The Dynamics of Agri-Food Trade Patterns - The Hungarian Case

Imre Fertő and L J Hubbard

Institute of Economics
Hungarian Academy of Sciences
and
School of Agriculture, Food and Rural Development
University of Newcastle upon Tyne, UK

ferto@econ.core.hu
lionel.hubbard@ncl.ac.uk

Contributed paper selected for presentation at the 25th International Conference of Agricultural Economists, August 16-22, 2003, Durban, South Africa

The Dynamics of Agri-Food Trade Patterns - The Hungarian Case

Abstract

We analyse the evolving pattern of Hungary's agri-food trade using recently developed empirical procedures based on the classic Balassa index and its symmetric transformation. The extent of trade specialisation exhibits a declining trend; Hungary lost comparative advantage for a number of product groups over the 1990s. The indices of specialisation have also tended to converge. For particular product groups, the picture is mixed: indices are reasonably stable for product groups with comparative disadvantage, but those with weak to strong comparative advantage show significant variation. The results reinforce the finding of a general decrease in specialisation, but do not support the idea of self-reinforcing mechanisms, emphasised strongly in much of the endogenous growth and trade literature.

Keywords international trade, revealed comparative advantage, Hungary

1. Introduction

Recently, there has been renewed interest in the analysis of agricultural trade between East and West Europe (e.g. Eiteljörge and Hartmann, 1999; Frohberg and Hartmann, 1999; Bojnec, 2001; Fertő and Hubbard, 2003). However, this has tended not to deal with the evolution of trade patterns, even though the theoretical literature on growth and trade stresses that comparative advantage is dynamic and develops endogenously over time. In particular, one strand of the literature (Lucas, 1988; Young, 1991; Grossman and Helpman, 1991) has demonstrated that the growth rate of a country may be permanently reduced by a 'wrong' specialisation. Another strand emphasises the role of factor accumulation in determining the evolution of international trade (Findlay, 1970, 1995; Deardorff, 1974).

In this paper we apply recently developed empirical methods in a preliminary analysis of the dynamics of Hungarian agri-food trade patterns. The paper is organised as follows. Section 2 briefly reviews some of the theoretical literature concerning the dynamics of trade patterns. Section 3 outlines the measurement of trade specialisation, while section 4 describes the empirical procedures we apply. Our results are reported and discussed in section 5, with a summary and some conclusions presented in section 6.

2. Trade Dynamics

The standard Heckscher-Ohlin model implies that the pattern of trade specialisation changes only if trading partners experience a change in their relative factor endowments. This suggests that the existence of persistent trade patterns is perfectly consistent with the model, if relative factor endowments of countries do not change significantly with respect to their main trading partners. New trade theory emphasises the importance of increasing returns to scale, which complicates prediction because of the specific assumptions needed about the nature of the scale economies. If economies of scale are internal to the firm, then the main implications of the factor proportions theorem do not change (Helpman and Krugman, 1985; Krugman, 1987). This may also be the case if economies are external to the firm but negligible with respect to factor intensity (Kemp, 1969; Markusen, 1981). However, in some models economies of scale can have a significant impact on trade outcomes (Wong, 1995).

Grossman and Helpman (1990, 1991), under the assumption that knowledge spillovers are international in scope, have shown that the history of the production structure of a country does not affect its long-run trade pattern, which depends only on the relative factor endowments. But other models show that dynamic scale economies arising from 'learning by doing' are country-specific, which suggests a lock-in effect for the pattern of specialisation. Krugman (1987) and Lucas (1988) demonstrate that in the presence of dynamic scale effects, the long-run trade pattern is determined by initial comparative advantage. Although varied in nature and outcomes, one of the main implications of the new trade models is that the pattern of trade tends to become more specialised. Yet Proudman and Redding (2000) focus on international trade and endogenous technical change and illustrate that a precisely specified model yields ambiguous conclusions as to whether trade patterns display persistence or mobility over time; they conclude that it is ultimately an empirical question.

