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Vertical Product Differentiation in International Trade: An Econometric Investigation

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Abstract

This paper presents a detailed econometric investigation of vertical product (i.e. quality) differentiation in EU markets. Use is made of trade statistics at the most detailed (8-digit CN) level to analyse the pattern of quality positioning in EU trade (of EU members and non-EU countries). Two different `quality indicators' are devised: one refers to the relative representation of producers in different quality segments in EU markets, the other amounts to the compilation of industry-level price gaps. Evidence is found for dramatic and rather stable hierarchical structures in the product qualities supplied by different national producers. The quality hierarchies are then related to a host of supply-side variables: wage rates, productivity levels, industrial research and development spending, exchange rate movements. The econometric analysis supports a rather robust explanatory framework relating the quality positioning of national producers to their relative supply-side characteristics.

Keywords: Vertical product differentiation, international trade, quality competition, EU markets

JEL classification: C23, F12, O31, O32

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Vertical Product Differentiation in International Trade: An Econometric Investigation

1 Introduction: Theory and empirical research on vertical product differentiation

The analysis of vertical differentiation in product markets has developed quite rapidly over the past two decades. Horizontal product differentiation, i.e. the differentiation in terms of 'varieties' of the same basic product which might *per se* be considered desirable by consumers, is still the dominant form of product differentiation considered (possibly because of the influential and convenient formal specification of the demand side by Dixit and Stiglitz, 1977). However, there is also a growing body of literature, both theoretical and empirical, which considers the issue of differentiation of product varieties with a clear hierarchy of qualities. The early theoretical literature analysed vertical product differentiation in oligopolistic market environments in which the number of qualities supplied and the positioning of producers over these qualities are a function of income differentiation on the demand side and of cost function parameters (see Shaked and Sutton, 1982; Gabszewicz and Thisse, 1979). In this model context, trade could affect the types and numbers of qualities supplied (see Gabszewicz et al., 1981). The static trade framework could be extended by considering differences in the factor input requirements across the different product qualities and this would then give rise to intra-industry specialization structures between different economies endowed with different factor proportions very much along Heckscher-Ohlin lines (see Falvey and Kierzkowski, 1987).

The next reappearance of the issue of vertical product differentiation came in the context of models which attempted to endogenize research and development spending leading to product development. Again, in principle, product development could be of two types: a widening of the product spectrum available (horizontal differentiation) or 'improvements' of product qualities (vertical differentiation). The latter aspect was particularly useful to grasp analytically an aspect of economic dynamics, namely Schumpeter's notion of 'creative destruction'. The 'destructive' aspect of product development – particularly in the hierarchical structure of vertical product differentiation – comes about because higher product qualities can fully or partially capture the markets of 'lower-quality' products. Given the monopolistically competitive structure of product markets, this would lead to a 'capital loss' for the inventor of the lower-quality product who had incurred substantial fixed costs for the invention and introduction of his/her product. If the inventor of the new product is different from the inventor of the older product, this capital loss amounts to an externality which the invention and introduction of a new, better-quality product entails; if the inventor is the same, then it implies a negative spillover effect from the new to the old product. In the first case, the externality gives rise to an incentive to invest into product development above the socially optimal level. In most models (see Aghion and Howitt, 1992, who built in turn on Judd, 1985), the new, higher-quality variety captures the entire market from the older, lower-quality variety. We shall return to this issue below when we discuss the problems which arise for our empirical work from the current state of theoretical research in this area.

The 'creative destruction' mechanism has been used to model some aspects of economic fluctuations (Aghion and Howitt, 1992), and also in endogenous growth models which converge to a steady-state path (Stokey, 1988). In the latter form, the model of endogenous vertical product differentiation has also been applied to deal with the growth of economies which are open to international trade and multinational investment (see Grossman and Helpman, 1991a,b; Dinopoulos et al., 1993). In these trade and growth models, the focus has been on two things: one, that the rate(s) at which new products are being invented and introduced in both the leading and lagging economies govern(s) the overall rate(s) of (endogenous) economic growth; two, that the relative allocation of productive factors across three different types of activities/sectors is determined by the relative endowment structures of the different trading economies. The three sectors are: a R&D sector in which new products/new qualities are being invented; a high-tech sector in which differentiated (high-tech) products are being produced; and a (low-tech) sector which produces a homogenous product and where no quality improvements take place. A steady-state growth global equilibrium will have Heckscher-Ohlin features in which the economy which is relatively better endowed with human capital will be specialized on the invention of new products (the most human-capital intensive activity) and the production of high-tech products (the next most human-capital intensive activity), while the economy endowed with relatively less human capital will specialize in producing and exporting the homogenous product and – if it also produces high-tech products – will have a negative trade balance in high-tech products. Transitional dynamics for these models have been conjectured but mostly not worked out properly. The models have been extended to the cases in which one country (the follower) does not invent new products but participates in global technical progress through imitation; imitation and invention rates (in the technological lead economy) will then be jointly determined and determine the steady-state growth rates of the two economies.

One of the main problems we have with the current state of the endogenous growth literature with vertical product differentiation from the point of view of our study is that the industrial organization equilibrium is characterized in these models as Bertrand-Nash with limit-pricing behaviour by the supplier of the superior-quality (state-of-the-art) product. This means that, at the point of entry of a new, superior-quality variant, the inferior-quality product sees its market share fall to zero and drops out of the market. This feature goes against much of the empirical evidence (including our own) which shows that a range of different qualities maintain positive market shares and, furthermore, that such distributions are rather persistent.

There are a number of ways in which one can account for the persistence of a range of qualities and the persistent presence of high-, medium- and low-quality producers in different product markets: one is the differentiation of the demand side, as discussed in the early literature reviewed above (Gabszewicz et al., 1981; Falvey and Kierzkowski, 1987); there, stable structures of income distributions (and hence of abilities to pay) lead to the continued presence of high- and lower-quality variants on product markets; another approach could simply be the 'love for quality variety'[1] by the same types of consumers (implicitly, this is what Smith, 1997, formal specification of the demand side implies).

There could also be a dynamic constellation in which 'followers' (i.e. non-state-of-the-art quality producers) are continuously benefiting from positive technological spillovers arising from the invention of top-quality products. That is, one could imagine a situation in which the invention of a new top-quality product cheapens the invention costs (or production costs) of a somewhat inferior-quality product. This can lead to a continued presence (and invention) of lower-quality products (and producers) which are one-step, two-steps, etc. behind the state-of-the-art producer/inventor. [Other possible models: product cycle and model with a spectrum of firms in each country.]

In our applied work, we shall try to obtain a picture of the degree and pattern of vertical product differentiation in international trade. We shall be restricted to the information contained in *trade statistics* which, of course, has the disadvantage of only giving a partial view of product markets but has, on the other hand, the advantage that trade statistics are available at a level of detail which is not normally the case with production or sales statistics. We shall be using Eurostat's trade statistics at the most detailed, 8-digit CN (Combined Nomenclature) product level. At this level about 10,000 manufactured products are distinguished, with information available for quantities sold and sales prices for the different countries' suppliers. At this level of detail we can be more confident that unit price comparisons are more reliable in revealing quality differences than at higher levels of aggregation where products are no longer so narrowly defined and differences in composition dominate the picture. Our concern will be with *intra-branch* (vertical) *product differentiation.* In particular the sample for the econometric study will be made up of 20 3-digit NACE[2] engineering industries (see Appendix Table A.2).

The structure of the paper is as follows: in section 2 we explain the 'quality indicators' constructed on the basis of the detailed trade statistics and we present a preliminary picture of the pattern of product

[1] By 'love for quality variety' we mean a situation in which the same consumer prefers to purchase a range of qualities as compared to purchasing just one quality which is regarded as the quality with the lowest quality-adjusted price. Examples for this type of behaviour could be that a person would like to have a range of suits available for different occasions, i.e. Sunday suits, everyday work suits, etc. even if he has to pay some premia (in terms of a slightly higher than the quality-adjusted price) for some of the items in his 'portfolio of differentiated qualities' to satisfy his 'love for quality variety'.

[2] 3-digit NACE refers to Eurostat's detailed industrial classification, distinguishing amongst about 100 manufacturing branches.

differentiation in EU markets. The quality indicators introduced in section 2 then serve as the dependent variables in the econometric work presented in section 3. Section 3 analyses the determinants of the positions of different producers in vertically differentiated product markets. Section 4 presents some conclusions and reports on further research plans.

2 Quality differentiation in EU markets

2.1 Two types of 'quality indicators':

In this section of the paper, we shall explain the construction of two types of 'quality indicators'. As indicated in the previous section, the database used for the construction of the quality indicators (which will serve as the dependent variables for the econometric analysis in section 3) is *Eurostat's Detailed Trade Statistics* which contain detailed information on trade values and volumes at the 8-digit CN (Combined Nomenclature, 6-digit NIMEXE before 1992) product level of trade to and from EU countries. We used this database to analyse the pattern of quality differentiation in intra-branch trade for some selected industries.

1. *The 'price/quality gap' (PG) indicator:*

   The price/quality gap (PG) indicator is a (weighted) average of the ratios at which a particular (national) producer sells the products on EU markets as compared to the prices charged by the mix of his/her competitors in a particular branch. To construct the PG indicator for a particular (3-digit NACE) industry we first calculated product prices (value per kg) at the detailed product level (i.e. for all the 8-digit product items belonging to that industry) across the whole range of competitors in EU markets (more precisely, in total EU imports including intra-EU trade). The industry-level 'price/quality gap indicators' (PG_j^c) were then constructed by taking the ratios of a particular country's product prices relative to the average EU import prices and aggregating these price ratios for an individual 3-digit NACE industry j, using the different products' shares in a country's exports to the EU as weights.

   Formally, the *industry-level (weighted) price/quality gap indicator* was arrived at as:

   $$PG_j^c = \sum_{i \in I(j)} \left(\frac{p_i^c}{p_i^{eu}} \right) \cdot \chi_i^c$$

   where p_i^c is the price (per kg) at which country c sells exports of the product item i on EU markets (refers here to the EU 12 market); p_i^{eu} is the average price of product item i in total EU 12 imports; χ_i^c is the share of product item i in country c's exports to the EU 12 market.

   We have

   $$\sum_{i \in I(j)} \chi_i^c = 1$$

   where $I(j)$ is the set of product items i belonging to NACE industry j.

   To minimize the effects of those errors in the data which show up in extreme outlier positions (at this level of detail the trade statistics contain errors which can distort the overall result), we attempted to detect these and remove them. For the calculations with product data for the 3-digit industries we tried to solve the problem as follows: For each country and year the mean and standard deviation of the price ratios to the EU import price were calculated considering all products assigned to a certain industry. A product was then identified to be an extreme outlier if its price ratio compared to the EU import price exceeded the above-mentioned mean plus three times the standard deviation. After the removal of outliers detected in this way the sum of the weights (export shares) had to be corrected to add up to unity again[3].

[3] The removal of the distorting effects of outliers was crucial to obtain reliable results. Many previous studies using unit prices at a more aggregate level do suffer from the fact that the disaggregated data from which the more aggregate figures were derived had not been checked for major punch-in mistakes.

It should be noted that the product level price comparisons were made using current ECU prices derived from EU import data. The results of our study will show that, over the years, the price gap variables do not shift dramatically (with some exceptions) in spite of rather enormous exchange rate fluctuations for some of the economies. We take this as support for (mostly) price-taking behaviour of producers given the quality of their products.

2. *The positioning of producers in different quality segments (the QS^i indicators):*

   The QS^i indicators reveal the biases in the compositions of different country's exports within a particular branch towards high-, medium-, and low-quality segments of the product spectrum traded in that branch. To calculate the QS^i indicators we proceeded as follows: We first ranked individual product items within a particular 3-digit NACE industry by the prices per kg which they fetch *on the EU import market as a whole* (including intra-EU trade). Once these products had been ranked in descending order, we demarcated three quality segments (Q^I comprising the more highly priced items, Q^{II} the medium priced items and Q^{III} the least priced items). Once such quality segments were defined within each 3-digit NACE industry, we could compare the degrees to which the different national exporters' product structures fell into these different quality segments. This was simply done by taking the ratios of the shares of the value of Q^i ($i = I, II, III$) products in a particular country's exports to EU markets relative to the value of the Q^i products in total EU imports (around one third of total EU imports within this industrial branch[4]). The indicators thus showed the extents to which a country's exports belonged respectively to the 'high-', 'medium-' and 'low-quality' segments of the product spectrum traded on EU markets within this branch.

$$QS_j^{i\,c} = \frac{\chi_j^{i\,c}}{\chi_j^{i\,eu}}$$

   where $\chi_c^{i\,c}$ and $\chi_j^{i\,eu}$ ($i = 1, 2, 3$) refer, respectively, to the shares of Q_j^i (i = I high-quality, i = II medium-quality, i = III low-quality) products in country c's exports and in total EU imports within industry j:

$$\chi_j^{i\,c} = \sum_{k \in Q^i(j)} \chi_k^c \qquad \chi_j^{i\,eu} = \sum_{k \in Q^i(j)} \chi_k^{eu} \qquad i = I, II, III.$$

   The QS^i indicators (being ratios) spread around 1.0.

