Has human capital become a scarce factor in Belgium?

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Nous parvenons tout d’abord à la conclusion à première vuc paradoxale que la Belgique, qui semble avoir un net avantage comparatif pour les biens à forte intensité en capital physique, aurait un désavantage comparatif pour ceux qui sont intensifs en capital humain, en ce sens que les performances commerciales des industries qui utilisent de façon intensive ce facteur de production sont médiocres. Le présent travail apporte par la suite à ces résultats un complément important. Grâce aux données de la centrale des Bilans de la Banque Nationale, il nous a en effet été possible d’étudier les avantages comparatifs en termes de profits et non seulement d’exportations nettes. Les secteurs à forte intensité en capital humain, apparaît-il, sont ceux qui ont les meilleures performances en termes de profits. Notre conclusion met en cause la politique industrielle du pays qui a traditionnellement soutenu très largement la création de capital physique et a soutenu ces secteurs à travers la crise alors même qu’ils avaient manifestement perdu une grande partie de leur compétitivité, alors que le soutien apporté par la Belgique à la recherche s’est constamment situé à un niveau très bas, largement en deçà de l’aide que lui ont apportée les autres pays industriels.

I. Preliminary Remarks

Research on the determinants of the comparative advantages of industries has been a favourite topic of applied research on international trade\(^1\). This work, inspired by the celebrated Heckscher Ohlin Samuelson theorem\(^2\), uses

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\(^1\) For and excellent and very recent application of these ideas but which uses a different approach and interpretation than those contained in this paper, see Bowen and al (1987). A good survey of this area of research is provided in Deardorff (1985).

\(^2\) Samuelson (1948), (1949). See the references therein to the earlier work of E.F. Heckscher and B. Ohlin.
net export performances as a measure of the international comparative advantages of industries. This theorem predicts that countries should have a comparative advantage in products that are intensive in factors in which they are better endowed than their competitors. The empirical work tests whether these indicators can be accounted for econometrically in terms of the factor intensities of the products of various industries, and of the abundance of the factors of production in the countries studied.

A recent research project, jointly directed by the present authors, based on these ideas, yielded a puzzling result concerning the human capital variable used in the regressions. In repeated tests it was found that the particular version of the human capital used in the multiple regression equations was negatively and significantly correlated with the inter-industry composition of Belgium's comparative advantage, although the physical capital intensity variable yielded positive and significant coefficients. Since at the very core of the Heckscher-Ohlin-Samuelson (H-O-S) theorem is the proposition that the commodity composition of trade will be determined mainly by the concordance of the endowment pattern of trading countries with the factor intensities of the production processes of the commodities traded, the above-mentioned results would suggest that human capital has become a scarce factor in Belgium in comparison to its main trading partners although the physical capital endowment has apparently remained abundant. Even more interesting was the fact that in the regressions carried out to assess the determinants of the inter-industry variations in the profit ratios ("competitiveness"), the same human capital variable showed a positive and highly significant correlation.

Since both of the present authors are well past the age at which rushing to print with what appears to be a surprising finding is almost a reflex-action, they decided to review the data, sharpen the measure of human capital used, rerun the regressions and reappraise the results. The present article synthesizes the relevant parts of the empirical findings and gives a rather detailed presentation of the interpretation of those results. A description of the theoretical background of the study, the specification, definition of the variables and regression results are given elsewhere (see THARAKAN, WAELEBROECK, VERSTRAELEN and SENHADJI 1988). The main thrust of the present paper is centered around the various hypotheses which can be put forward to explain the surprising empirical findings. In a rather lengthy statistical annex the essential elements of the econometric exercise are given.
II. Physical Capital, Human Capital, Comparative Advantage and Profitability of the Belgian Industrial Sectors

As explained in more detail in the Statistical Annex, the regressions formulated to explain the inter-industry variations in the comparative advantage of Belgium were specified on the basis of a synthesis of the factor proportions theory, the neo-factor proportions extensions of it and some of the theoretical developments which incorporate imperfect competition variables. Specifically, the explanatory variables consisted of an index of human capital, an index of physical capital, two alternative measures of concentration, a measure of economies of scale, an index for tariff protection and a proxy for non-tariff barriers. The dependent variable representing the "revealed comparative advantage" of Belgium was calculated using the Balassa index, and thus reflects the trade performance of countries. The "profits regressions" which sought to explain the inter-industry differences in competitiveness used as dependent variable the average annual profits (plus depreciation) as a percentage of the turnover of the industry concerned. We felt that this variable was in some ways even more interesting than a trade performance variable which is strongly influenced by historical factors, as large capacities that were built up in better times are kept going in sectors that are no longer competitive. Profit, on the other hand, is a forward looking indicator of economic performance. The specification of the "profits equations" contained the same independent variables as those described above in addition to two alternative variables measuring the "trade openness" of the sector concerned. In addition to testing the basic equations, regressions were also carried out to explain the revealed comparative advantage of the Belgium Luxemburg Economic Union (BLEU) with respect to intra- and extra-European Community trade\(^1\). The technique of "pooling" i.e. a combination of time series and cross section was used, although it should be mentioned that regressions using data for individual years gave the same pattern of results.