3. Measuring Trade Specialisation

The most popular indicator of a country's trade specialisation is the Revealed Comparative Advantage (RCA) index first proposed by Balassa (1965):

(1) $B = (x_{ij} / x_{tj}) / (x_{in} / x_{tn})$

where x represents exports, i is a commodity, j is a country, t is a set of commodities and n is a set of countries. B is based on observed trade patterns; it measures a country's exports of a commodity in relation to its total exports and to the corresponding export performance of a set of countries. If B>1, then a comparative advantage is revealed, that is a sector in which the country is relatively more specialised.

Many researchers have attempted to refine revealed comparative advantage (e.g. Donges and Riedel, 1977; Kunimoto, 1977; Bowen, 1983; and Vollrath, 1987, 1989 and 1991). Iapadre (2001) provides a critical overview on the most commonly used devices for measuring international specialisation. Here we focus only on the B index.

A problem with the Balassa index is that its value is asymmetric; it varies from one to infinity for products in which a country has a revealed comparative advantage, but only from zero to one for commodities with a comparative disadvantage. This asymmetry creates at least two problems. First, if the mean of the B index is higher than its median, then the distribution of B will be skewed to the right. This means that the relative weight of sectors with B>1 will be overestimated compared to sectors with B<1 (De Benedictis and Tamberi, 2001). This issue has a bearing on econometric work focusing on revealed comparative advantage patterns, as Dalum et al. (1998 p. 427) point out: "A skewed distribution violates the assumption of normality of the error term in regression analysis ... In addition, the use of the B in regression analysis gives much more weight to values above one, when compared with observations below one."

Second, a methodological problem arises when one applies the logarithmic transformation of the Balassa index, because a change in B from 0.01 to 0.02 has the same impact as a change from 50 to 100. (This criticism also applies to some other RCA indices.) Dalum et al. (1998) propose a revealed symmetric comparative advantage (RSCA) index to alleviate the skewness problem:

(2) $RSCA = (B-1) / (B+1)$.

The RSCA ranges from minus one to plus one and avoids the problem of zero values, which arises in the logarithmic transformation. The main advantage of this approach is that changes below unity have the same weight as changes above unity. But the disadvantage is that forced symmetry does not necessary imply normality in the error terms and may hide some of the B dynamics (De Benedictis and Tamberi, 2001).

A further problem with the B index, as noted by Proudman and Redding (2000), is that its arithmetic mean across sectors is not necessarily equal to one. The numerator in equation (1) is unweighted by the share of total exports accounted for by a particular product group, while the denominator is a weighted sum of export shares of all commodities. Hence, if a country's trade pattern is described by high export shares in a few sectors, which account for a small share of exports to the reference market, this implies high values for the numerator and low values for the denominator. This yields a mean value of B above one in a given country. Moreover, average values of B may change over time, hence a country may misleadingly display changes in its average extent of specialisation as measured by the B index. Proudman and Redding propose an alternative measure of revealed comparative advantage in which a country's export share in a given product group is divided by its mean export share in all commodity groups:

$$(3)\quad \overline{B}_{ij} = \frac{B_{ij}}{\frac{1}{n}\sum_{i} B_{ij}}.$$

The mean value of the normalised B in (3) is constant and equal to one. The interpretation of this index is that one normalises the B measure by its cross-section mean in order to abstract from changes in the average extent of specialisation. However, De Benedictis and Tamberi (2001) point out that the procedure is not satisfactory; the normalised B index loses its consistency with respect to the original B, because it may display the opposite status where the B value falls in the range between one and its mean.

Earlier, Hillman (1980) had investigated the relationship between the B index and comparative advantage as indicated by pre-trade relative prices, abstracting from considerations caused by the possibility of government intervention on exports. He showed that the B index is not appropriate for cross-commodity comparison of comparative advantage, because in this case the value of B is independent of comparative advantage in the Ricardian sense of pre-trade relative prices. Yeats (1985) provided empirical evidence that the B index in the country-industry approach fails to serve as an appropriate cardinal or ordinal measure of a country's RCA. But he also noted that the quantitative evidence developed by the RCA approach is fully consistent with the prediction of factor proportion theory.