2.2 A preliminary examination of the pattern of vertical product differentiation in EU markets

In the following we shall review the pattern of vertical product differentiation in EU trade which emerges from the calculations of the two quality indicators defined above.

2.2.1 Price/quality gaps:

In Figure B.1 we can see an example of the calculation of price/quality gap indicators for a range of economies for one NACE industry (NACE 32 mechanical engineering). As described above, indicators have been scaled so that they take on the value of 1.0 for total EU imports; values below 1.0 imply that a particular country sells its (weighted) commodity basket on EU markets within that industry at a price below the average of total EU imports (including intra-EU trade); the opposite is true for values above 1.0.

[4] For EU total imports within each 3-digit NACE industry, each quality segment should in principle comprise one third of the total value of imports of the EU 12 (including intra-EU trade) in the respective year; this is how we attempted to construct the product quality segments. However, it is in general not possible to achieve this value precisely because of the need to cut off before the product that causes the cumulative value to exceed a third of the total EU import value. Because of this problem (linked to the discrete number of products belonging to each quality segment) the demarcation of the segments therefore differs from year to year and industry to industry (i.e. they do not neatly lead to segments accounting each for exactly one third of total EU imports within each industry). By taking the share ratios $QS_j^{i\,c}$ ($i = I, II, III$; see below), however, a comparison across countries and industries was possible.

The following general results emerge from an inspection of these indicators for a range of industries (the industries we examined were engineering industries, textiles, clothing and leather products and food, drinks and tobacco; see Landesmann and Burgstaller, 1997, for details):

- There seems to be something of an EU market integration effect, i.e. EU members sell broadly at lower prices on EU markets than comparable countries such as the (ex-)EFTA countries Austria, Switzerland and the Scandinavian countries.

- There might be some evidence of an impact of high/low values of exchange rates, such as indicated by the very high values for the price/quality variables for Japan and Switzerland; however, there is mostly remarkable stability of the indicators over the years, particularly in the case of most of the Central and Eastern European countries (CEECs) which experienced dramatic exchange rate movements over the period.

- From the inspection of the figures (and similar figures for other 2- and 3-digit industries) we can observe a pattern of 'product quality' ranking in line with one's priors as regards the stages of economic development associated with the different economies. The advanced industrial economies (with the additional factor of the EU integration effect) stick out as the economies with the highest values for the 'quality gap' indicator, followed by the Southern European economies, then the NICs and then the CEECs and the lowest quality producing developing countries such as India and China (see footnote 6 below for a definition of the membership of the different country groups). We shall give more systematic statistical substance to this observation below.

We move on to report results from a first simple (descriptive) cross-industry regression analysis: Here we used the calculated price/quality gap indicators for the full range of engineering industries (20 NACE 3-digit industries[5]; see Appendix Table A.2), then calculated three-year averages for the periods 1988-90 and 1992-94 and regressed these simply on country (or country group) dummies[6]. These regressions provide an overview of the significance of price/quality gaps across the range of 3-digit NACE industries considered. Comparisons across the two periods (1988-90 and 1992-94) show, furthermore, interesting shifts in the performances of the different countries or country groups. Tables A.3 and A.4 give the results for these and the following regressions reported in this section.

Figure B.2 plots the estimated coefficients on the country dummies for the groups of engineering industries for the two periods 1988-90 and 1992-94. We can clearly see the hierarchical range of different quality producers and this range conforms to our expectations. We can see the industrially advanced economies with (mostly) positive coefficient estimates for the prices they fetch on EU markets (always in relation to the EU average import prices) - they are significant at the 5% level only for the USA, Japan, Switzerland and Sweden -, then moving to moderately negative coefficient estimates for Italy, Spain and Portugal, the NICs1 and NICs2 (for the former insignificant at the 5% level and for the latter two, significant only in the earlier period), to the group of distinctly low-quality producers comprising some Southern European economies (Greece, Turkey), all of the Central and Eastern European economies, as well as China and India; for this group of low-quality producers highly significant negative parameter estimates were obtained.

[5] The transport equipment industries were excluded from this sample because of the dominance of single product items in the trade structures of some of the branches.

[6] The specifications of these regressions amount to $\log PG^c_{j\,t} = \alpha^c_t \cdot dummy^c + \varepsilon^c_j$ which were estimated over countries (or country groups) c and across industries j belonging to a particular industry group (such as engineering or textiles, clothing and leather products) and for time periods $t = 88-90$ and $92-94$ (i.e. three-year averages). Log PG refers to the dependent variable, the log of the price/quality gap variable; ε^c_j refers to the usual randomly distributed stochastic term; see Tables A.3 and A.4 for the results for two groups of industries, the engineering industries and textiles, clothing and leather products. The same specification was used further on for the QS^i quality segmentation variables. At the bottom of the two tables are estimates for country groups, which comprised: EUN (Northern countries of the European Union except Ireland but including Italy), EUS (Southern EU countries – Spain, Portugal and Greece), EFTA (with Switzerland, Austria, Sweden and Finland), EASTW (a group of 'Western' CEECs – CSFR/Czech Republic, Hungary, Poland, Yugoslavia/Slovenia), EASTE (a group of 'Eastern' CEECs – Bulgaria, Romania, Slovakia for the period 1992-94 and the Soviet Union/Russia) and the NICs (NICs1 comprising Hong Kong, Singapore, South Korea and Taiwan; NICs2 comprising Indonesia, Malaysia, Philippines and Thailand).

Important and interesting are the developments of the countries of Central and Eastern Europe (CEECs) from the base period 1988-90 to 1992-94: We can clearly see a bifurcation into two groups: the group of 'Western' CEECs (comprising the Czech Republic, Hungary, Poland and Slovenia) and the group of 'Eastern' CEECs (comprising Bulgaria, Romania, Russia and Slovakia); the former group experiences a distinct improvement in their positions while the latter group is further falling behind. This can be clearly seen from the estimates presented for country groups in Figure B.3 (EASTW stands here for 'Western CEECs', EASTE for 'Eastern CEECs').

2.2.2 Product quality segmentation:

We start again with an example for the relative representation of different national producers in the high-, medium-, and low-quality product segments of a particular industry. Figure B.4 presents a chart for NACE industry 342 (electrical machinery). If all three bars for a particular country were of equal size (.333) then the products belonging to the different quality segments (Q^I for high-, Q^{II} for medium-, Q^{III} for low-quality segments) would be represented in a country's exports to the EU in exactly the same proportions as they are represented in total EU imports (including intra-EU trade). Bars below that value would indicate an 'under-representation' of a country's exports in this quality segment, bars above that value would show an 'over-representation'. Over the range of countries and country groups depicted, we can see that the CEECs belong to a small set of countries (such as Turkey and China) which mostly exports electrical machinery products in the lowest quality segment; alternatively, there is a very strong under-representation in the high-quality segment of EU product markets.

As we can see from Figure B.4, individual industries can throw up some unreliable results which, however, get washed away if one pools the information over a set of 3-digit NACE industries. Thus we move again to reporting some simple, descriptive regressions estimating country dummy coefficients to find evidence for significant under- or over-representation of a country's exports in particular product quality segments. We focus on the high-quality segment and, again, on the range of engineering industries (for the results of these estimations, see again Tables A.3 and A.4).

Figures B.5 and B.6 show again the estimated dummy coefficients for the different suppliers to the EU market in the form of a bar chart; negative bars indicate an under-representation, positive bars an over-representation (always relative to the overall structure of EU imports) in the high-quality segments of EU engineering products. We can see – confirming our analysis of the quality gap indicators above – that the Central and Eastern European producers have significantly extended the range of countries situated at the low-quality end of EU engineering imports. Similar results could be found for the other industries (textiles, clothing and footwear and food and drinks) which we examined (see Landesmann and Burgstaller, 1997, for details).

2.2.3 Quality positioning and GDP per capita

The final descriptive information we want to offer in this section are plots of the estimated coefficients for the dummy variables for both sets of regressions against GDP per capita (in PPP)[7]. We can see from Figures B.7 and B.8 that the ranking of countries in terms of GDP per capita relates well with the country dummies estimated for the two sets of equations; the under-/over-representation of a country's exports in the high-quality segment and the size of its positive or negative price gap. Again, we can see the order of magnitude of the shifts in the estimated dummy coefficients over the two periods, 1988-90 to 1992-94 (GDP per capita was held constant).

We summarize the two most important findings of our preliminary statistical analysis so far:

- The evidence suggests a clearly marked pattern of vertical product differentiation in EU product markets insofar as this could be revealed with the partial data set on trade flows (including intra-EU trade) in the EU markets.

[7]The GDP per capita figures for the Western countries and LDCs were taken from the Summers and Heston database, those for the CEECs from the Vienna Institute's (WIIW) database.

- There is some casual evidence that the ranking of a country's position in these vertically differentiated product markets is linked to its stage of economic development in general (as measured by GDP per capita).

3 Econometric analysis of the determinants of producers' locations in vertically differentiated product markets

3.1 Specifications

In the following we shall report the results of our analysis of the determinants of producers' positions in quality-differentiated product markets. The dependent variables in our analysis are the two types of 'quality indicators' discussed in the previous section of the paper: one refers to the relative presence of the countries' producers in the high-, medium-, or low-quality segments of specific industrial product markets; we shall focus on the relative representation in the highest quality segment (the variable QS^I). The other indicator is the (weighted) price gap variable PG.

As we shall see below, the specifications used to determine the pattern of quality differentiation in trade will differ somewhat depending upon which of the two types of quality indicators we shall use.

In general, the following explanatory variables have been used: *relative labour unit costs*, decomposed into *relative compensation rates per worker* (referred to as 'wages' in short) and *(labour) productivity levels* (referred to as 'productivity') as well as *relative R&D intensity* (measured as a stock of R&D[8]. per unit of constant price value added).

The above variables have always been constructed as 'relative' variables, i.e. a country's labour compensation rates, productivity levels, R&D intensities relative to the group of competitors whereby the competitors' values were calculated as weighted averages, with the competitors' weights being their export shares in the particular industry. To derive relative variables they had to be compared in a common currency and, mostly, the rates used for this comparison were international PPP (purchasing power parity) rates. The reason for using these rates was that we were interested in analysing the relationships between longer-run developments in relative labour compensation rates, productivity levels and technology intensity, undistorted by short-run exchange rate fluctuations, on the one hand, and product quality, on the other hand. In those cases in which all the above variables were expressed in PPP terms, another variable was added to explain the pressures which shorter-run (or longer-run) *deviations of current exchange rates from PPP rates* could put on the relative price gaps of traded products and on the quality compositions of these products.

Let us explain now the reasons for the inclusion of the above explanatory variables and what our priors were concerning the directions in which they would affect the dependent variables. This is best discussed separately with respect to each of the dependent variables, i.e. QS^I and PG.

1. *The specifications of the regressions determining the positioning in the different quality segments (QS^I):*

   The following functional specifications were used for determining the relative positioning of different producers in the different quality segments of the product spectra traded in the different industries:

   (a) constant elasticity (log-log) form:

$$\ln QS^I = \underset{(+)}{\beta_1 \ln wages_{ex}} + \underset{(+)}{\beta_2 \ln prod_{pp}} + \underset{(+)}{\beta_3 \ln R\&D_{pp}} + D_c + D_j$$

   (b) semi-log (log-lin) form:

[8]The R&D ('knowledge') stock has been constructed from R&D expenditure flow data by perpetual inventory method with an assumed linear yearly depreciation rate of .2 (see also Coe and Helpman, 1995, and Landesmann and Pfaffermayr, 1997).

$$\ln QS^I = \beta_1 wages_{ex} + \beta_2 prod_{pp} + \beta_3 R\&D_{pp} + D_c + D_j$$
$$\quad (+) \qquad\qquad (+) \qquad\qquad (+)$$

The subscripts *ex* and *pp* indicate whether the variables are expressed in current exchange rates or in purchasing power parities. D_c and D_j denote country and industry dummies respectively (see Table A.1 and Table A.2, respectively, for the countries and industries included in the different panel estimations); *wages, prod, R&D* refer respectively to the compensation rates, productivity levels and R&D intensities, all relative to the values of a weighted average of competitors. In brackets underneath the regressors are the expected signs of the estimated parameters (considering as dependent variable QS^I, i.e. the representation in the top-quality segment).