In the tables given in the remaining part of this section we limit our attention to the results pertaining to the human- and physical capital variables.

Econometric estimations capture of course only the general causes that influence all of the observations available and "throws into the residuals" specific causes that affect any particular observation. Curiosity about the causes of the residuals in the present econometric exercise led to undertaking a set of simple case studies designed to shed light on this topic.

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1 As is mentioned in the Statistical Annex, data pertaining to BLEU were used for this purpose because separate data for the internal and external EC trade for Belgium were not available for that set of regressions.
through interviews with persons who are well informed about particular sectors.

Table I shows the t values of the regression coefficients pertaining to human- and physical capital variables in the equations formulated to explain the inter-industry composition of the revealed comparative advantage of Belgium and BLEU. In all regressions, the human capital has yielded a negative sign and all t values are significant\(^1\). The level of significance of this result is particularly high in the regressions pertaining to the internal EC trade. It is clearly lower for extra-EC trade which of course includes also the trade with the developing world. In one of such extra-EC trade regressions (nr 6) the t value only just manages to reach the 0.05 level of significance. In the regressions covering Belgium's trade with all destinations, the magnitude of the t values are, as could be expected, somewhere between those pertaining to the two sets of trade flows (internal-EC and extra-EC) previously mentioned.

In contrast to the performance of the human capital variable, the physical capital has yielded a positive sign in all regressions and is very highly significant. The t values are the highest in the regressions pertaining to the BLEU's extra-EC trade which contains also the trade with the developing countries. But they remain also very high in cases where regressions sought to explain BLEU's revealed comparative advantage in its internal EC trade, or Belgium's trade pattern with the world as a whole.

The message contained in the figures in table I is sharp and clear. Belgium or Belgium/Luxemburg has a revealed comparative disadvantage in the human capital intensive industries and a revealed comparative advantage in the physical capital intensive ones. And if the "revealed" comparative advantage reflects the "real" one, then in Belgium/BLEU, human capital is a relatively scarce factor while the physical capital endowment is abundant, according to the 'conventional' interpretation of the H-O-S theory.

But the results of the profits regressions presented in table II are at least equally surprising. For the same sample of industries and the same years, the inter-industry composition of profits is \textit{positively} and very significantly correlated with human capital. At the same time the t values pertaining to the physical capital have decreased substantially, turning insignificant in one

\(^1\) Unless otherwise stated, the term "significant" is used in this text to mean 0.05 level of significance.
TABLE I
Human Capital, Physical Capital and the revealed comparative advantage of Belgium and BLEU (t-ratios)

<table>
<thead>
<tr>
<th>N°</th>
<th>Dependent variable</th>
<th>Human Capital (CH)</th>
<th>Physical Capital (KA)</th>
<th>Number of Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Revealed comparative advantage of Belgium : all destinations</td>
<td>-3.86</td>
<td>6.09</td>
<td>456</td>
</tr>
<tr>
<td>2</td>
<td>Idem</td>
<td>-3.24</td>
<td>5.53</td>
<td>456</td>
</tr>
<tr>
<td>3</td>
<td>Revealed comparative advantage of BLEU : Internal EC-trade</td>
<td>-4.78</td>
<td>5.91</td>
<td>456</td>
</tr>
<tr>
<td>4</td>
<td>Idem</td>
<td>-4.34</td>
<td>5.48</td>
<td>456</td>
</tr>
<tr>
<td>5</td>
<td>Revealed comparative advantage of BLEU : Extra-EC-trade</td>
<td>-2.19</td>
<td>10.38</td>
<td>456</td>
</tr>
<tr>
<td>6</td>
<td>Idem</td>
<td>-1.88</td>
<td>10.30</td>
<td>456</td>
</tr>
</tbody>
</table>

Note: for the complete results pertaining to the specifications, see Table-A-I in the statistical annex.

