S.E. of regression | 0.043975 | Sum squared resid | 1.032628 |
| Durbin-Watson stat | 0.813840 | Instrument rank | 8.000000 |

**Table 15: Regression results for the EU 15 and labor-intensive sectors (nominal data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/20/07 Time: 11:03
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 68
Total pool (balanced) observations: 544
Instrument list: c (log(mrca?)-log(mrca?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcagrow?-mrcagrow?(-1)) (releuv?(-1)-releuv?(-2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.007019 | 0.004285 | -1.637924 | 0.1020 |
| LOG(MRCA?)-LOG(MRCA?(-1)) | 0.042137 | 0.026862 | 1.568672 | 0.1173 |
| SPEZDUMMY? | 0.008360 | 0.004093 | 2.042782 | 0.0416 |
| EXGROW?-EXGROW?(-1) | -0.025706 | 0.038501 | -0.667670 | 0.5046 |
| MRCAGROW?-MRCAGROW?(-1) | -0.023562 | 0.036628 | -0.643269 | 0.5203 |
| RELEUV?(-1)-RELEUV?(-2) | -0.014464 | 0.012891 | -1.122082 | 0.2623 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.539204 | 0.034501 | 15.62863 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | 1.46E-06 | 6.33E-06 | 0.230620 | 0.8177 |

| | | | |
|---|---|---|---|
| R-squared | 0.562891 | Mean dependent var | 0.002999 |
| Adjusted R-squared | 0.557182 | S.D. dependent var | 0.066046 |
| S.E. of regression | 0.043950 | Sum squared resid | 1.035331 |
| Durbin-Watson stat | 0.810016 | Instrument rank | 8.000000 |

**Table 16: Regression results for the EU 15 and science-based and differentiated goods (real data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/20/07 Time: 11:01
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 70
Total pool (balanced) observations: 560
Instrument list: c (log(mrcar?)-log(mrcar?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcargrow?-mrcargrow?(-1)) (releuv?(-1)-releuv?( -2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.003623 | 0.008044 | -0.450320 | 0.6527 |
| LOG(MRCAR?)-LOG(MRCAR?(-1)) | -0.002737 | 0.011697 | -0.233975 | 0.8151 |
| SPEZDUMMY? | 0.000816 | 0.008794 | 0.092820 | 0.9261 |
| EXGROW?-EXGROW?(-1) | 0.086177 | 0.037413 | 2.303378 | 0.0216 |
| MRCARGROW?-MRCARGROW?(-1) | -4.50E-05 | 0.000104 | -0.432451 | 0.6656 |
| RELEUV?(-1)-RELEUV?(-2) | -0.013541 | 0.018897 | -0.716560 | 0.4739 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.653446 | 0.049255 | 13.26670 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | 1.13E-05 | 1.32E-05 | 0.858321 | 0.3911 |

| | | | |
|---|---|---|---|
| R-squared | 0.495445 | Mean dependent var | 0.028143 |
| Adjusted R-squared | 0.489046 | S.D. dependent var | 0.140212 |
| S.E. of regression | 0.100225 | Sum squared resid | 5.544829 |
| Durbin-Watson stat | 1.752409 | Instrument rank | 8.000000 |

**Table 17: Regression results for the EU 15 and science-based and differentiated goods (nominal data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/20/07 Time: 11:04
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 70
Total pool (balanced) observations: 560
Instrument list: c (log(mrca?)-log(mrca?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcagrow?-mrcagrow?(-1)) (releuv?(-1)-releuv?(-2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.011617 | 0.008029 | -1.446841 | 0.1485 |
| LOG(MRCA?)-LOG(MRCA?(-1)) | 0.318547 | 0.054670 | 5.826728 | 0.0000 |
| SPEZDUMMY? | -0.001157 | 0.008571 | -0.134950 | 0.8927 |
| EXGROW?-EXGROW?(-1) | 0.138589 | 0.053714 | 2.580110 | 0.0101 |
| MRCAGROW?-MRCAGROW?(-1) | -0.253240 | 0.078496 | -3.226142 | 0.0013 |
| RELEUV?(-1)-RELEUV?(-2) | -0.021032 | 0.018331 | -1.147338 | 0.2517 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.586656 | 0.052287 | 11.21996 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | 3.24E-05 | 1.36E-05 | 2.379247 | 0.0177 |