Let us first deal with the reasons for the inclusion of the explanatory variables and then with the choice of functional forms.

All the three variables, relative compensation rates, relative labour productivity levels and relative R&D intensity, are seen in this model – as long-run variables – to be proxies for differences either in the input structures or in the levels of the technologies used by different producers. Higher/lower compensation rates reflect in the longer run a different composition of the workforces (a higher or lower share of skilled workers) and/or higher/lower labour productivity levels because of a larger/smaller amount of complementary inputs. Differences in labour productivity levels can again reflect differences in the skill composition of the labour forces and in the degrees to which the workforces are equipped with complementary types of inputs. Differences in R&D intensities are – in this model – in the first instance indicators of differences in the degree to which different firms are capable of inventing and/or producing higher-quality products. As output measures (at constant prices) are not adjusted for quality improvements, this should not affect labour productivity levels; it would however affect the remuneration of employees.

Between the first two variables, wage rates and productivity levels, one can expect a close relationship and we have used an instrumental variables approach to deal with the potential interrelationship between these two explanatory variables[9]. Furthermore, while we have argued that product quality improvement might not get reflected in productivity levels (measured at constant prices), R&D activity is also directed at process innovation and not only product innovation and this would affect productivity levels. Hence, one could expect some relationship between R&D activity and productivity. Here again we have attempted to deal with this relationship between the explanatory variables by adopting an instrumental variables approach.

Finally, in the quality segment (QS^I) regressions we have used the compensation rate variable measured at current exchange rates rather than PPP rates. This means that it combines longer-run determinants of compensation rates (such as changes in the skill composition) with short-run cost pressures which could result from a temporary overvaluation of the exchange rate or from other short-term pressures on the wage rates. However, both these two factors, improvements in the skill-composition of the labour force, or pressures of higher wage rates, should affect the dependent variable in the same direction: one acts as a facilitator and the other as a cost pressure to improve relative product quality.

We should also mention an important difference between the two dependent variables (QS^I and PG): changes in the price gaps are the result of up-grading the quality within a narrowly specified product category, while changes in the representation in the different quality segments means that a producer has changed the product programme across product categories and, indeed, across quality segments. One would expect the latter to be more affected by the type of variables which initiate important changes in the process- and product-technologies of a firm (or in the mix of firms making up a national industry); it is therefore in the quality segment regressions that we would most expect an impact of changes in relative R&D intensities.

[9] However, if the IV approach was not successful as a result of weak instruments, we proceeded by omitting one of the two variables as explained below.

As to the two different functional specifications (1a) and (1b) above, the log-log specification (1a) assumes constancy in the percentage effects which changes in the explanatory variables would have on the quality composition variable. One could, however, also argue that improvements in relative R&D or capital intensity, or increased relative wage pressures might lead to over-proportionate effects on the ability or pressure to improve the quality of the product programme; this would indicate a non-linearity, which is represented by the log-linear formulation (1b). We therefore estimate both the two functional forms.

2. *The specifications of the regressions determining the price/quality gaps (PG):*

As mentioned above, the price gap variable had been calculated from unit price comparisons at current exchange rates. To obtain information separately about the impact of both longer-term trend variables and of shorter-term currency movements, all other variables including the relative compensation rates were expressed in PPP terms and we added the ratio between the current exchange rate and the PPP rate (ex/ppp) as an explanatory variable. This variable was not included in the case of the quality segmentation (QS^I) regressions where, instead, the relative compensation rate variable was introduced at current exchange rates.

The specification of the price-gap regression equation was in the following log-log (constant elasticity) form:

$$\ln PG = \underset{(+)}{\beta_1 \ln wages_{pp}} + \underset{(?)}{\beta_2 \ln prod_{pp}} + \underset{(?)}{\beta_3 \ln R\&D_{pp}} + \underset{(-)}{\beta_4 \ln ex/ppp} + D_c + D_j$$

The exchange rates (and PPP rates) used – in the *ex/ppp* variable – were trade-weighted exchange rates (and PPP rates) with the countries' export shares as weights; this allowed us to treat the USA in the same way as all the other countries. The variable is constructed in such a way that an increase in *ex/ppp* means a depreciation of the current exchange rate relative to the PPP rate and therefore a negative sign is expected for the estimated parameters of this variable.

In the above specification, relative price gaps are seen as a function of relative unit labour costs – $wages \times prod^{-1}$ – and of R&D activity directed at improvements in both product quality and process technology.

The potential interdependencies between the different variables follow a similar, but not identical, pattern as in the QS^I regressions. The relative compensation rates of workers would again be affected by differences in productivity levels as well as by product quality. R&D intensity will – as mentioned above – affect process technology and product quality. This time – differently from the QS^I regressions – the impact of R&D will affect the price gaps in two different directions: its effect on improved process technology should reduce unit costs and should hence lead to a fall in the relative price; its effect on product quality should have a positive impact on the relative price. We have no general prior as to which of these two effects is stronger (it depends upon industry technology and product market characteristics), so that the sign for the R&D variable in the price gap regressions might take a positive or negative value and/or the coefficient might turn out to be insignificant. To some extent, a similar indeterminacy exists with the productivity variable: it is perfectly possible for two producers to have different levels of (labour) productivity but the same levels of unit costs reflecting different positions on the same iso-cost curve (i.e. different amounts of complementary inputs combined with a higher or lower level of labour inputs).

As mentioned above, we pursued a two-pronged strategy (in both the QS and the PG regressions) in relation to the problem of interdependence amongst the right-hand variables: In the first instance, we adopted an instrumental variables approach to control for these interdependencies (the incidence of strike activity to control for wage pressures independent of productivity advances; profit margins to control for R&D spending independent of contemporaneous productivity advances). However, the set of instruments we had available at the industry level proved to be weak and we then adopted the strategy to eliminate the less significant variable (from the pair of potentially interdependent variables) from the regression.

3.2 Data

The econometric results reported in the current paper refer to a panel data set constructed for 20 engineering industries from the set of 3-digit NACE industries (see Table A.2 for a list of these industries; the transport equipment industries were excluded from our panel). For these 20 engineering branches the detailed QS_j^c and PG_j^c variables (our 'product quality' indicators) were constructed from the detailed 8-digit CN trade statistics (as described in section 2 of this paper).

As regards the other variables (i.e. the regressors) used in our analysis, we constructed industry-level data for the following variables: compensation rates per employee, (labour) productivity levels (output per employee), R&D intensity (R&D stocks per unit of value added)[10]. These industry level data were extracted from 2 data sets: the *OECD's STAN database* for the OECD economies and the *Vienna Institute for International Economic Studies (WIIW) Structural Database* for the Central and Eastern European (CEE) economies. Both these two data sets report industrial statistics only at a much higher level of aggregation (the STAN database for 5 different engineering industries excluding the transport equipment branches, the WIIW database for 3 engineering branches). Hence the industry-level data had to be stretched across the 20 engineering branches for which we had been able to construct separate values for the dependent variables (i.e. the same compensation rates, productivity levels, R&D intensities were applied to groups of sub-industries within the engineering sector). This imposed severe data constraints on our regression analysis limiting the degree of variation of the regressors considerably.

The countries included in our panel estimations are reported in Table A.1. We can see that three different panels were constructed: one for 11 OECD economies for which also R&D expenditure data were available, another for 16 OECD economies including the 5 OECD economies (Austria, Belgium, Spain, Portugal and Greece) for which R&D expenditure was not available at the industry level, and a third including as well a range of Central and Eastern European economies (Hungary, Poland, Czech Republic, Slovak Republic, Romania). The industrial STAN database allowed us to construct a consistent industry panel for OECD economies for the years 1988-92 (consistent data for later years were not yet available across a wide enough range of economies) and this data set was complemented by an additional stretch of years for an earlier period 1977-79. In the first set of estimations we included only the later period while in another set we shall report results from the pooling of the panels from both these two periods (see section 3.3.3 below). The reason for developing these rather distant panel data sets was that we were also interested in analysing the determinants of long-term changes (i.e. across the two periods) in the quality positioning of different producers (these results will be reported separately).

When we included the Central and Eastern European producers (CEECs) into our panels we used data for these economies for the period 1992-95 (including the relative exchange rate to PPP rate movements), as we considered the developments over the period 1989-92 in these economies to be too much affected by the structural breaks of the immediate transition period and hence inappropriate to be used for our analysis. In panel data set 3 we are thus, in effect, comparing the CEECs' industrial statistics for the period 1992-95 with the OECD industrial statistics for 1989-92; we believe that this is preferable to using the earlier period (1989-92) statistics for the CEE economies.

With all these *caveats* concerning the limitations of our data set we shall now proceed to report the results from our econometric investigation.

3.3 Results

3.3.1 Results with the QS^I regressions:

The estimated equations for the representation in the high-quality segment (QS^I) are set out in Tables A.5 to A.7. All estimated equations produce consistent results and stable estimated coefficients. As expected, productivity and R&D were significant in all specifications and the overall explanatory power of all equations is just over 30%, not unsatisfactory for cross-section work.

One surprise was the negative sign for wages, but this variable was not significant at the 5% significance level. Excluding this variable, also due to the possible endogeneity of wages and productivity, yielded

[10] To construct the R&D stocks we deflated R&D current expenditures with value added deflators; otherwise see footnote 8 above.

results very similar to the ones obtained with the wage variable in it. We tried to solve the problem by applying a 2SLS estimator. However, our instruments were rather poor (the additional instruments used were hours of work lost through strike activity and price-cost margins) so that the procedure did not produce satisfactory results; hence we adopted the alternative to omit the insignificant variable.

The country dummies show the expected signs with the exception of Japan which had an insignificant coefficient. We should, however, remember that the country dummies are estimated for the full sample in relation to one reference country (through omission of that country's dummy), in our case Germany. Including Eastern European countries (Table A.7) yielded also rather plausible results in the relative ranking of these countries except for the instability of the Romanian dummy when the wage variable is in- or excluded. This could result from the fact that wages in Romania are extremely low (even by CEE standards) and this might be sufficient to (endogenously) explain Romania's position in the quality spectrum of European trade flows. Overall, the semi-log model seems the more appropriate specification (see also the argument given in section 3.1).

3.3.2 Results with the price gap (PG) regressions

Tables A.8 and A.9 summarize the estimated equations for the PG regressions. Using the different country samples, especially with or without the Central and Eastern European countries (CEECs), yielded rather distinct results.

The specification with only the OECD countries included (Table A.8) produced estimates with an adjusted R^2 of about 0.30, which again is not unsatisfactory. However, the short-term exchange rate variable is highly significant while the other variables do in general not exercise a significant influence on the price gap. In the first specification (left column, Table A.8) the estimated coefficient for the wage variable is significant, but this result is not very stable to the inclusion of otherwise insignificant country dummies.

To deal with the possible endogeneity of wages and productivity, we again decided to omit one of the two variables from the regression. Since both variables were insignificant, we omitted productivity as we expected that in the short run wage pressure would be the more important variable to explain the development of price gaps (and also because of the ambivalence with respect to the expected sign of the productivity variable; see discussion in section 3.1). However, the results did not improve.

Omitting Austria, Belgium, Spain, Portugal and Greece from the country sample allowed us to include the R&D variable (right-hand columns in Table A.8). With respect to the other variables the results were rather similar to those obtained above. The coefficient on the R&D variable had a negative sign and was insignificant. Our expectation concerning the sign of this variable was ambivalent (see section 1) and whatever evidence there is, it indicates that R&D investment is process-improving rather than product-quality improving or that the two effects are roughly in balance.

The estimated country dummies yielded again a rather plausible ranking of countries, this time with positive values for the USA, Canada and Japan and negative values for several Western European countries (always with Germany as the reference country).

Expanding the sample to include all countries (i.e. including the CEECs) produced quite interesting results (Table A.9). The overall explanatory power jumps to 53%, rather exceptional for cross-section work. In this regression, the ex/ppp variable is again highly significant and has the expected negative sign. The wage variable becomes highly significant (!) and with the expected positive sign. The results are due to the fact, mentioned above, that including the Central and Eastern European countries increases the variability of the sample.