Before proceeding to suggest some hypotheses to explain what appears, at first sight to be a double paradox, it is worth emphasizing that alternative formulations of the basic equations, sharper definition of the variables and repeated runs of the regressions showed these results to be very highly robust. No econometric sleight of hand produced them; none will take them away.
III. Some Explanatory Hypotheses

We feel that the following hypotheses merit being investigated in trying to explain the rather puzzling results reported above:

_Hypothesis 1: The Quality of Human Capital_

The term human capital of course refers to the productive qualities embodied in the labour-force. In the relevant literature, emphasis is placed in this context on the contributions of education and health, to the stock of human capital, although by and large the accent has been on the former, particularly in the case of high income countries where the development and diffusion of health services leave not much room for stark inter-country differences. The ambiguities inherent in the notion of human capital are well known and need no detailed repetition here (see Myrdal 1970, Balogh 1964). Some of these reservations have centered around the shortcomings of the indices used to measure investment in human capital (or human capital intensity), particularly the heterogenous character of the educational mix. Another shortcoming is the difficulty in distinguishing between the consumption and investment elements in such measures. Again such indices do not necessarily capture important elements such as on-the-job training and entrepreneurship. In spite of these limitations, the basic thrust of the argument of the proponents of investment in human capital has retained considerable force. Essentially it states that education, by imparting knowledge and skills and also by inculcating rational attitudes towards life, can increase efficiency and productivity of the labour force in addition to facilitating the necessary institutional reforms. All of these could influence significantly the comparative advantage of a country in international trade or the inter-industry differences in profitability.

As will be explained in more detail in the Statistical Annex, in our earlier research on this subject, a broader measure of human capital was used which was the ratio of white-collar workers to the total labour force. It was to clarify whether the puzzling results yielded by that particular version of the variable were partly due to its broader than usual definition, that in the present exercise the more conventional measure of human capital (the ratio of professional, technical and scientific workers to the total workforce) was retained. This sharpened variable, if anything, accentuated the apparent paradox.
### Table II

Human Capital, Physical Capital and the profitability of the Belgian industries (t-ratios)

<table>
<thead>
<tr>
<th>Nº</th>
<th>Dependent variable</th>
<th>Human Capital (CH)</th>
<th>Physical Capital (KA)</th>
<th>Number of Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Profits as percentage of turnover</td>
<td>5.95</td>
<td>1.95</td>
<td>456</td>
</tr>
<tr>
<td>2</td>
<td>Idem</td>
<td>5.98</td>
<td>1.57</td>
<td>456</td>
</tr>
<tr>
<td>3</td>
<td>Idem</td>
<td>5.81</td>
<td>2.47</td>
<td>456</td>
</tr>
<tr>
<td>4</td>
<td>Idem</td>
<td>5.83</td>
<td>2.05</td>
<td>456</td>
</tr>
</tbody>
</table>

Is the problem due to the fact that Belgian human capital, though abundant, is of low quality? The country’s educational system imposes high standards, but is sometimes said to be too rigid and academic. Is factual knowledge overemphasized compared with the acquisition of an ability to learn? There is no clear support of this hypothesis. The institutional investors who have been operating in Belgium do swear by the productive qualities of the Belgian workforce. Even leaders of international high technology industries established in Belgium seem to think highly of the thoroughness of methodology and intellectual flexibility imparted in particular by the Belgian secondary school system.

Another possible explanation is the very high level of personal taxation in Belgium (the second in the world). The brain drain from Belgium was, it is true, small in the period covered by our sample. It is however conceivable

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1 See the interview with the Director General of IBM, Belgium, *La Libre Belgique*, 30 Novembre 1987, p. 2.

2 See the striking comparative figures provided in the Bulletin de la Kredietbank, March 6, 1987, to which our attention was drawn by M. Dewatripont. These confirm the perception of the authors who, as university professors, have a grass roots perception of the phenomenon that may be no less reliable than statistical data. Our perception leads us to think however that, although until a few years ago, it was true that few of Belgium’s clever people emigrated to countries that offered better career opportunities (not only more money), this is no longer the case.
that Belgian enterprises, to maintain adequate net income incentives to skilled personnel, have had to offer them very high gross wages. This point came up several times in the case studies. Spokesmen of the Chemical Industry (one of the research intensive sectors) drew attention to the fact that a Belgian researcher with a gross salary of BF 2 million per year retains only 44.8 % of it after taxes while his counterpart in a similar income bracket will retain 75 % in the U.S., 72.4 % in France and 61.22 % in the Federal Republic of Germany.