Hillman (1980) developed a condition that has to be fulfilled to obtain a correspondence between the B index and pre-trade relative prices in cross-country comparisons for a given product. He showed that comparative advantage according to pre-trade relative prices requires the following necessary and sufficient condition:

$$(4)\ 1-\frac{X_{ij}}{W_i} > \frac{X_{ij}}{X_j}\left(1-\frac{X_j}{W}\right),$$

where X_{ij} is exports of commodity i by country j, X_j is total exports of country j, W_i is world exports of commodity i, and W is the world's total exports. Assuming identical homothetic preferences across countries, the condition in equation (4) is necessary and sufficient to guarantee that changes in the B index are consistent with changes in relative factor-endowments. This condition guarantees that growth in the level of a country's exports of a commodity results in an increase in the B index. For an empirical test, Marchese and Nadal de Simone (1989) transformed Hillman's condition into the following form:

$$(5)\ \ HI = \left(1-\frac{X_{ij}}{W_i}\right) / \frac{X_{ij}}{X_j}\left(1-\frac{X_j}{W}\right).$$

If HI is larger than unity, the B index used in cross country comparison will be a good indicator of comparative advantage. The authors argued that Hillman's index should be calculated in any empirical research attempting to identify the long-term implications of trade liberalisation using the B index. However, only two studies appear to have applied Hillman's index. Marchese and Nadal de Simone (1989) show that Hillman's condition is violated in less than 10 per cent of exports of 118 developing countries in 1985, and in the data set used by Hinloopen and Van Marrewijk (2001) it is violated for only 7 per cent of export value and less than 1 per cent of the number of observations. These results suggest that Hillman's condition is less restrictive than might have been expected.

4. Empirical Model and Procedures

We use an approach following Brasili et al (2000), Proudman-Redding (2000) and Hinloopen and van Marrewijk (2001). Whereas these studies concentrate exclusively on manufacturing sectors, we focus on agri-food sectors and investigate the stability in the pattern of the B indices for Hungary.

Some specifications measure RCA at the global level (e.g. Vollrath, 1991), others at a regional or sub-global level (as in Balassa's original specification), whilst some restrict the analysis to bilateral trade between just two countries or trading partners (e.g. Dimelis and Gatsios, 1995; Gual and Martin, 1995). Given that we are interested in the dynamics of the agri-food trade pattern of Hungary, the B index is calculated in a world context.

Following Marchese and Nadal de Simone (1989), the B indices calculated from our data set are found to be fully consistent with Hillman's condition.

Our investigations are focused mainly on the stability of the B index over time. One can distinguish at least two types of stability: (i) stability of the distribution of the B indices from one period to the next; and (ii) stability of the value of the B indices for particular product groups from one period to the next (Hinloopen and Van Marrewijk, 2001).

The first type of stability is investigated in three ways. First, applying the procedure of Hinloopen and Van Marrewijk (2001) we focus on the probability density function and the cumulative distribution. Second, after Dalum et al. (1998) we use regression analysis to test whether the degree of B changes. To alleviate the skewness issue relating to the B index, Dalum et al used RSCA (equation 2) and estimated:

(6) $RSCA_{ij}^{t2} = \alpha_i + \beta_i RSCA_{ij}^{t1} + \varepsilon_{ij}$,

where superscripts t1 and t2 describe the start year and end year, respectively. The dependent variable, RSCA at time t2 for commodity i in country j, is tested against the independent variable which is the value of RSCA in year t1; α and β are standard linear regression parameters and ε is a residual term. If β=1, then this suggests an unchanged pattern of RSCA between periods t1 and t2. If β>1, the country tends to be more specialised in product groups in which it is already specialised, and less specialised where initial specialisation is low. In other words, the existing specialisation of the country is strengthened. If 0< β<1, then commodity groups with low (negative) initial RSCA indices grow over time, while product groups with high (positive) initial RSCA indices decline. The special case where β<0 indicates a change in the sign of the index. However, Dalum et al. (1998) point out that β>1 is not a necessary condition for growth in the overall specialisation pattern. Thus, following Cantwell (1989), they argue it can be shown that:

(7a) $\sigma_i^{2t2} / \sigma_i^{2t1} = \beta_i^2 / R_i^2$,

and hence,

(7b) $\sigma_i^{t2} / \sigma_i^{t1} = |\beta_i| / |R_i|$,

where R is the correlation coefficient from the regression and σ^2 is the variance of the dependent variable. It follows that the pattern of a given distribution is unchanged when β=R. If β>R the degree of specialisation has grown, while if β<R the degree of specialisation has fallen.

The third way in which the stability of the distribution of B is examined seeks to measure the extent to which Hungarian agri-food exports have become *relatively* more or less specialised over the period. This is undertaken using the Gini coefficient as a measure of concentration (see, for example, Amiti, 1998). The Gini coefficient is used as a summary measure of the difference in the structure of exports between Hungary and the world. The closer the Gini coefficient is to its upper bound of 1, the greater the difference in structure and specialisation of Hungarian agri-food exports vis-à-vis the world.

The second type of stability, that of the value of the B indices for particular product groups, is examined following a recent empirical method pioneered by Proudman and Redding (2000) and applied by Brasili et al. (2000) and Hinloopen and Van Marrewijk (2001). A Markovian transition probability matrix is estimated to identify the persistence and mobility of revealed comparative advantage as measured by the B index. Following Hinloopen and Van Marrewijk (2001), we divide the B index into four classes:

Class a: $0 < B \leq 1$;

Class b: $1 < B \leq 2$;

Class c: $2 < B \leq 4$;

Class d: $4 < B$.

Class a refers to all those product groups without a comparative advantage. The other three classes, b, c, and d, describe the sectors with a comparative advantage, roughly classified into weak comparative advantage (class b), medium comparative advantage (class c) and strong comparative advantage (class d).

5. Dynamics of Hungarian Agri-Food Trade

We focus on Hungary's agri-food trade patterns at the global level over the period 1990-2000. The data are supplied by UNCTAD at the three-digit level of the SITC and contain 61 product groups. Contrary to most empirical studies, we measure the B index with respect to total merchandise exports and total world exports.

5.1 Stability of the Distribution of B

The distribution of the B indices in the start and end years of the period are given in Figure 1, which shows estimates of the probability density functions for 1990 and 2000. Both distributions are asymmetric and right-skewed. Note that contrary to the expectation of Hinloopen and Marrewijk (2001), the distribution of the indices is not monotonically decreasing. The distribution shifted up between 1990 and 2000, suggesting an increase in the number of below zero sectors. In other words, Hungary lost some of its revealed comparative advantage in agri-food sectors over the period. However, the distribution did not move to the right, indicating no increase of international specialisation. The statistical significance of the movement in the distribution of B indices was performed using a two-tailed Wilcoxon signed rank test. This was chosen instead of the more traditional t-test because it does not require the assumption of normality in the distribution of the data. The null hypothesis of no difference in the distributions was rejected at the 5% level.

Table 1 provides three types of information on the distribution of the B index over all eleven years of the period. First, percentile points P-z are reported, where z ranges from 5 to 95. This shows information on the cumulative distribution of the B index. For example, in 1990 the P-25 point is 0.16, which means that 25 per cent of the observations in 1990 had a B index below 0.16. Second, some summary statistics on the distribution are presented - the mean, the maximum and the standard deviation. Third, the B index points B<y are reported, where y varies from 1 to 8. For example, the B<4 point in 1990 is 0.82, indicating that 82 per cent of the observations had a B index of below 4.