Country dummies are positively significant for Austria, USA, Canada and Japan, and negatively significant for Southern and Eastern European countries.

3.3.3 Pooling data over the periods 1977-79 and 1988-92

Regression results with data pooled over two periods, 1977 to 1979 and 1988 to 1992, are presented in Table A.10. These regressions are preliminary to an analysis which will look at the determinants of longer-term changes in the quality positioning of producers in vertically differentiated product markets. In view of aiming towards an explanation of long-run changes, we calculated (three- and five-year) averages of dependent and explanatory variables for the two sub-periods (1977-79 and 1988-92) respectively (these sub-periods will be complemented with data for further sub-periods in future estimations).

In these regressions an additional time × country dummy (time set to one for the period 1988-92 and to minus one for the period 1977-79) was included to allow for 'residual' country-specific shifts in a country's quality positioning over this roughly 10-year interval; these dummies catch shifts in the dependent variable which are left unexplained by the other explanatory variables. Overall, the results from these regressions show a high degree of stability of the model estimates in comparison with the estimates reported above. This is particularly true for the QS^I estimates. In these estimates the additional country shift dummies are significant only for a small set of countries; only Finland shows a consistently significant 'residual' positive shift in its positioning in the high-quality segment. In the price gap (PG) regressions, the 'residual' shift in a country's price gap over the 10-year interval is almost not significant; in the case of Austria and Portugal it is sensitive to the inclusion of the R&D variable.

Averaging over a 3- or 5-year period respectively, smoothes otherwise fluctuating exchange rate movements leading to insignificant ex/ppp estimates. Although one might expect longer-term over-/under-valuation of national currencies to have an impact upon the quality positioning of producers, such over-/under-valuation is (see literature) in turn related to inter-country differences in productivity levels (in tradable vs. non-tradable sectors) and quality differences. These interdependencies have not been considered in our model discussion (and resulting estimation strategy) so far and an investigation of these will be done in future work.

4 Summary of the results and current extensions of the research

Overall, the results from our econometric analysis are rather promising, yielding in most cases robust estimates compatible with our priors regarding the determinants of the quality positioning of different producers in international product markets.

We used two types of 'quality indicators' to describe a producer's location in vertically differentiated product markets: one was a product compositional variable describing the relative presence of different producers in the highest quality segment of traded products in EU markets (with each quality segment comprising about one third of the total value of trades in each industry where trades include EU imports and intra-EU trade); the other indicator amounted to the calculation of industry-level 'price gap' variables for the different producers (relative to average EU trade prices). Both indicators were derived from calculations made at the most detailed (8-digit) level of international trade statistics.

Our priors regarding the determinants of the two types of 'quality indicators' were that sustained longer-term supply-side efforts were needed (proxied by relative R&D intensities and relative productivity levels) to achieve changes in the product programmes which lead to a higher share representation in the highest quality segment of international trade. Price gaps, on the other hand, were more prone to be affected by shorter-run wage pressures and short-run exchange rate movements in addition to long-run determinants.

These priors regarding the relevance of the different explanatory variables in the two sets of regressions were largely borne out by our estimation results: The R&D intensity variable and the productivity level variable were positive and significant in the case of the QS^I regressions, while the wage and ex/ppp variables were significant with the expected sign in the price gap regressions (the former when our data set was extended to yield sufficient variability).

The R&D intensity and productivity variables were, furthermore, expected to have a two-directional impact on competitors' price gaps as R&D is targeted at (and the productivity level related to) improvements in both process technology and product quality; this meant that the signs for these two variables (in the PG regressions) could go in either direction depending upon the relative strength of these two effects. This ambivalence was again borne out by our results.

The most important direction in which we are currently extending our work is to compile data at the industrial level regarding the skill composition of the workforces employed in the different economies since, in the current exercise, we only had relative compensation rates as indicators for differences in the skill composition of the workforces. But compensation rates are, of course, affected both by independent wage pressures (influenced by the characteristics of labour and product markets) as well as by the skill structure of the labour force. This points towards the urgency to decompose the wage variable into a longer-term human capital component and shorter-term wage pressures. To achieve such a decomposition we are presently compiling human capital indicators at the industry level for a wide range of countries which are not readily available. We feel that this extension of our database will provide scope for an important addition to our explanation of quality positioning in international trade.

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A Tables

Table A.1: **Countries – Country samples**

Country	Sample 1	Sample 2	Sample 3
Germany	x[a]	x	x
France	x	x	x
Belgium	x		x
Netherlands	x	x	x
Italy	x	x	x
United Kingdom	x	x	x
Austria	x		x
Finland	x	x	x
Sweden	x	x	x
Denmark	x	x	x
Spain	x		x
Portugal	x		x
Greece	x		x
Hungary			x
Poland			x
Czech Republic			x
Slovak Republic			x
Romania			x
United States	x	x	x
Japan	x	x	x
Canada	x	x	x

[a]indicates that country is in this sample

Table A.2: **List of 3-digit NACE engineering industries**

Mechanical engineering:

321 Manufacture of agricultural machinery and tractors
322 Manufacture of machine-tools for working metal, and of other tools and equipment for use with machines
323 Manufacture of textile machinery and accessories; manufacture of sewing machines
324 Manufacture of machinery for the food, chemical and related industries
325 Manufacture of plant for mines, iron and steel industry, foundries, civil engineering, building; mechanical handling equipment
326 Manufacture of transmission equipment for motive power
327 Manufacture of other machinery and equipment for use in specific branches of industry
328 Manufacture of other machinery and equipment

Electrical goods:

330 Manufacture of office machinery and data processing machinery
341 Manufacture of insulated wires and cables
342 Manufacture of electrical machinery (motors, generators, transformers, switches, switchgear and other basic plant)
343 Manufacture of electrical apparatus and appliances for industrial use; manufacture fo batteries and accumulators
344 Manufacture of telecommunications equipment, electrical and electronic measuring and recording equipment, and electro-medical equipment
345 Manufacture of radio and television receiving sets, sound reproducing and recording equipment and of electronic equipment and apparatus (except electronic computers); manufacture of gramophone records and prerecorded magnetic tapes
346 Manufacture of domestic type electric appliances
347 Manufacture of electric lamps and other electric lighting equipment
371 Manufacture of measuring, checking and precision instruments and apparatus
372 Manufacture of medical and surgical equipment and orthopaedic appliances (except orthopaedic footwear)
373 Manufacture of optical instruments and photographic equipment
374 Manufacture of clocks and watches and parts thereof

Table A.3: **Regressions of quality segment and price gap variables on country (country group) dummies** (coefficients and t-values for NACE engineering industries 321 – 328, 341 – 347 and 371 – 374)

Dependent var.	**1988 – 90**						**1992 – 94**					
	QS I		**QS III**		**PGT**		**QS I**		**QS III**		**PGT**	
	coeff.	**t-ratio**	**coeff.**	**t-ratio**	**coeff.**	**t-ratio**	**coeff.**	**t-ratio**	**coeff.**	**t-ratio**	**coeff.**	**t-ratio**
USA	0.241	1.27	- 0.355	-2.38**	0.428	3.14**	0.168	0.94	- 0.344	-2.62**	0.436	3.25**
Japan	- 0.002	-0.01	- 0.475	-3.19**	0.352	2.59**	0.042	0.23	- 0.424	-3.23**	0.530	3.94**
Canada	0.140	0.73	- 0.455	-3.06**	0.238	1.74*	0.111	0.62	- 0.408	-3.11**	0.226	1.68*
Germany	- 0.133	-0.70	0.026	0.17	0.123	0.90	- 0.086	-0.48	0.010	0.07	0.177	1.32
France	- 0.170	-0.89	0.041	0.27	0.055	0.40	- 0.221	-1.23	0.093	0.71	0.115	0.85
Belgium / Lux	- 0.354	-1.86*	0.150	1.01	- 0.031	-0.23	- 0.391	-2.18**	0.160	1.22	0.080	0.59
Netherlands	- 0.127	-0.67	- 0.034	-0.23	0.069	0.51	- 0.191	-1.07	0.009	0.07	0.145	1.08
Italy	- 0.365	-1.92*	0.193	1.29	- 0.125	-0.92	- 0.448	-2.50**	0.185	1.41	- 0.105	-0.78
UK	- 0.019	-0.10	- 0.067	-0.45	0.084	0.62	- 0.062	-0.34	- 0.063	-0.48	0.146	1.08
Austria	- 0.029	-0.15	- 0.044	-0.30	0.176	1.29	- 0.249	-1.39	0.045	0.34	0.227	1.69*
Switzerland	0.161	0.85	- 0.559	-3.75**	0.610	4.47**	0.035	0.19	- 0.445	-3.39**	0.719	5.34**
Ireland	0.083	0.43	- 0.364	-2.45**	0.196	1.44	- 0.105	-0.58	- 0.433	-3.30**	0.202	1.50
Finland	- 0.307	-1.62	0.030	0.20	0.188	1.38	- 0.394	-2.19**	0.030	0.23	0.182	1.35
Sweden	- 0.316	-1.66*	0.013	0.08	0.231	1.69*	- 0.384	-2.14**	- 0.007	-0.05	0.312	2.32**
Denmark	- 0.390	-2.05**	- 0.004	-0.03	0.034	0.25	- 0.569	-3.17**	0.096	0.73	0.193	1.44
Spain	- 0.385	-2.02**	0.114	0.77	- 0.115	-0.85	- 0.471	-2.63**	0.163	1.24	0.007	0.05
Portugal	- 0.529	-2.78**	0.115	0.77	- 0.184	-1.35	- 0.242	-1.35	0.018	0.13	- 0.108	-0.80
Greece	- 0.582	-3.06**	0.005	0.04	- 0.556	-4.08**	- 0.333	-1.86*	- 0.167	-1.27	- 0.678	-5.04**
Turkey	- 0.601	-3.16**	0.166	1.11	- 0.960	-7.05**	- 0.727	-4.05**	0.077	0.58	- 0.727	-5.41**
Hungary	- 0.906	-4.76**	- 0.013	-0.09	- 0.961	-7.05**	- 0.600	-3.35**	0.093	0.70	- 0.818	-6.08**
Poland	- 1.322	-6.95**	0.341	2.29**	- 1.069	-7.85**	- 0.864	-4.82**	0.419	3.19**	- 0.854	-6.35**
CSFR / CR	- 1.309	-6.88**	0.283	1.90*	- 0.895	-6.57**	- 0.685	-3.82**	0.254	1.94*	- 0.650	-4.84**
Slovak Rep.							- 0.718	-4.00**	0.283	2.16**	- 1.258	-9.35**
Bulgaria	- 0.864	-4.54**	0.071	0.48	- 0.920	-6.75**	- 0.584	-3.26**	0.147	1.12	- 1.431	-10.64**
Romania	- 1.824	-9.58**	0.170	1.14	- 2.159	-15.84**	- 0.993	-5.54**	0.149	1.13	- 1.964	-14.60**
YU / Slovenia	- 1.141	-6.00**	0.361	2.42**	- 0.684	-5.02**	- 0.952	-5.31**	0.330	2.51**	- 0.505	-3.76**
SU / Russia	- 0.762	-4.01**	0.039	0.26	- 0.810	-5.94**	- 0.521	-2.91**	0.251	1.91*	- 1.382	-10.27**
NICS 1	- 0.232	-1.22	- 0.203	-1.36	- 0.341	-2.51**	- 0.251	-1.40	- 0.064	-0.49	- 0.160	-1.19
NICS 2	- 0.534	-2.81**	- 0.547	-3.68**	- 0.285	-2.09**	- 0.287	-1.60	- 0.280	-2.13**	- 0.186	-1.38
China							- 0.819	-4.56**	0.150	1.14*	- 1.045	-7.77**
India	- 0.232	-1.22	- 0.150	-1.01	- 0.525	-3.85**	- 0.533	-2.97**	0.110	0.83	- 0.792	-5.89**
RoW	0.063	0.33	- 0.156	-1.05	0.021	0.16	0.042	0.23	- 0.068	-0.52	0.010	0.07
R square ad.	**0.219**		**0.081**		**0.464**		**0.112**		**0.096**		**0.521**	
USA	0.241	1.25	- 0.355	-2.36**	0.428	2.85**	0.168	0.93	- 0.344	-2.59**	0.436	3.01**
Japan	- 0.002	-0.01	- 0.475	-3.16**	0.352	2.35**	0.042	0.23	- 0.424	-3.20**	0.530	3.66**
Canada	0.140	0.72	- 0.455	-3.03**	0.238	1.58	0.111	0.61	- 0.408	-3.08**	0.226	1.56
EUN	- 0.223	-3.04**	0.043	0.77	0.030	0.52	- 0.281	-4.10**	0.070	1.39	0.107	1.95*
EUS	- 0.499	-4.45**	0.078	0.90	- 0.285	-3.29**	- 0.349	-3.33**	0.005	0.06	- 0.260	-3.10**
EFTA	- 0.123	-1.27	- 0.140	-1.87*	0.301	4.02**	- 0.248	-2.73**	- 0.094	-1.42	0.360	4.97**
EASTW	- 1.179	-10.53**	0.204	2.35**	- 0.975	-11.26**	- 0.716	-6.84**	0.255	3.33**	- 0.774	-9.25**
EASTE	- 1.148	-11.83**	0.160	2.13**	- 1.143	-15.24**	- 0.754	-9.29**	0.232	3.91**	- 1.308	-20.18**
NICS	- 0.383	-2.79**	- 0.375	-3.53**	- 0.313	-2.95**	- 0.269	-2.10**	- 0.172	-1.83*	- 0.173	-1.69*
China	0.000	0.00	0.000	0.00	0.000	0.00	- 0.819	-4.51**	0.150	1.13*	- 1.045	-7.21**
India	- 0.232	-1.20	- 0.150	-1.00	- 0.525	-3.50**	- 0.533	-2.94**	0.110	0.83	- 0.792	-5.46**
RoW	0.063	0.32	- 0.156	-1.04	0.021	0.14	0.042	0.23	- 0.068	-0.51	0.010	0.07
R square ad.	**0.188**		**0.065**		0.350		**0.091**		**0.078**		**0.444**	