Could entrepreneurship account for the difference? Our case studies showed that it is imaginative entrepreneurship which led industries which are not in the high technology group (for e.g. beer, tufted carpets, veneered and treated wood, chipboards) to perform well. But such an explanation based on the "missing component" would still leave unanswered the question why the human capital variable which is negatively correlated with Belgium’s comparative advantage turned positive in explaining the profitability of the same industries.

**Hypothesis 2 : Belgium is Poorly Endowed with Human Capital relative to its Main competitors :**

As mentioned earlier, interpreted within the framework of the trade theory, our regressions pertaining to the revealed comparative advantage suggest that Belgium has become poorly endowed with human capital particularly in relation to its main competitors, while the Belgian physical capital endowment remains abundant. More precisely, the implication of our results is that the ratio between the ratios of the endowment of human capital and physical capital in Belgium and in its competitors would be less than unity. In symbols, this hypothesized endowment relationship could be written as:

\[
[(ECH_B/EKA_B) < (ECH_IC/EKA_IC)]
\]

where ECH and EKA stand for the endowment of human capital and physical capital respectively, the subscript B represent Belgium and IC stands for Belgium's main competitors. The regressions suggest a similar endowment relationship between Belgium and the rest of the world, although here we should keep in mind that Belgium's trade with industrial countries accounts for a large share of its world trade.

To the best of our knowledge, the most recent published estimates of Belgium's human- and physical capital endowment comparable with those of other industrialised countries and the world as a whole are those carried out by CULEM (1984). Culem made those estimates on the basis of the data
put together by Leamer for his work on the sources of international com- parative advantage (see LEAMER 1984). Physical capital endowments were estimated on the basis of accumulated and discounted gross domestic investment flow since 1948, assuming an average life span of 15 years for the investment. Human capital was defined as the share of the professional, technical and scientific workers in the total active population. The figures pertained to the year 1975. Thus on the whole, the endowment figures pro- vided by CULEM (1984) can be corresponded with the factor intensity fi- gures used in our regressions.

Table III shows the relative factor endowment ratios we have calculated on the basis of the figures provided by CULEM (1984).

Belgium's human capital endowment relative to that of the industrialised countries is less than unity. But the physical capital endowment of Belgium relative to that of other industrialised countries (EKAB/EKAI C) is clearly higher than unity. The crucial ratio which compares the relationship between Belgium's human- and physical capital endowment with the industrialised countries shows clearly that human capital endowment is at a relative disadvantage in Belgium. These ratios are in conformity with the results we have obtained for the respective variables.

The ratios presented in table III also show that Belgium's relative physical capital abundance is clearly greater in comparison to that of the world. This also is in accordance with the regression results. In a direct comparison, the human capital endowment of Belgium does not appear to be at a disadvantage with that of the world as a whole. But the comparison of the human capital/physical capital endowment ratio of Belgium relative to that of the world [EHCB/EKAB/(EHCW/EKAW)] shows once again Belgium to be at a relative disadvantage as far as human capital endowment is concerned. Interestingly, our regression results confirm that interpretation of the endowment variable. The fact that the significance level of the human capital intensity variable in the corresponding regression (with the world) is lower than that obtained for the regressions pertaining to EC must be due to the fact that the obstacles to the trade of BLEU with the rest of EC is far less than in the case of the trade with the world as a whole.
### TABLE III
Relative factor endowment ratios: 1975

<table>
<thead>
<tr>
<th>No</th>
<th>Definition</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>([\text{EHC}<em>B/\text{EHC}</em>{IC}])</td>
<td>0.98</td>
</tr>
<tr>
<td>2</td>
<td>([\text{EKA}<em>B/\text{EKA}</em>{IC}])</td>
<td>1.27</td>
</tr>
<tr>
<td>3</td>
<td>([\text{EHC}<em>B/\text{EKA}<em>B)/(\text{EHC}</em>{IC}/\text{EKA}</em>{IC})])</td>
<td>0.77</td>
</tr>
<tr>
<td>4</td>
<td>([\text{EHC}_B/\text{EHC}_w])</td>
<td>1.68</td>
</tr>
<tr>
<td>5</td>
<td>([\text{EKA}_B/\text{EKA}_w])</td>
<td>3.15</td>
</tr>
<tr>
<td>6</td>
<td>([\text{EHC}_B/\text{EKA}_B)/(\text{EHC}_w/\text{EKA}_w])</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Meaning of symbols:

- \(\text{EHC}_B\): Human capital endowment of Belgium
- \(\text{EHC}_{IC}\): Human capital endowment of industrial countries
- \(\text{EKA}_B\): Physical capital endowment of Belgium
- \(\text{EKA}_{IC}\): Physical capital endowment of industrial countries
- \(\text{EHC}_w\): Human capital endowment of the world
- \(\text{EKA}_w\): Physical capital endowment of the world.