| | | | |
|---|---|---|---|
| R-squared | 0.521503 | Mean dependent var | 0.028143 |
| Adjusted R-squared | 0.515435 | S.D. dependent var | 0.140212 |
| S.E. of regression | 0.097602 | Sum squared resid | 5.258463 |
| Durbin-Watson stat | 1.707812 | Instrument rank | 8.000000 |

**Table 18: Regression results for the EU 10 and labor-intensive sectors (real data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/20/07 Time: 11:01
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 47
Total pool (unbalanced) observations: 369
Instrument list: c (log(mrcar?)-log(mrcar?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcargrow?-mrcargrow?(-1)) (releuv?(-1)-releuv?( -2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.011154 | 0.008672 | 1.286117 | 0.1992 |
| LOG(MRCAR?)-LOG(MRCAR?(-1)) | 0.066179 | 0.017281 | 3.829468 | 0.0002 |
| SPEZDUMMY? | 0.001356 | 0.006603 | 0.205279 | 0.8375 |
| EXGROW?-EXGROW?(-1) | -0.018808 | 0.017335 | -1.084950 | 0.2787 |
| MRCARGROW?-MRCARGROW?(-1) | -0.000248 | 0.000117 | -2.131893 | 0.0337 |
| RELEUV?(-1)-RELEUV?(-2) | 0.037434 | 0.030996 | 1.207734 | 0.2279 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.774257 | 0.034614 | 22.36840 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | -3.78E-05 | 3.21E-05 | -1.178352 | 0.2394 |

| | | | |
|---|---|---|---|
| R-squared | 0.777101 | Mean dependent var | 0.061893 |
| Adjusted R-squared | 0.772779 | S.D. dependent var | 0.114504 |
| S.E. of regression | 0.054581 | Sum squared resid | 1.075469 |
| Durbin-Watson stat | 1.286857 | Instrument rank | 8.000000 |

**Table 19: Regression results for the EU 10 and labor-intensive sectors (nominal data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/20/07 Time: 11:01
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 47
Total pool (unbalanced) observations: 369
Instrument list: c (log(mrca?)-log(mrca?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcagrow?-mrcagrow?(-1)) (releuv?(-1)-releuv?(-2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.017231 | 0.008654 | 1.991180 | 0.0472 |
| LOG(MRCA?)-LOG(MRCA?(-1)) | 0.141490 | 0.025146 | 5.626728 | 0.0000 |
| SPEZDUMMY? | 0.006147 | 0.006374 | 0.964499 | 0.3354 |
| EXGROW?-EXGROW?(-1) | -0.046166 | 0.019584 | -2.357378 | 0.0189 |
| MRCAGROW?-MRCAGROW?(-1) | 0.003693 | 0.028656 | 0.128858 | 0.8975 |
| RELEUV?(-1)-RELEUV?(-2) | 0.017018 | 0.030455 | 0.558806 | 0.5766 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.738293 | 0.035600 | 20.73862 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | -5.87E-05 | 3.09E-05 | -1.899817 | 0.0583 |

| | | | |
|---|---|---|---|
| R-squared | 0.787264 | Mean dependent var | 0.061893 |
| Adjusted R-squared | 0.783139 | S.D. dependent var | 0.114504 |
| S.E. of regression | 0.053323 | Sum squared resid | 1.026434 |
| Durbin-Watson stat | 1.299174 | Instrument rank | 8.000000 |