It is clear from Table 1 that the P-z values have declined over time. While 50 per cent of the observations in 1990 had a B index below 0.83, this value was only 0.55 in 2000. That is, the distribution has shifted to the left. However, the mean of the B index fell significantly only after 1996. Nevertheless, the evidence indicates that the global comparative advantage in Hungarian agriculture has worsened. The proportion of product groups with a B index below one (B<1) rose from 55 per cent to 67 per cent between 1990 and 2000, i.e. some product groups lost their comparative advantage. Furthermore, comparing initial year and final year values of the last three rows (B<2 to B<8), we may conclude that comparative advantage lessened for commodity groups having weak and strong comparative advantage, whilst the percentage of groups revealing medium comparative advantage increased.

Figure 1 Distribution of the B index for Hungary, 1990 and 2000

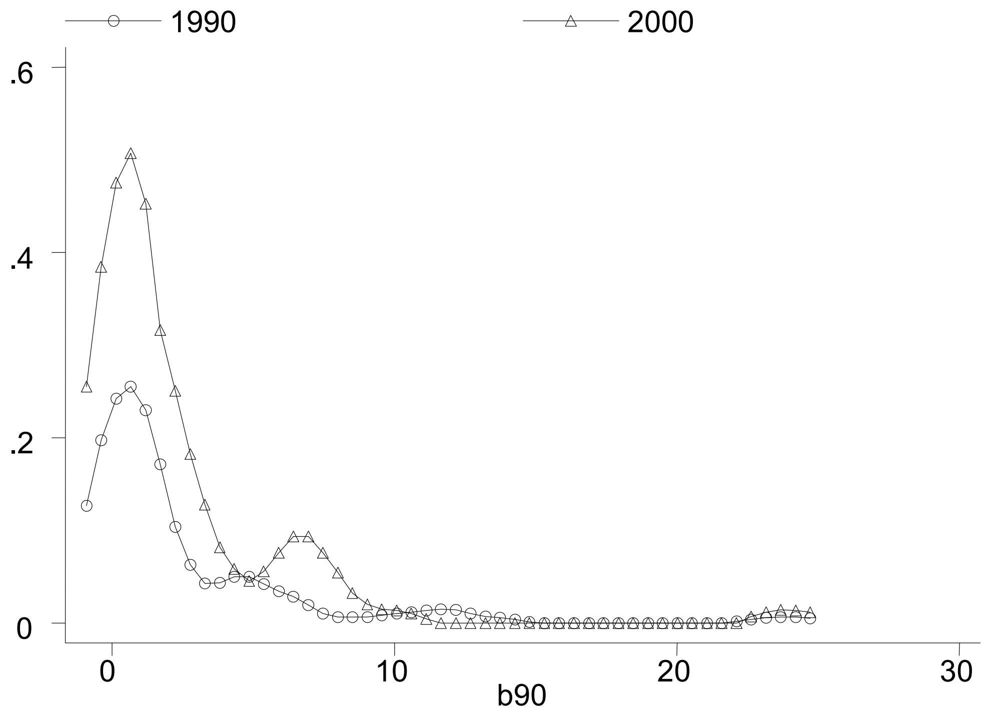

Table 1 Distribution of the B index, 1990-2000

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
P-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P-10	0.01	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00
P-25	0.16	0.17	0.13	0.28	0.17	0.09	0.13	0.06	0.13	0.10	0.05
P-50	0.83	0.91	1.08	0.74	0.82	0.84	1.06	0.74	0.71	0.59	0.55
P-75	3.19	3.04	2.79	2.46	2.44	2.60	2.48	2.17	2.27	1.56	1.39
P-90	5.88	7.94	5.55	5.40	4.98	5.97	6.03	4.46	3.30	2.93	3.31
P-95	10.89	11.06	9.73	8.76	8.21	8.28	8.03	5.47	4.95	4.36	3.62
mean	2.37	3.18	2.45	2.15	2.03	2.08	2.15	1.66	1.38	1.17	1.16
maximum	23.83	45.78	29.56	21.02	15.88	14.28	18.04	10.80	9.12	10.43	11.89
st. deviation	4.05	6.55	4.40	3.58	3.11	2.94	3.12	2.20	1.75	1.76	1.85
B<1	0.55	0.51	0.49	0.58	0.55	0.55	0.46	0.57	0.58	0.67	0.67
B<2	0.73	0.68	0.66	0.69	0.64	0.67	0.66	0.74	0.73	0.83	0.83
B<4	0.82	0.76	0.83	0.86	0.87	0.84	0.85	0.85	0.91	0.94	0.97
B<8	0.93	0.90	0.94	0.94	0.94	0.94	0.95	0.98	0.99	0.99	0.99