Note: Factor endowment figures for EC separately were not available in Culem (1984), but those pertaining to industrialised countries as a whole were.

**Hypothesis 3: Policy Induced Distortions to the Detriment of Human Capital**

Another hypothesis which can be clearly linked to the one sketched above (hypothesis 2) involves the longstanding emphasis in Belgium's industrial policies on subsidising the creation of physical capital, and the limited support that has gone to research. A precise quantification of the total amount of subsidies that have been provided to the Belgian industrial sector is of course difficult, because part of it consists of indirect help such as
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infrastructure development, state guarantees for loans, public procurement, fiscal concessions, etc. HEREMANS (1983) who made a careful analysis of the financing aspects of the regional industrial policy in Belgium during the period more or less corresponding to the one covered by this study, estimates that the total annual direct help to the industries in the form of subsidies amounted to about 150 billion Belgian francs. Out of this amount an important part went to the loss-making sectors. Heremans also notes that the so-called "national" sectors - coal, steel, ship-building, textiles and blown glass - were budgeted to receive 20 billion Belgian francs per year, without counting the help extended in the form of state guarantees. During the same period, the annual allocation for research and development work within the framework of the science policy amounted only to 8.5 billion Belgian francs. More recent estimates (SPPS 1985) show that the governmental intervention in favour of industrial research around the end of the period considered in this study amounted to about 5.6 billion Belgian francs.

In any case what is clear is that whether considered in terms of the research and development expenditure in industrial enterprises as a percentage of the gross national product or in terms of the ratio of research and development personnel in industrial enterprises to the active population, Belgium compares unfavourably with the main OECD countries and ranks below its main trading partners. The ratio of research and development in the industrial enterprises to the GNP in Belgium was about 1.1 % by 1981 while the corresponding figures for the Federal Republic of Germany and France were clearly higher and that of Holland marginally better (Korea : 1.7 %...). Similarly, the ratio of the research and development personnel to the active population in Belgium was far below that of Germany and lower than that of France and Holland (SPPS 1985).

If this "policy induced distortion hypothesis" is correct, it can largely explain the surprising results we have obtained in our regressions, particularly the opposing signs which the human capital variable yielded in the revealed comparative advantage and profits regressions respectively. The industrial subsidization policy which was apparently biased in favour of physical capital intensive industries did not necessarily prevent some of them from making persistent losses. Market forces would have normally wiped out the capacities mistakenly built up in the earlier period, but public policy chose to block this adjustment by granting further subsidies to firms experiencing difficulties, freezing in effect the unbalanced pattern of production and also freezing the resulting pattern of trade.

Whereas the trade regressions reflect a distorted pattern of trade, the profit regressions provide a better reflection of the inter-industry pattern of
competitiveness. In these regressions the human capital performs well in terms of the inter-industry composition of profitability while the physical capital which did very well in terms of "revealed" trade ratios has a much less significant result. This is apparently because inter-firm competition at the domestic level goes some way in cancelling out the subsidies granted to physical capital. This might suggest that Belgium in fact has a potential comparative advantage in the human capital intensive industries which might "reveal" itself if a more evenhanded industrial policy is followed.

Conclusion

Econometric research on the determinants of the inter-industry difference of revealed comparative advantage and profitability in Belgium showed that the former is negatively and significantly and the latter positively and significantly correlated with the human capital intensity. The physical capital intensity on the other hand was positively and very significantly correlated to the revealed comparative advantage of Belgium but in the regressions for profitability, that variable's performance was less consistent. This pattern of results proved to be quite robust. Within the logic of the factor proportions and neo-factor proportions theories, these results suggest that human capital has become a relatively scarce factor in Belgium while the endowment of the physical capital has remained abundant. The results obtained for the "profits regressions" raise strong doubts about the validity of such an interpretation.