**(*) indicates significance at the 5 (10) % level

Table A.4: **Regressions of quality segment and price gap variables on country (country group) dummies** (coefficients and t-values for NACE textile, clothing and footwear industries 436, 438, 439, 441, 442, 451, 453, 455, 456)

Dependent var.	1988 – 90						1992 – 94					
	QS I		QS III		PGT		QS I		QS III		PGT	
	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio
USA	- 0.105	-0.31	0.115	0.33	0.206	1.95*	- 0.180	-0.65	0.044	0.15	0.324	3.21**
Japan	- 0.151	-0.42	- 0.530	-1.43	0.626	5.57**	- 0.172	-0.58	- 0.212	-0.67	0.831	7.77**
Canada	- 0.253	-0.75	- 0.061	-0.17	0.242	2.29**	0.015	0.05	- 0.255	-0.86	0.168	1.66*
Germany	- 0.020	-0.06	- 0.084	-0.24	0.261	2.46**	0.159	0.57	- 0.140	-0.47	0.269	2.67**
France	0.139	0.41	- 0.042	-0.12	0.346	3.27**	0.233	0.84	- 0.113	-0.38	0.360	3.57**
Belgium / Lux	- 0.271	-0.80	0.129	0.37	0.055	0.52	- 0.406	-1.46	0.193	0.65	0.134	1.33
Netherlands	- 0.249	-0.74	0.060	0.17	- 0.055	-0.52	- 0.295	-1.06	0.039	0.13	0.034	0.34
Italy	0.197	0.58	- 0.430	-1.23	0.196	1.85*	0.175	0.63	- 0.346	-1.17	0.196	1.95*
UK	0.155	0.46	- 0.141	-0.40	0.195	1.84*	0.129	0.46	- 0.138	-0.46	0.244	2.42**
Austria	- 0.295	-0.87	- 0.376	-1.07	0.396	3.74**	- 0.266	-0.95	- 0.305	-1.03	0.496	4.92**
Switzerland	0.108	0.32	- 0.456	-1.30	0.735	6.95**	0.174	0.63	- 0.533	-1.80*	0.812	8.05**
Ireland	- 0.569	-1.68*	0.011	0.03	0.027	0.25	- 0.587	-1.98**	0.017	0.06	0.155	1.45
Finland	- 0.173	-0.51	- 0.044	-0.13	0.571	5.40**	- 0.131	-0.47	- 0.311	-1.05	0.394	3.91**
Sweden	- 0.265	-0.78	- 0.109	-0.31	0.218	2.06**	- 0.272	-0.97	0.031	0.11	0.184	1.83*
Denmark	- 0.511	-1.51	- 0.069	-0.20	0.380	3.59**	- 0.301	-1.08	- 0.269	-0.91	0.380	3.77**
Spain	- 0.319	-0.94	- 0.242	-0.69	0.265	2.51**	- 0.026	-0.09	- 0.139	-0.47	0.288	2.85**
Portugal	- 0.775	-2.29**	- 0.050	-0.14	0.036	0.34	- 0.569	-2.04**	- 0.038	-0.13	0.047	0.47
Greece	- 0.285	-0.84	- 1.194	-3.41**	0.064	0.60	- 0.159	-0.57	- 0.462	-1.56	0.147	1.46
Turkey	- 0.368	-1.09	- 0.770	-2.20**	0.081	0.77	0.092	0.31	- 0.583	-1.86*	0.114	1.07
Hungary	- 0.858	-2.39**	- 0.329	-0.89	- 0.303	-2.70**	- 0.648	-2.32**	- 0.095	-0.32	0.031	0.31
Poland	- 0.589	-1.64	- 0.549	-1.48	- 0.506	-4.51**	- 0.238	-0.85	- 0.191	-0.65	- 0.272	-2.70**
CSFR / CR	- 0.711	-2.10**	- 0.314	-0.90	- 0.501	-4.74**	- 0.533	-1.91**	0.082	0.28	- 0.235	-2.33**
Slovak Rep.	0.000	0.00	0.000	0.00	0.000	0.00	- 0.990	-3.35**	0.142	0.45	- 0.702	-6.56**
Bulgaria	- 1.110	-3.09**	- 0.409	-1.10	- 0.933	-8.31**	- 0.472	-1.60	- 0.052	-0.17	- 0.554	-5.18**
Romania	- 0.846	-2.50**	- 1.359	-3.88**	- 0.641	-6.06**	- 0.523	-1.88*	- 1.115	-3.77**	- 0.660	-6.55**
YU / Slovenia	- 0.443	-1.23	- 0.318	-0.86	- 0.113	-1.00	- 0.245	-0.83	- 0.504	-1.61	0.077	0.72
SU / Russia	- 0.720	-2.13**	- 0.596	-1.70*	- 0.909	-8.59**	- 0.741	-2.66**	- 0.277	-0.94	- 0.868	-8.61**
NICS 1	- 0.272	-0.81	- 0.994	-2.84**	- 0.027	-0.26	- 0.338	-1.21	- 0.596	-2.01**	0.066	0.66
NICS 2	- 0.508	-1.42	- 0.340	-0.92	- 0.057	-0.51	- 0.244	-0.83	- 0.284	-0.90	- 0.010	-0.09
China	0.000	0.00	0.000	0.00	0.000	0.00	- 0.523	-1.88*	- 0.201	-0.68	- 0.506	-5.02**
India	0.435	1.21	- 0.574	-1.55	- 0.116	-1.04	0.438	1.48	- 0.686	-2.18**	- 0.125	-1.17
RoW	- 0.455	-1.35	- 0.236	-0.67	- 0.148	-1.40	- 0.080	-0.29	- 0.071	-0.24	- 0.104	-1.04
R square ad.	0.004		0.011		0.594		0.070		0.018		0.605	
USA	- 0.105	-0.32	0.115	0.33	0.206	1.78*	- 0.180	-0.64	0.044	0.15	0.324	2.86**
Japan	- 0.151	-0.43	- 0.530	-1.42	0.626	5.11**	- 0.172	-0.58	- 0.212	-0.68	0.831	6.94**
Canada	- 0.253	-0.76	- 0.061	-0.17	0.242	2.09**	0.015	0.05	- 0.255	-0.87	0.168	1.48
EUN	- 0.080	-0.64	- 0.082	-0.62	0.197	4.51**	- 0.044	-0.41	- 0.110	-0.99	0.231	5.42**
EUS	- 0.459	-2.38**	- 0.495	-2.44**	0.122	1.83*	- 0.252	-1.55	- 0.213	-1.25	0.160	2.46**
EFTA	- 0.156	-0.94	- 0.246	-1.40	0.480	8.31**	- 0.124	-0.88	- 0.279	-1.90*	0.472	8.35**
EASTW	- 0.719	-3.59**	- 0.394	-1.87**	- 0.439	-6.34**	- 0.473	-2.92**	- 0.068	-0.40	- 0.158	-2.43**
EASTE	- 0.780	-4.54**	- 0.689	-3.81**	- 0.656	-11.05**	- 0.596	-4.63**	- 0.377	-2.75**	- 0.552	-10.56**
NICS	- 0.383	-1.58	- 0.686	-2.69**	- 0.041	-0.49	- 0.294	-1.44	- 0.449	-2.10**	0.030	0.37
China	0.000	0.00	0.000	0.00	0.000	0.00	- 0.523	-1.88*	- 0.201	-0.68	- 0.506	-4.48**
India	0.435	1.23	- 0.574	-1.54	- 0.116	-0.95	0.438	1.47	- 0.686	-2.20**	- 0.125	-1.04
RoW	- 0.455	-1.36	- 0.236	-0.67	- 0.148	-1.28	- 0.080	-0.28	- 0.071	-0.24	- 0.104	-0.93
R square ad.	0.030		0.004		0.517		0.058		0.007		0.505	

**(*) indicates significance at the 5 (10) % level

Table A.5: **Dependent variable: Quality Segment I** *double-log model*
just OECD-countries

variable	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio
wages	-0.141	-1.84			-0.119	-1.51		
productivity	0.126	2.90	0.111	2.61	0.146	3.28	0.153	3.44
r & d					0.078	2.28	0.066	2.06
country dummies								
Belge[a]	-0.704	-4.96	-0.683	-4.84				
Netherlands	-0.156	-2.03	-0.163	-2.13	-0.180	-2.62	-0.140	-2.00
Italy	-0.328	-4.83	-0.330	-4.87	-0.272	-4.34	-0.226	-3.41
United Kingdom	[b]		[b]		[b]		0.152	2.46
Finland	-0.266	-4.17	-0.265	-4.17	-0.256	-4.28	-0.197	-3.12
Sweden	-0.200	-3.06	-0.222	-3.48	-0.212	-3.40	-0.167	-2.54
Denmark	-0.354	-4.19	-0.347	-4.11	-0.360	-4.87	-0.283	-3.69
Spain[a]	-0.356	-4.48	-0.305	-4.09				
Portugal[a]	-0.713	-5.37	-0.544	-5.61				
Greece[a]	-0.529	-5.60	-0.412	-5.82				
United States	0.286	4.20	0.270	4.02	0.291	4.73	0.325	5.11
Japan	0.069	1.08	0.064	1.00	0.039	0.68	0.093	1.52
Canada	0.228	3.01	0.252	3.57	0.290	4.18	0.333	4.61
test statistics								
$\overline{R}^2$	0.306		0.305		0.323		0.326	
Log-Likelihood	-1264.24		-1280.78		-698.22		-696.29	
No. of obs.	1412		1432		1008		1008	
Deg.Fr.	1378		1399		977		977	
fixed effects								
321	0.298	3.67	0.299	3.72	0.205	2.73	0.157	2.03
322	0.053	0.65	0.049	0.61	0.079	1.05	0.033	0.42
323	0.256	3.14	0.268	3.34	0.219	2.92	0.174	2.24
324	-0.006	-0.08	-0.002	-0.02	-0.062	-0.83	-0.109	-1.40
325	0.147	1.81	0.157	1.95	0.085	1.13	0.035	0.45
326	-0.154	-1.90	-0.137	-1.70	-0.108	-1.43	-0.156	-2.01
327	-0.053	-0.66	-0.043	-0.54	-0.021	-0.29	-0.067	-0.86
328	0.038	0.47	0.049	0.62	0.041	0.55	-0.004	-0.06
330	-0.267	-3.27	-0.241	-3.02	-0.202	-2.66	-0.247	-3.15
341	-0.616	-7.96	-0.604	-7.87	-0.754	-10.19	-0.805	-10.57
342	-0.013	-0.18	-0.011	-0.15	-0.019	-0.26	-0.062	-0.82
343	0.120	1.55	0.123	1.60	0.231	3.12	0.185	2.43
344	0.085	1.08	0.071	0.91	0.080	1.06	0.031	0.40
345	-0.238	-3.18	-0.231	-3.12	-0.115	-1.59	-0.171	-2.27
346	0.029	0.39	0.046	0.61	0.027	0.38	-0.013	-0.17
347	-0.462	-5.52	-0.448	-5.40	-0.133	-1.66	-0.172	-2.11
371	0.027	0.35	0.053	0.71	0.072	0.96	0.032	0.42
372	0.043	0.56	0.079	1.06	-0.039	-0.51	-0.072	-0.92
373	0.260	3.47	0.272	3.70	0.055	0.73	0.002	0.02
374	-0.967	-13.02	-0.950	-12.99	-0.796	-10.57	-0.852	-10.95