Source: Based on UNCTAD SITC code data at three-digit level.

The relatively high β values in Table 2 reveal that trade patterns have not altered considerably from one year to the next. The β/R ratios show that the pattern of revealed comparative advantage has converged. Furthermore, they suggest that the dispersion in the distribution of the B index has been stable. Contrary to the intention of the normalisation approach proposed by Dalum et al. (1998) and Laursen (1998), the Jarque-Bera tests report non-normality in the error terms for 7 of the 10 regressions.

Table 2 Stability of the B index

	α	β	R	β/R	J-B*
1991	-0.22	0.66	0.72	0.92	4.95
1992	-0.25	0.68	0.76	0.89	29.94
1993	-0.23	0.78	0.89	0.88	121.80
1994	-0.20	0.80	0.86	0.93	26.53
1995	-0.19	0.82	0.91	0.90	0.85
1996	-0.19	0.82	0.94	0.87	3.67
1997	-0.22	0.80	0.89	0.90	38.03
1998	-0.16	0.82	0.90	0.91	102.68
1999	-0.12	0.91	0.93	0.98	24.69
2000	-0.03	0.98	0.96	1.02	202.13

Source: Based on UNCTAD SITC code data at three-digit level.

Note: * Jarque-Bera test: $\chi^2_{2,5\%} = 5.99$.

The extent to which Hungarian agri-food exports have become relatively more or less specialised over the period, vis-à-vis the world, is shown by the Gini coefficients in Table 3. In general, these have decreased, indicating that Hungary's exports have become less specialised in relation to global exports. Regressing the log of the Gini coefficients on a simple time trend (see, for example, Amiti, 1998), there is a significant decrease in specialisation of around 1% per annum.

Table 3 Gini Coefficients based on B indices

Year	Gini coefficient
1990	0.71
1991	0.73
1992	0.69
1993	0.69
1994	0.68
1995	0.67
1996	0.66
1997	0.65
1998	0.62
1999	0.66
2000	0.67

5.2 Intra-distribution Dynamics

Further information on the dynamics of the B index can be obtained by analysis of Markovian transition matrices. Our estimated transition matrix in Table 4 is based on the eleven-year period, and shows the probability of passing from one state to another between the start year (1990) and end year (2000).

Table 4 Transition probabilities of B index

B	a	b	c	d
a	0.82	0.12	0.06	0.00
b	0.82	0.18	0.00	0.00
c	0.50	0.33	0.17	0.00
d	0.18	0.09	0.55	0.18
initial distribution	0.54	0.18	0.10	0.18
final distribution	0.67	0.15	0.15	0.03
limit distribution	0.80	0.14	0.06	0.00

Source: Based on UNCTAD SITC code data at three-digit level.

The transition matrix suggests that values of the B index are fairly persistent from 1990 to 2000 for observations with a comparative disadvantage (class a). The diagonal element of 0.82 indicates the probability of a product with a comparative disadvantage in 1990 having that same status at the end of the period. However, indices in classes b, c and d display a considerable variation in their pattern. The probability of a loss of comparative advantage for those observations starting with a weak comparative advantage (class b) are high (0.82), whilst the probability of a move from class c (medium comparative advantage) to class a is 0.50. There is a zero per cent chance of moving from class a, b or c to class d (high comparative advantage) and the probability of an observation remaining in class d is only 0.18. The limit distribution suggests a 'worse case scenario' should these trends continue.