In examining different hypotheses which could explain this apparent paradox, we tend to favour the view that the bias in the public policy in favouring the physical capital at the detriment of human capital has distorted the pattern of production and consequently distorted the pattern of trade. But the inherent relative strength of the human capital endowment in Belgium comes through in the profit regressions where the intensity of that variable has a clearly positive and significant impact. On the other hand, the rather misleading extent of the strength shown by the physical capital intensity in the trade regressions loses its robustness because inter-firm competition within industries cancels out at least part of the effect of the subsidies and leaves them no better off as far as profitability is concerned. It appears that, contrary to what the trade regressions results suggested, Belgium might have an inherent comparative advantage in human capital intensive industries, which should reveal itself if a more even-handed economic policy is followed.
Bibliography


Statistical Annex


The theoretical basis of the empirical exercise carried out in this study is a synthesis of the factor-proportions theory, the neo-factor-proportions versions of it, the imperfect competition explanations of international trade and elements of commercial policy theory. The capital/labour ratios (KA) used in our regressions represent the core of the factor proportions theory which hold that the commodity composition of trade between countries will be determined by the concordance of the pattern of the factor endowment of trading countries with the factor intensities of the production processes of the commodities traded. Similarly, the Human Capital variable (HC) takes into account the proposition advanced by the neo-factor proportions theorists who hold that the concordance between the endowment of human capital (as distinct from the physical capital) and the human capital intensity of the production process is an important determinant of the commodity composition of trade.

The imperfect competition theory of international trade is at present one of the most dynamic areas in international economics and it takes into account some of the determinants of the commodity composition of trade which the factor proportions theories assume away. The variables representing economies of scale (EE) and the two concentration indices (CON1, CON2) used in our regressions reflect important aspects of the theoretical developments in this field.

The third group of variables allows for the impact of protection on comparative advantage and profits. Both tariff protection (TP) and non-tariff barriers (QUOT) were taken into account. The theory of protection suggests that the structure of protection might have a "protective effect" or a "lobbying effect". If the former prevails, the inter-industry structure of protection will have a "positive" effect on the "revealed" comparative advantage by reducing the imports. If the "lobbying effect" prevails, the correlation will be negative as protection will tend to concentrate in the weak sectors.

In the specification of the profits regressions, in addition to the above variables, two indices of "openness" (OUV1, OUV2) were also used. The Belgian franc was overvalued during much of the period for which data were available. This, it was thought, could bias the results as the rate of profits could be different in the "sheltered" sectors where trade is small than in industries whose trade is large.

A.2. Definition of Variables

The "Balassa-index" of revealed comparative advantage (RCA) used in the present study was defined as :

\[ \text{RCA}_i = \frac{\frac{X_i}{M_i}}{\frac{X_t}{M_t}} \]

(1)
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where \( \text{RCA}_i = \text{revealed comparative advantage of sector } i, \)
\( X_i = \text{value of the exports of sector } i, \)
\( M_i = \text{value of imports of sector } i, \)

\[
X_t = \sum_i X_i
\]
\[
M_t = \sum_i M_i
\]

This measure was calculated using Belgian export and import figures (RCABET). Secondly, it was calculated for the international European Community trade (RCABLEU I), and extra-EC trade (RCABLEUX) for the BLEU (separate data for these flows were not available for Belgium). These three measures were calculated using trade data for the years 1977-1982.

The profits variable (PROF) was quantified as:

\[
(2) \quad \frac{\text{profits} + \text{depreciation}}{\text{turnover}} \cdot 100
\]

and was calculated for each of the sectors and years corresponding to the RCA variable.

Human capital (CH) was quantified as:

\[
(3) \quad \frac{\text{number of scientific, professional and technical workers}}{\text{total number of workers}} \cdot 100
\]

This variable was calculated for each of the sectors corresponding to those of the above-mentioned variables RCA and PROF. Since the data necessary for calculating this particular version of human capital are available only from the decennial census, it pertains to 1981. Inter-industry rankings of human capital do not, of course, change within very short periods.

In the original research which led to the present study, human capital intensity was quantified as the ratio of white collar workers to the total number of workers in each sector in the sample. The data necessary for calculating that particular version of human capital were available for every one of the years included in the sample. In the corresponding regressions, that version of human capital also yielded negative and significant results (see Tharakan, Waelbroeck, Verstraelen and Senhadji, 1988). The present, more conventional and rigorous definition of human capital was in fact used to further ascertain if the results obtained earlier were really robust. Note that the Spearman rank correlation between CH and the earlier version of the variable for 1981 was 0.77.
Economies of scale (EE) was estimated as:

\[
(4) \quad \frac{\text{value added in the industry}}{\text{the total number of firms in the industry}}
\]

This index represents a sort of "revealed" economies of scale.