[a]no data on r & d available
[b]country dummy not significant

Table A.6: **Dependent variable: Quality Segment I** *semi-log model*
just OECD-countries

variable	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio
wages	-0.105	-1.35			-0.096	-1.33		
productivity	0.086	3.58	0.080	3.38	0.052	2.10	0.050	2.00
r & d					0.104	3.11	0.096	2.91
country dummies								
Belge[a]	-0.706	-4.97	-0.683	-4.85				
Netherlands	-0.206	-2.61	-0.204	-2.60	-0.185	-2.65	-0.181	-2.60
Italy	-0.331	-4.89	-0.328	-4.86	-0.271	-4.47	-0.270	-4.45
Finland	-0.269	-4.22	-0.264	-4.16	-0.280	-4.66	-0.273	-4.56
Sweden	-0.219	-3.40	-0.230	-3.63	-0.270	-4.24	-0.275	-4.32
Denmark	-0.382	-4.59	-0.371	-4.48	-0.422	-5.83	-0.404	-5.68
Spain[a]	-0.349	-4.46	-0.315	-4.24				
Portugal[a]	-0.638	-5.86	-0.567	-5.91				
Greece[a]	-0.514	-6.45	-0.455	-6.76				
United States	0.299	4.52	0.284	4.39	0.329	5.58	0.316	5.43
Japan	0.071	1.12	0.070	1.11	0.052	0.92	0.056	0.98
Canada	0.242	3.22	0.267	3.83	0.295	4.59	0.295	4.59
test statistics								
$\overline{R}^2$	0.308		0.308		0.328		0.328	
Log-Likelihood	-1262.64		-1278.44		-694.42		-695.34	
No. of obs.	1412		1432		1008		1008	
Deg.Fr.	1378		1399		977		978	
fixed effects								
321	0.318	2.94	0.213	2.61	0.127	1.26	0.043	0.54
322	0.074	0.69	-0.036	-0.44	0.006	0.06	-0.076	-0.98
323	0.277	2.58	0.183	2.24	0.145	1.46	0.062	0.80
324	0.014	0.13	-0.087	-1.06	-0.134	-1.34	-0.218	-2.80
325	0.168	1.55	0.072	0.88	0.013	0.13	-0.072	-0.92
326	-0.133	-1.23	-0.222	-2.72	-0.181	-1.80	-0.266	-3.42
327	-0.031	-0.29	-0.128	-1.57	-0.092	-0.93	-0.175	-2.25
328	0.057	0.53	-0.036	-0.44	-0.035	-0.35	-0.119	-1.52
330	-0.242	-2.25	-0.329	-3.88	-0.267	-2.70	-0.350	-4.56
341	-0.633	-5.94	-0.720	-9.35	-0.862	-8.56	-0.951	-12.49
342	-0.027	-0.26	-0.125	-1.63	-0.125	-1.28	-0.207	-2.71
343	0.103	0.98	0.007	0.09	0.120	1.21	0.035	0.46
344	0.061	0.57	-0.048	-0.64	-0.043	-0.42	-0.132	-1.74
345	-0.217	-2.01	-0.313	-4.02	-0.195	-1.88	-0.286	-3.68
346	0.020	0.20	-0.065	-0.84	-0.068	-0.70	-0.148	-1.92
347	-0.501	-4.91	-0.584	-7.81	-0.281	-2.92	-0.363	-4.90
371	0.057	0.58	-0.035	-0.47	-0.015	-0.15	-0.098	-1.24
372	0.072	0.74	-0.013	-0.17	-0.129	-1.32	-0.207	-2.68
373	0.290	2.78	0.188	2.51	-0.021	-0.20	-0.114	-1.47
374	-0.933	-8.80	-1.029	-13.53	-0.861	-8.14	-0.956	-12.18

[a]no data on r & d available

Table A.7: **Dependent variable: Quality Segment I**

variable	*double-log model*				*semi-log model*			
	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio
wages	-0.068	-0.87			-0.134	-1.41		
productivity	0.077	1.93	0.098	2.30	0.092	3.25	0.086	3.06
country dummies								
Belgie	-0.599	-3.63	-0.619	-3.74	-0.652	-3.92	-0.626	-3.79
Netherlands	[a]		-0.153	-1.69	-0.220	-2.28	-0.221	-2.29
Italy	-0.295	-3.63	-0.329	-3.94	-0.329	-3.96	-0.329	-3.95
Finland	-0.213	-2.71	-0.243	-3.04	-0.241	-3.01	-0.243	-3.03
Sweden	-0.173	-2.14	-0.210	-2.62	-0.194	-2.38	-0.216	-2.69
Denmark	-0.338	-3.44	-0.351	-3.55	-0.382	-3.90	-0.368	-3.78
Spain	-0.312	-3.43	-0.311	-3.55	-0.361	-3.91	-0.319	-3.65
Portugal	-0.611	-4.17	-0.547	-4.81	-0.654	-5.06	-0.565	-5.01
Greece	-0.504	-4.84	-0.462	-5.55	-0.570	-5.95	-0.496	-6.16
Hungary	-0.620	-3.17	-0.470	-4.12	-0.660	-5.21	-0.551	-5.48
Poland	-1.013	-4.50	-0.835	-7.60	-1.017	-7.93	-0.903	-9.06
Czech Republic	-0.740	-3.44	-0.574	-5.25	-0.751	-5.90	-0.638	-6.42
Slovak Republic	-0.883	-3.97	-0.724	-5.69	-0.893	-6.16	-0.780	-6.45
Romania	-1.363	-3.13	-0.984	-8.42	-1.193	-8.93	-1.071	-10.50
United States	0.325	4.07	0.275	3.30	0.302	3.63	0.279	3.42
Japan	0.072	0.92	0.037	0.46	0.044	0.56	0.042	0.53
Canada	0.245	2.83	0.211	2.37	0.222	2.52	0.222	2.52
test statistics								
$\overline{R}^2$	0.311		0.312		0.314		0.313	
Log-Likelihood	-1669.26		-1668.18		-1665.09		-1666.12	
No. of obs.	1580		1580		1580		1580	
Deg.Fr.	1542		1542		1541		1542	
fixed effects								
321	0.180	2.06	0.216	2.42	0.256	2.03	0.133	1.45
322	0.102	1.16	0.140	1.57	0.178	1.42	0.057	0.62
323	0.324	3.70	0.363	4.06	0.400	3.21	0.280	3.06
324	0.093	1.06	0.131	1.47	0.169	1.35	0.049	0.53
325	0.188	2.15	0.224	2.50	0.264	2.09	0.141	1.54
326	-0.164	-1.87	-0.127	-1.42	-0.087	-0.69	-0.210	-2.29
327	-0.220	-2.51	-0.181	-2.02	-0.144	-1.16	-0.263	-2.87
328	0.049	0.56	0.088	0.99	0.123	0.98	0.002	0.02
330	-0.289	-3.28	-0.244	-2.71	-0.251	-2.01	-0.366	-3.89
341	-0.525	-6.22	-0.489	-5.61	-0.477	-3.77	-0.604	-6.82
342	-0.073	-0.88	-0.032	-0.37	-0.028	-0.23	-0.148	-1.69
343	0.071	0.85	0.111	1.28	0.117	0.95	-0.004	-0.05
344	0.094	1.12	0.135	1.53	0.141	1.13	0.014	0.17
345	-0.476	-5.77	-0.447	-5.31	-0.410	-3.24	-0.537	-6.08
346	-0.090	-1.09	-0.050	-0.58	-0.046	-0.38	-0.163	-1.85
347	-0.268	-3.08	-0.216	-2.35	-0.228	-1.89	-0.348	-4.08
371	-0.232	-2.77	-0.183	-2.18	-0.152	-1.28	-0.266	-3.10
372	-0.023	-0.27	0.031	0.37	0.054	0.47	-0.054	-0.64
373	0.360	4.36	0.400	4.78	0.443	3.61	0.319	3.70
374	-1.090	12.94	-1.054	12.37	-1.009	-8.05	-1.134	-12.77

[a]country dummy not significant

Table A.8: **Dependent variable: price gap** *just OECD-countries*

variable	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio
wages	0.126	2.57	0.073	1.58	0.080	1.52	0.062	1.23
productivity	0.038	1.49			0.042	1.47		
ex/ppp	-0.402	-5.39	-0.467	-6.61	-0.490	-4.78	-0.519	-5.22
r & d					-0.034	-1.58	-0.019	-0.97
country dummies								
France	[a]		[a]		-0.088	-2.08	[a]	
Netherlands	[a]		[a]		-0.099	-2.15	[a]	
Italy	-0.154	-3.50	-0.204	-4.70	-0.260	-6.00	-0.209	-5.41
United Kingdom	0.103	2.31	[a]		[a]		[a]	
Austria [b]	0.292	5.05	[a]					
Finland	[a]		[a]		-0.121	-2.89	-0.109	-2.61
Sweden	0.126	2.84	[a]		[a]		[a]	
Denmark	[a]		-0.166	-2.96	-0.179	-3.73	-0.181	-3.79
Spain [b]	[a]		-0.100	-2.22				
Greece [b]	-0.369	-6.83	-0.456	-8.53				
United States	0.361	7.80	0.344	7.49	0.286	6.03	0.350	8.62
Japan	0.256	5.67	0.172	3.97	0.121	2.97	0.148	3.79
Canada	0.235	4.77	0.193	3.94	0.140	2.91	0.197	4.60
test statistics								
$\overline{R}^2$	0.310		0.299		0.271		0.268	
Log-Likelihood	-689.96		-703.94		-235.04		-238.52	
No. of obs.	1398		1418		1004		1004	
Deg.Fr.	1367		1389		972		975	
fixed effects								
321	0.002	0.04	0.038	0.74	0.073	1.49	0.033	0.71
322	0.146	2.78	0.182	3.50	0.131	2.69	0.093	2.01
323	0.002	0.03	0.037	0.72	0.006	0.13	-0.031	-0.68
324	0.078	1.50	0.113	2.17	0.129	2.66	0.091	1.97
325	0.038	0.73	0.078	1.51	0.086	1.78	0.050	1.08
326	0.145	2.77	0.179	3.46	0.194	3.98	0.156	3.36
327	0.003	0.07	0.041	0.79	0.044	0.91	0.007	0.16
328	0.126	2.40	0.160	3.07	0.186	3.80	0.146	3.14
330	0.119	2.18	0.172	3.25	0.173	3.50	0.136	2.89
341	0.177	3.62	0.225	4.71	0.284	5.85	0.236	5.27
342	0.076	1.56	0.123	2.56	0.196	4.06	0.149	3.33
343	0.122	2.50	0.169	3.54	0.208	4.28	0.159	3.55
344	0.098	1.99	0.146	3.08	0.171	3.43	0.116	2.60
345	0.177	3.66	0.245	5.15	0.312	6.55	0.270	6.02
346	0.127	2.59	0.177	3.66	0.174	3.64	0.131	2.92
347	0.088	1.70	0.117	2.41	0.156	2.94	0.091	2.01
371	0.013	0.26	0.050	1.01	0.160	3.22	0.115	2.47
372	-0.072	-1.40	-0.045	-0.88	0.162	3.19	0.114	2.41
373	-0.154	-3.19	-0.101	-2.13	-0.043	-0.88	-0.080	-1.72
374	-0.376	-7.42	-0.302	-6.06	-0.335	-6.67	-0.365	-7.49