**Table 20: Regression results for the EU 10 and science-based and differentiated goods (real data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/20/07 Time: 11:03
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 47
Total pool (balanced) observations: 376
Instrument list: c (log(mrcar?)-log(mrcar?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcargrow?-mrcargrow?(-1)) (releuv?(-1)-releuv?( -2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.016909 | 0.024473 | 0.690932 | 0.4900 |
| LOG(MRCAR?)-LOG(MRCAR?(-1)) | 0.033464 | 0.030523 | 1.096340 | 0.2736 |
| SPEZDUMMY? | -0.005049 | 0.019981 | -0.252705 | 0.8006 |
| EXGROW?-EXGROW?(-1) | -0.000128 | 0.001073 | -0.118860 | 0.9055 |
| MRCARGROW?-MRCARGROW?(-1) | -3.47E-05 | 1.66E-05 | -2.087700 | 0.0375 |
| RELEUV?(-1)-RELEUV?(-2) | 0.002037 | 0.017001 | 0.119803 | 0.9047 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.669493 | 0.063284 | 10.57911 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | 8.83E-05 | 0.000105 | 0.837945 | 0.4026 |

| | | | |
|---|---|---|---|
| R-squared | 0.504141 | Mean dependent var | 0.131024 |
| Adjusted R-squared | 0.494709 | S.D. dependent var | 0.254973 |
| S.E. of regression | 0.181245 | Sum squared resid | 12.08866 |
| Durbin-Watson stat | 1.765296 | Instrument rank | 8.000000 |

**Table 21: Regression results for the EU 10 and science-based and differentiated goods (nominal data for RCAs)**

Dependent Variable: (LOG(PROD?)-LOG(PROD?(-1)))
Method: Pooled IV/Two-stage Least Squares
Date: 08/20/07 Time: 11:03
Sample (adjusted): 1997 2004
Included observations: 8 after adjustments
Cross-sections included: 47
Total pool (balanced) observations: 376
Instrument list: c (log(mrca?)-log(mrca?(-1))) spezdummy? (exgrow? -exgrow?(-1)) (mrcagrow?-mrcagrow?(-1)) (releuv?(-1)-releuv?(-2)) (log(prod?(-2))-log(prod?(-3))) (gdppc?(-1)-gdppc?(-2))
Cross sections without valid observations dropped

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.022102 | 0.024315 | 0.909009 | 0.3639 |
| LOG(MRCA?)-LOG(MRCA?(-1)) | 0.097527 | 0.051307 | 1.900855 | 0.0581 |
| SPEZDUMMY? | -0.003512 | 0.020060 | -0.175081 | 0.8611 |
| EXGROW?-EXGROW?(-1) | -0.005334 | 0.009401 | -0.567419 | 0.5708 |
| MRCAGROW?-MRCAGROW?(-1) | 0.012917 | 0.036455 | 0.354338 | 0.7233 |
| RELEUV?(-1)-RELEUV?(-2) | -0.003248 | 0.016839 | -0.192894 | 0.8471 |
| LOG(PROD?(-1))-LOG(PROD?(-2)) | 0.638359 | 0.065321 | 9.772698 | 0.0000 |
| GDPPC?(-1)-GDPPC?(-2) | 6.34E-05 | 0.000103 | 0.617896 | 0.5370 |

| | | | |
|---|---|---|---|
| R-squared | 0.498880 | Mean dependent var | 0.131024 |
| Adjusted R-squared | 0.489348 | S.D. dependent var | 0.254973 |
| S.E. of regression | 0.182203 | Sum squared resid | 12.21690 |
| Durbin-Watson stat | 1.697339 | Instrument rank | 8.000000 |

## Relative Price Dynamics in a Structural Analysis

Capital mobility has much increased between EU 15 and EU accession countries, and EU countries in Eastern Europe are as much to be characterized as market economies with profit-maximizing firms as are countries in Western Europe. In a nutshell this implies

- that we have in each country equality of the marginal product of capital $Y_K$ and the real interest rate r
- that marginal products are equal across countries $Y_K = Y_K*$
- that the interest parity will hold (driven by portfolio capital flows) so that in a simplified perfect foresight setup the nominal interest rate is $i = i* + dlne/dt$