Industrial concentration was measured in two alternative ways (CON1, CON2):

\[
(5) \quad \text{CON1} = C_{4d} = \sum_{i=1}^{4} \left( \frac{\text{TO}_i}{\text{TO}_t} - \frac{X_i}{X_t} \right)
\]

where:
- \( \text{TO}_i \) = total turnover of firm \( i \)
- \( X_i \) = exported turnover of firm \( i \)
- \( \text{TO}_t \) = total turnover of the industry
- \( X_t \) = turnover exported by the industry.

\[
(6) \quad \text{CON2} = \frac{C_4 \text{ Firm}}{C_4 \text{ Establishment}}
\]

where:
- \( C_4 \text{ Firm} \) = the share of the four biggest firms in the total turnover of the industry
- \( C_4 \text{ Establishment} \) = the share of the four biggest establishments in the total turnover of the industry.

The first of these two measures is standard in this type of work. The interpretation of the second is less obvious. A high value of that indicator (CON2) suggests that large firms are split into several smaller establishments and that the coordination of various production units is easily achieved in such industries (JACQUEMIN, DE GHELINCK AND HUVEENERS, 1978). We suggest that this type of industries are those in which multinationals are predominant. The data pertaining to the concentration variables were available for only one year each (CON1 in 1976 and CON2 in 1973). But the inter-industry composition of concentration does not vary over a short period of time.

Tariff protection \( (TP_i) \) was defined as follows:

\[
(7) \quad TP_i = \frac{\text{DD}_i}{\text{MT}_i} \cdot \frac{\text{MTB}_i}{\text{ME}_i} \cdot 100
\]

where:
- \( \text{DD}_i \) = value of tariffs on the imports of sector \( i \) into Belgium,
- \( \text{MT}_i \) = value of the imports of sector \( i \),
- \( \text{MTB}_i \) = value of imports of sector \( i \) for BLEU,
- \( \text{ME}_i \) = value of the imports from extra-EC countries in sector \( i \) in BLEU.
The weighting procedure implied in equation (7) takes into account the fact that tariffs apply only to imports from extra-EC countries. The variable was quantified for the years 1978 to 1982. For 1977, the average of the 6 available years was used.

Non-tariff barriers (QUOT) were proxied by a dummy variable as follows:

\[
(8) \quad \text{QUOT} = 1 \quad \text{where non-tariff barriers exist;} \\
\quad \text{QUOT} = 0 \quad \text{where there are no non-tariff barriers.}
\]

The "openness variable" was relevant only for the profit regressions. Two alternative measures were developed as follows:

\[
(9) \quad \text{OUV1}_i = \frac{X_i + M_i}{2TO_i} \cdot 100
\]

where:
- \( X_i \) = exports of sector \( i \),
- \( M_i \) = imports of sector \( i \), and,
- \( TO_i \) = turnover of sector \( i \).

\[
(10) \quad \text{OUV2}_i = \frac{M_i}{(TO_i + M_i)X_i} \cdot 100
\]

where the symbols have the same meaning as in equation (9).

A.3. Specifications

The basic regressions formulated to explain the inter-industry composition of the revealed comparative advantage of Belgium's total trade (\( \text{RCA}_{\text{BT}} \)) and the inter-EC trade (\( \text{RCA}_{\text{BLEU}} \)) and extra-EC trade (\( \text{RCA}_{\text{BLEU} X} \)) of BLEU were specified as follows:

\[
(11) \quad \text{RCA}_{\text{BT}} = f(\text{CH}, \text{KA}, \text{EE}, \text{CON1}, \text{TP}, \text{QUOT})
\]

\[
(12) \quad \text{RCA}_{\text{BT}} = f(\text{CH}, \text{KA}, \text{EE}, \text{CON2}, \text{TP}, \text{QUOT})
\]

\[
(13) \quad \text{RCA}_{\text{BLEU} \ I} = f(\text{CH}, \text{KA}, \text{EE}, \text{CON1})
\]

\[
(14) \quad \text{RCA}_{\text{BLEU} \ I} = f(\text{CH}, \text{KA}, \text{EE}, \text{CON2})
\]

\[
(15) \quad \text{RCA}_{\text{BLEU} X} = f(\text{CH}, \text{KA}, \text{EE}, \text{CON1}, \text{TP}, \text{QUOT})
\]

\[
(16) \quad \text{RCA}_{\text{BLEU} X} = f(\text{CH}, \text{KA}, \text{EE}, \text{CON2}, \text{TP}, \text{QUOT})
\]