[a] country dummy not significant
[b] no data on r & d available

Table A.9: **Dependent variable: price gap**

variable	coeff.	t-ratio	coeff.	t-ratio
wages	0.178	3.59	0.187	4.12
productivity	0.012	0.47		
ex/ppp	-0.430	-7.45	-0.430	-7.50
country dummies				
Italy	-0.177	-3.42	-0.177	-3.44
Austria	0.278	4.28	0.277	4.29
Greece	-0.341	-6.54	-0.343	-6.63
Hungary	-0.298	-3.74	-0.300	-3.80
Poland	-0.239	-2.90	-0.238	-2.90
Slovak Republic	-0.669	-7.60	-0.669	-7.64
Romania	-0.354	-2.15	-0.332	-2.11
United States	0.327	5.88	0.329	5.98
Japan	0.215	4.21	0.218	4.31
Canada	0.201	3.63	0.203	3.69
test statistics				
$\overline{R}^2$	0.533		0.532	
Log-Likelihood	-975.73		-981.85	
No. of obs.	1561		1581	
Deg.Fr.	1528		1549	
fixed effects				
321	0.095	1.72	0.094	1.72
322	0.202	3.66	0.199	3.65
323	0.006	0.11	0.003	0.06
324	0.106	1.92	0.104	1.89
325	0.076	1.38	0.075	1.38
326	0.228	4.14	0.223	4.10
327	0.040	0.73	0.040	0.73
328	0.152	2.73	0.149	2.72
330	0.104	1.81	0.112	1.98
341	0.283	5.37	0.277	5.40
342	0.145	2.74	0.138	2.68
343	0.171	3.23	0.165	3.20
344	0.019	0.36	0.016	0.32
345	0.154	2.98	0.154	3.00
346	0.234	4.44	0.230	4.43
347	0.170	3.03	0.161	3.09
371	0.060	1.11	0.062	1.17
372	-0.019	-0.34	-0.019	-0.34
373	-0.258	-4.85	-0.251	-4.77
374	-0.375	-6.71	-0.365	-6.60

Table A.10: **Pooled Regressions over the longer period 1977/1979 – 1988/1992**

	QS^I (log-log)		QS^I (log-log)		QS^I (semi-log)		QS^I (semi-log)		log PG		log PG		log PG	
	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio	coeff.	t-ratio
wages	-0.163	-1.29	-0.144	-1.21	-0.095	-0.69	-0.069	-0.57	0.219	2.48	0.138	1.56	0.147	1.74
productivity	0.130	2.37	0.109	1.86	0.067	1.87	-0.003	-0.09	0.004	0.10	0.013	0.35		
r & d			0.139	3.17			0.194	3.54			-0.050	-1.57	-0.049	-1.55
ex/ppp									0.048	0.45	0.011	0.10	0.013	0.12
country dummies														
Italy									-0.246	-3.12	-0.289	-3.87	-0.286	-3.86
Finland	-0.360	-3.06	-0.490	-4.90	-0.351	-2.96					-0.141	-1.99	-0.141	-1.99
Sweden			-0.204	-2.02			-0.526	-5.16			0.177	2.49		
Denmark			-0.299	-2.72			-0.290	-2.74					0.176	2.48
Spain	-0.390	-3.12			-0.347	-2.80	-0.375	-3.44	-0.230	-2.83				
Portugal	-0.689	-3.59			-0.553	-3.70			-0.386	-3.47				
Greece	-0.362	-2.30			-0.325	-2.33			-0.727	-7.59				
United States	0.398	3.26	0.285	2.90	0.418	3.41	0.304	3.14	0.196	2.34	0.254	3.59	0.256	3.65
Japan	0.262	2.23	0.129	1.29	0.256	2.17	0.105	1.07	0.207	2.81	0.217	3.22	0.216	3.21
Canada	0.339	2.61	0.361	3.45	0.353	2.71	0.350	3.39						
time dummies														
Austria									0.208	2.26				
Finland	0.264	2.38	0.243	2.83	0.257	2.31	0.232	2.72						
Portugal	0.245	2.13							0.223	3.08				
test statistics														
adj. R2	0.211		0.234		0.205		0.237		0.337		0.212		0.214	
Log-Likelihood	-586.27		-317.57		-588.89		-316.66		-311.83		-144.44		-144.50	
No. of obs.	573		423		573		423		568		422		422	
Deg.Fr.	542		393		543		393		537		393		394	

B Figures

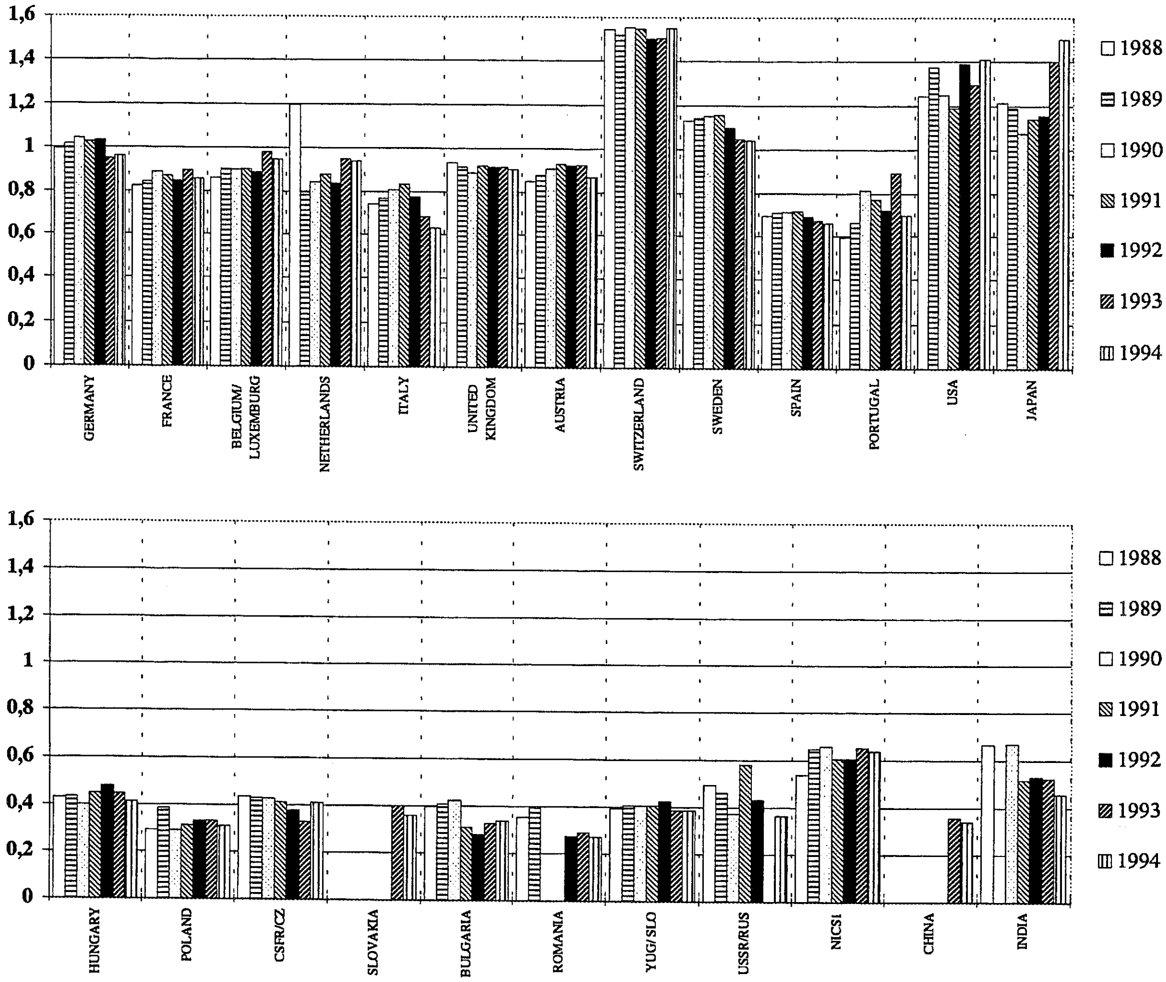

Figure B.1: Price/quality gaps in exports to the EU (Nace32–mechanical engineering)

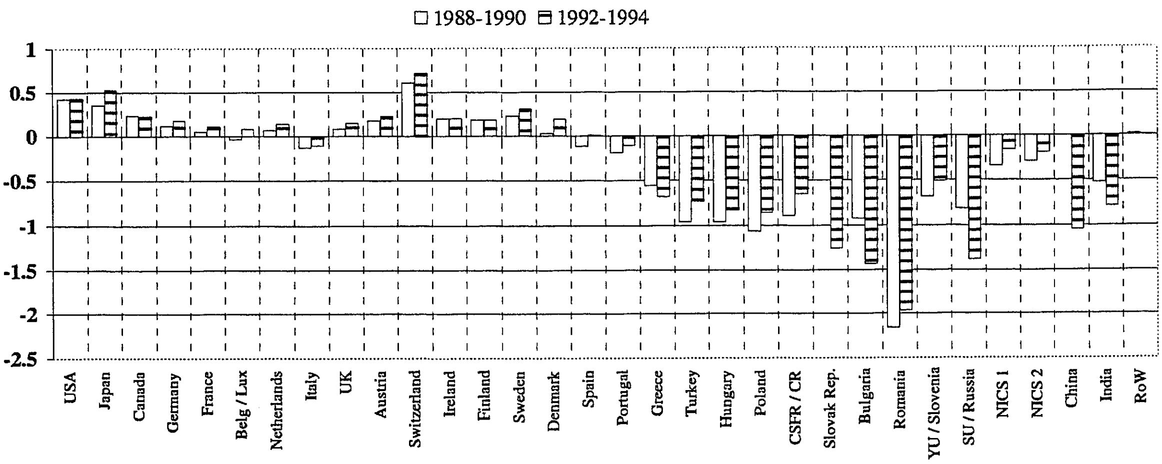

Figure B.2: Engineering industries – Shifts in country dummies: price gaps

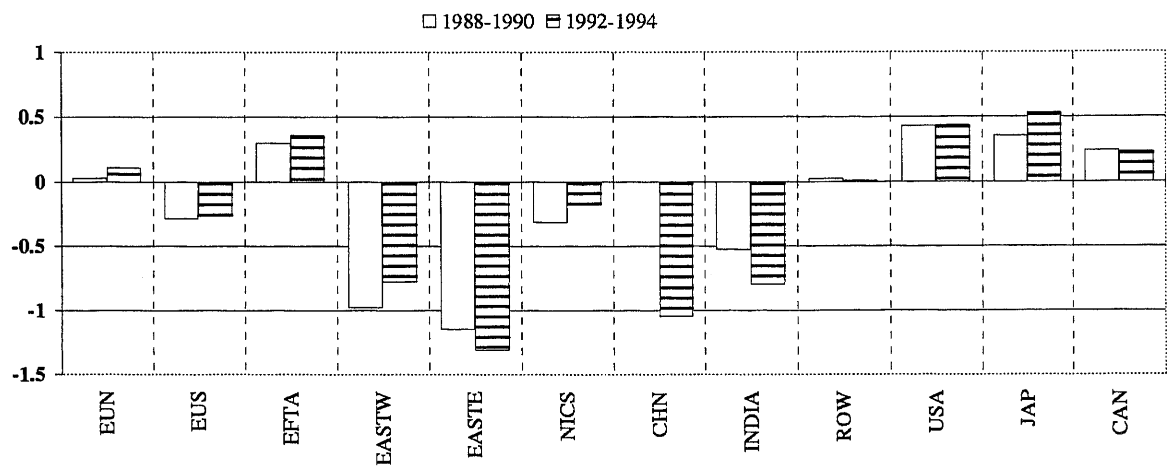

Figure B.3: Engineering industries – Shifts in country group dummies: price gaps

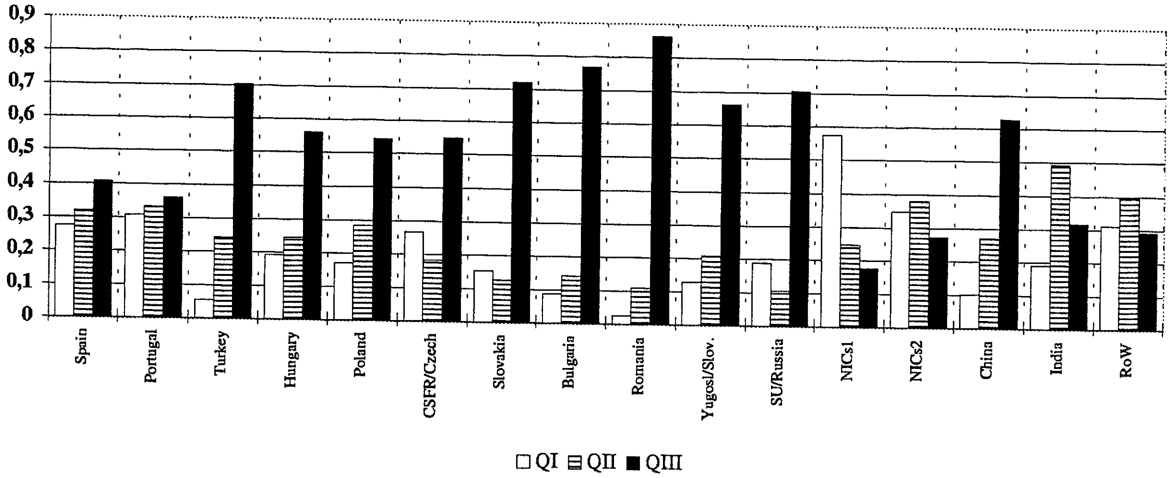

Figure B.4: **Comparative export structure in different quality segments; (NACE 342) - electrical machinery**