Considering that $i = r + \pi$ ($\pi$ is the inflation rate) and that $i* = r* + \pi*$ the implication of these three conditions is that $\pi - \pi* = dlne/dt$ so that the purchasing power parity must hold in the relative form $P = \lambda eP*$ where $\lambda$ is a parameter which expresses such influences as transportation costs and differences in product quality. For ease of exposition we will assume for both countries considered a constant velocity (V in the home country and V* in the foreign country) so that the price level P is determined according to the quantity equation in the most basic form:

(20) $P = [M/Y]\ V$

(21) $P* = [M*/Y*]\ V*$

Output can be split in both countries into tradables (T-goods) and nontradables (N-goods) which both are produced according to a Cobb-Douglas production function which reads for country I:

(22) $T = f(A',L',K') = A'L'^{\alpha'}K'^{\beta'}$

(23) $N = h(A'',L'',K'') = A''L''^{\alpha''}K''^{\beta''}$

If factors are rewarded according to the marginal product rule we have (with $\Omega$ denoting average sectoral labor productivity):

(24) $W'/P' = \partial f/\partial L = \alpha'\Omega'$

(25) $W''/P'' = \partial h/\partial L = \alpha''\Omega''$

We may assume that labor within each country is relatively mobile – but not perfectly mobile – so that $W' = (1 + \omega)W''$ where $-1 < \omega < 1$. Typically the parameter $\omega$ will be positive if one assumes that the best workers have been attracted by the tradables sector. The latter might be partly reflecting efficiency wage effects. Dividing one product wage equation by the other we get after taking logarithms:

(26) $\ln(P''/P') = \ln(\alpha'/\alpha'') + \ln(\Omega'/ \Omega'') + \omega + 1$

Next we define – with $\varphi$ denoting the share of expenditures falling on tradables - the aggregate price level as follows:

(27) $P = P'\varphi P''(1 - \varphi)$

Therefore we have

(28) $\ln P = \varphi \ln P' + (1 - \varphi)\ln P''$

Combining the equation $\ln(P''/P') = \ln(\alpha'/\alpha'') + \ln(\Omega'/\Omega'') + \omega + 1$ with the definition of the price level (in logarithms) we get

(29) $\ln P = \ln P'' - \varphi(\ln(\alpha'/\alpha'') + \ln(\Omega'/\Omega'') + \omega + 1)$

Abroad we have

(30) $\ln P'^* = \ln P^* - \varphi^*(\ln(\alpha'^*/\alpha''^*) + \ln(\Omega'^*/\Omega''^*) + \omega^* + 1)$

Taking into account $\ln P = \ln(eP)$ – that is we have set $\lambda = 1$ and solving for the tradables price $\ln P'$ gives for the home country:

(31) $\ln P' = \ln(eP^*) - \varphi(\ln(\alpha'/\alpha'') + \ln(\Omega'/\Omega'') + \omega + 1)$

The tradables price is a positive function of $eP^*$, domestic velocity and the wage premium in the tradables sector; and a negative function of the relative output elasticity ratio and the relative productivity ratio. Assuming a constant wage premium parameter $\omega$ we can state: The tradables price will not rise if the growth rate of wages is in line with productivity growth in each sector while productivity growth rates are identical in both sectors.

Subtracting $\ln P'^*$ from $\ln P'$ while assuming $\varphi = \varphi^*$ and taking into account the quantity equation abroad we get an expression which explains the aggregate relative export unit value

(32)
$$\ln[P'/(eP'^*)] = -\ln[M^*/Y^*] + \ln(V/V^*) - \varphi[\ln(\alpha'/\alpha'') - (\alpha'^*/\alpha''^*)] - \varphi[\ln(\Omega'/\Omega'') - \ln(\Omega'^*/\Omega''^*)] + \varphi[\omega - \omega^*]$$

The implication is that the relative tradables price is a negative function of the ratio $M^*/Y^*$, a positive function of $V/V^*$, a negative function of the relative output elasticitys of labor $[\ln(\alpha'/\alpha'') - (\alpha'^*/\alpha''^*)]$ and a negative function of the international relative productivity differential; and a positive function of the international tradables wage premium ratio. A fall of the relative export unit value could particularly reflect a sectoral wage premium which grows faster abroad than at home.

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