The regressions formulated to explain the inter-industry composition of profits (PROF) were written as follows:

\[
(17) \quad \text{PROF} = f(\text{CH}, \text{KA}, \text{EE}, \text{CON1}, \text{TP}, \text{QUOT}, \text{OUV1})
\]

\[
(18) \quad \text{PROF} = f(\text{CH}, \text{KA}, \text{EE}, \text{CON2}, \text{TP}, \text{QUOT}, \text{OUV1})
\]

\[
(19) \quad \text{PROF} = f(\text{CH}, \text{KA}, \text{EE}, \text{CON1}, \text{TP}, \text{QUOT}, \text{OUV2})
\]

\[
(20) \quad \text{PROF} = f(\text{CH}, \text{KA}, \text{EE}, \text{CON2}, \text{TP}, \text{QUOT}, \text{OUV2})
\]
The observations for the 6 years were pooled. The equations were estimated using Ordinary Least Squares.

A.4. Regression results

The results (t-values) of the revealed comparative advantage regressions (equations 11 to 16) are given in Table A.1. The performance of the human and physical capital was discussed in detail in the main text and will not be repeated here. Another variable which performed consistently is CON2, i.e. the concentration variable which reflects the smooth coordination of various production units within large establishments. If our suggestion that such coordination is more smoothly achieved by multinationals, the positive and significant result of the CON2 variable indicates the relatively high export propensity of the multinationals established in Belgium. The tariff protection variable (TP1) has systematically yielded a negative sign, suggesting the prevalence of "lobbying effect" but the coefficients have no acceptable levels of significance. Interestingly, the dummy representing the non-tariff barriers yields a negative and rather significant results in the regressions for the extra-EC trade of BLEU. This too suggests the prevalence of the lobbying effect, indicating that non-tariff barriers tend to appear in sections vulnerable to imports. But a curious result is that in the regressions for the RCA in the total trade of Belgium, the variable QUOT gives a positive and significant result. Since this trade flow involves also the internal EC trade where the incidence of such measures might be different from that in the case of extra-EC trade, not much should be read into this result.

The only other explanatory variable yielding results of some interest is the Economics of scale (EE) which has a negative sign and is significant in the regressions pertaining to the extra-EC trade while it is not significant in the other regressions. One possible explanation is that the existence of the tariff and non-tariff barriers against Belgian exports to non-EC countries discriminates against industries exploiting high economies of scale.

As is usual of this kind of cross-section regressions, the coefficients of determination obtained are not high. After all, econometric analysis of this type captures only the general causes. As mentioned in the main text, we investigated the industry specific causes reflected in the large residuals by undertaking a series of case studies. Note also that the F-tests which shows the significance of the regression as whole verifies that the null hypothesis can be rejected and we conclude that each one of the equations is significant as a whole.

The results of the profits regressions (equations 17 to 20) are reported in Table A.2. In this case too the performance of the important human and physical capital variables have been discussed in the main text. The only other variable which yields a somewhat significant and consistent performance is the non-tariff protection (QUOT). Its sign is, in all cases, positive and in two out of four alternative specifications, the coefficient is significant. So it is likely that the non-tariff barriers have partially contributed to the profits earned by the Belgian industries. But this result is not robust. It is also interesting to note that the two alternative formulations of the "openness variables" yield negative signs, but the coefficients are not significant. Neither of the concentration variables have yielded results with acceptable levels of significance. So, while the industries which are presumably dominated by the activity of the multinationals might register good trade performance, there is no special reason to believe that such dominance necessarily raises the competitiveness of the industry as a whole reflected in the profit rates. The economies of scale have yielded no significant results in any of the alternative formulations. The coefficients of determination are low which is to be expected not only because of the cross-sectional na-
ture of the sample, but also due to the fact that the inter-industry composition of profits are predominantly influenced by industry-specific factors. The F-statistic is highly significant. Finally, a careful analysis of the correlation matrix of the variables showed no reason to believe that the results obtained in the regressions have been biased by the existence of multicollinearity.
<table>
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<tr>
<th>No.</th>
<th>Dependent variable</th>
<th>Human Capital</th>
<th>Physical Capital</th>
<th>Economie of scale</th>
<th>Concentration variables</th>
<th>Protection variables</th>
<th>R²</th>
<th>F-statistic</th>
<th>Number of observations</th>
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<tr>
<td>1</td>
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<td>0.86</td>
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<td>Table A.2: Regressions for the profitability of Belgian industries (t-ratios)</td>
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<td><strong>Human Capital</strong></td>
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<td><strong>R²</strong></td>
<td><strong>F-statistic</strong></td>
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