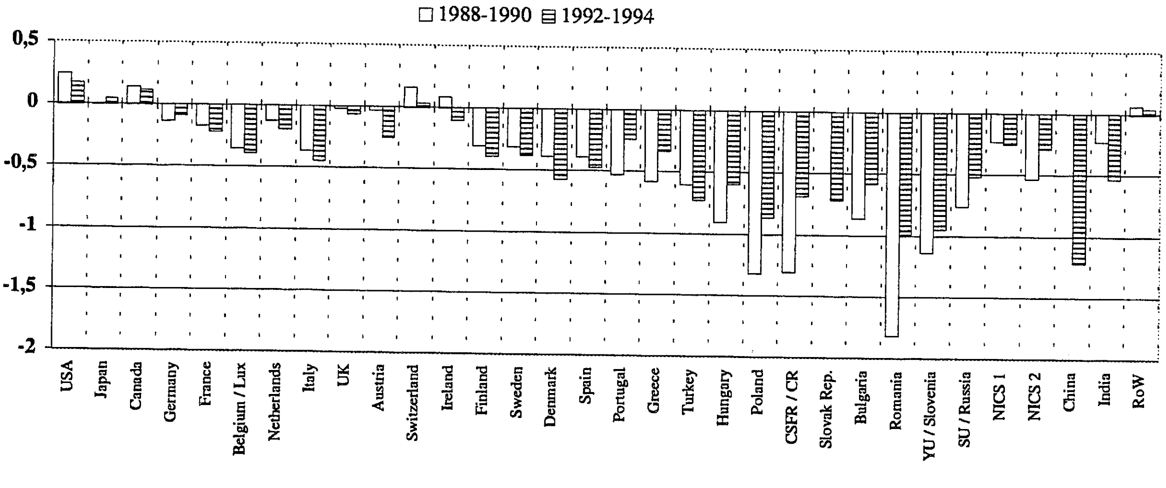

Figure B.5: **Engineering industries – Shifts in country dummies: top quality segment**

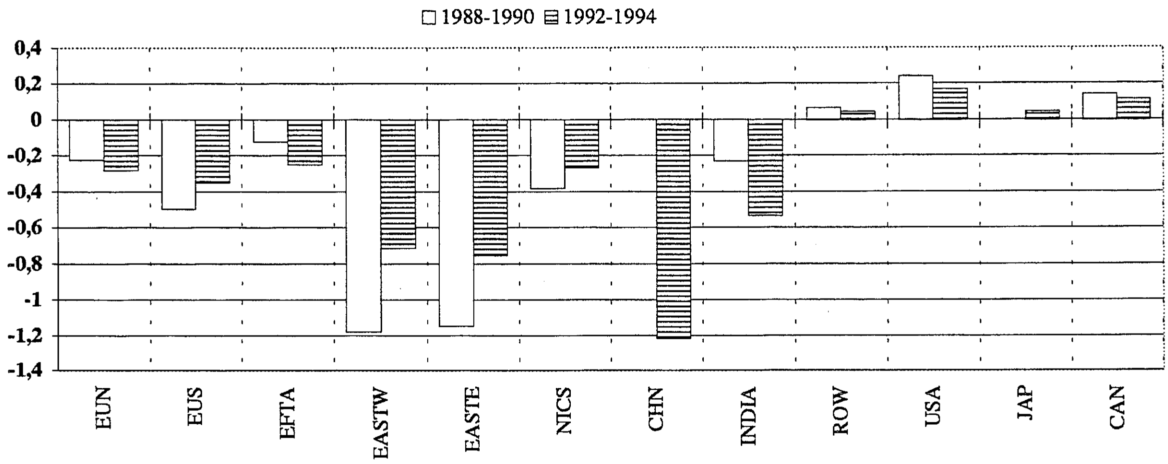

Figure B.6: Engineering industries – Shifts in country group dummies: top quality segment

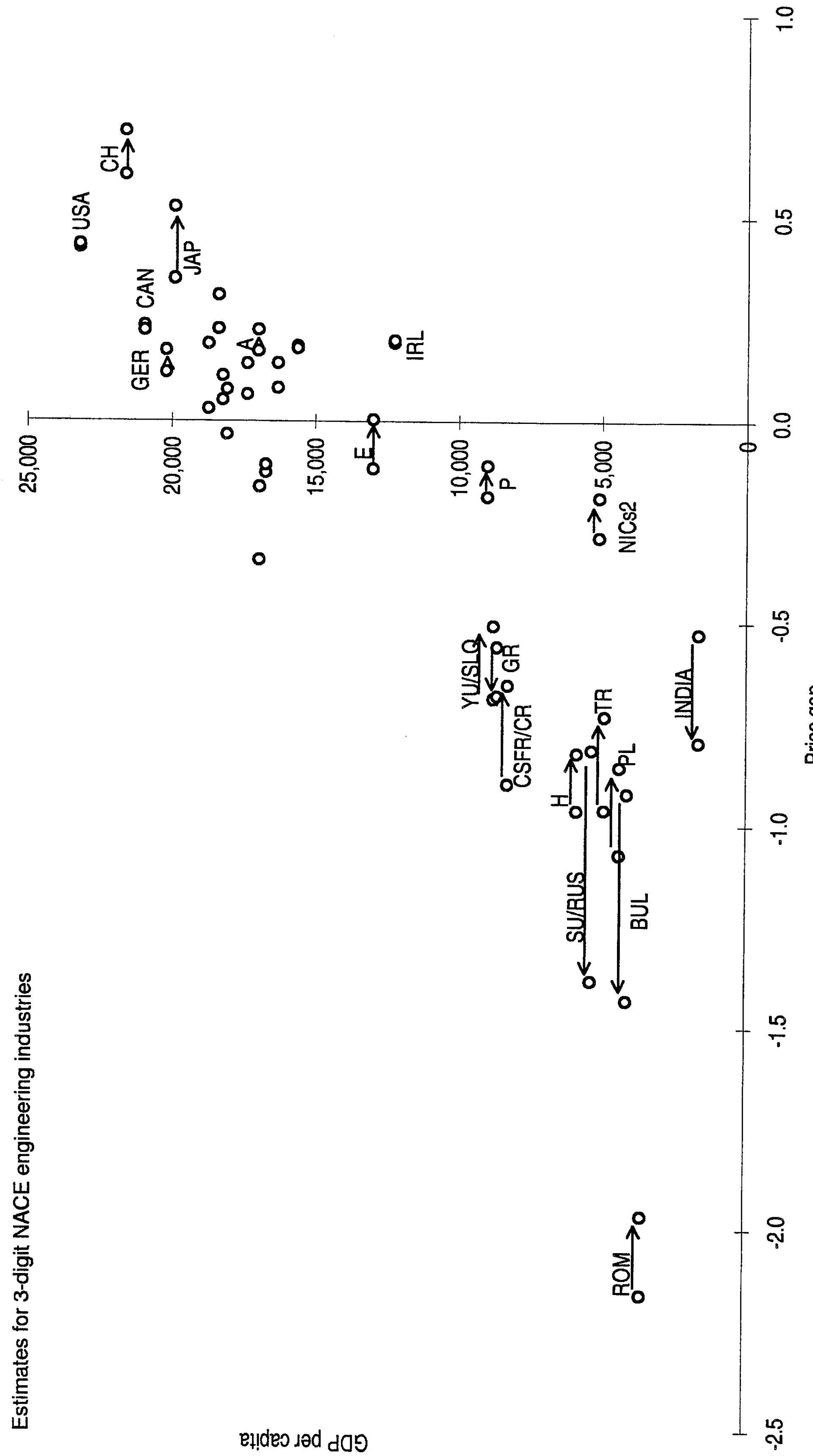

Figure B.7: Shifts in country dummies (price gap) 1988/90 to 1992/94 and GDP per capita

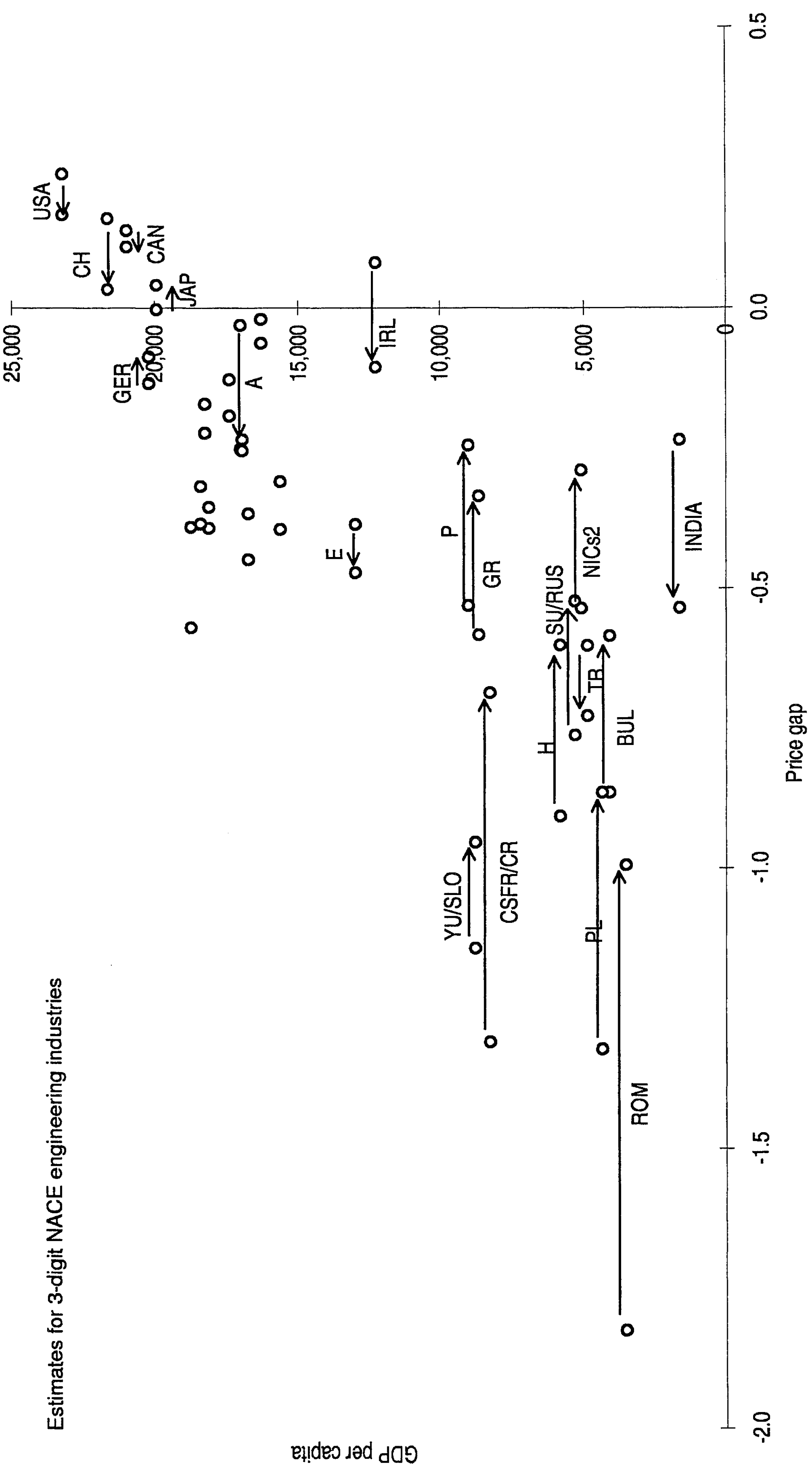

Figure B.8: Shifts in country dummies (representation in high quality segment) 1988/90 to 1992/94 and GDP per capita

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