6. Summary and Conclusions

In this paper we have described the changing pattern of Hungarian revealed comparative advantage in agri-food trade. As a measure of trade specialisation we have employed the classic Balassa index and its symmetric transformation. The main empirical findings can be summarised as follows.

Despite significant changes in Hungarian agriculture during transition, the distribution of the B indices remained fairly stable over the period 1990 to 2000. However, the extent of specialisation in Hungarian agri-food trade exhibits a declining trend. In other words, Hungary has lost comparative advantage for some product groups over time. Another feature of the B indices is that their pattern has converged over the period. Specialisation in agri-food exports is shown to have decreased. The stability of the B indices for particular product groups is mixed. Results suggest that the B indices are stable for observations with comparative disadvantage, in all cases. But product groups with weak to strong comparative advantage show a significant variation over the period.

How are these stylised measurements linked to findings of other empirical studies and the predictions of theory? An overall picture emerging from other empirical studies (Balassa, 1977; Amendola et al., 1992; Laursen, 2000; Proudman and Redding, 2000; and Brasili et al., 2000) is that one can observe a general decrease in specialisation, with a few exceptions. Our study of Hungary's agri-food trade reinforces this result. From a theoretical point of view, the tendency towards a more symmetric and less polarised distribution of the B index is in accordance with the Heckscher-Ohlin model. Furthermore, our results do not support the idea that self-reinforcing mechanisms, emphasised strongly in much of the endogenous growth and trade literature, are evident.

References

Amendola, G., Guerrieri, P. and Padoan, P.C. (1992). International Patterns of Technological Accumulation and Trade. *Journal of International and Comparative Economics*, Vol. 1. 173-197.

Amiti, M. (1998). New Trade Theories and Industrial Location in the EU: A Survey of Evidence, Oxford Review of Economic Policy, 14, 45-53.

Balassa, B. (1965). Trade Liberalization and Revealed Comparative Advantage. *The Manchester School of Economic and Social Studies*, 33, 99-123.

Balassa, B. (1977). Revealed Comparative Advantage Revisited: An Analysis of Relative Export Shares of the Industrial Countries, 1953-71. *The Manchester School of Economic and Social Studies*, 45, 327-344.

Bowen, H.P. (1983). On the Theoretical Interpretation of Indices of Trade Intensity and Revealed Comparative Advantage. *Weltwirtschaftliches Archiv*, Vol. 119, 464-472.

Brasili, A., Epifani, P. and Helg, R. (2000). On the Dynamics of Trade Patterns. *De Economist*, 148, (2) 233-257.

Cantwell, J. (1989). *Technological Innovation and Multinational Corporations*. Oxford: Blackwell.

Dalum, B., Laursen, K. and Villumsen, G. (1998). Structural Change in OECD Export Specialisation Patterns: De-Specialisation and 'Stickiness'. *International Review of Applied Economics*, 12, 423-443.

Deardorff, A. (1974). Factor Proportions and Comparative Advantage in the Long Run: Comment. *Journal of Political Economy*, 82, 829-833.

De Benedictis, L. and Tamberi, M. (2001). A note on the Balassa Index of Revealed Comparative Advantage. Manuscript.

Dimelis, S. and K. Gatsios (1995), 'Trade with Central and Eastern Europe: The Case of Greece', in R. Faini and R. Portes (eds.), *EU Trade with Eastern Europe: Adjustment and Opportunities* (London: CEPR).

Eiteljörge, U. and M. Hartmann (1999). 'Central-Eastern Europe Food Chains Competitiveness', chapter 12 in *The European Agro-Food System and the Challenge of Global Competition* (ISMEA: Rome).

Fertő, I and Hubbard, L.J. (2003). Revealed Comparative Advantage and Competitiveness in Hungarian Agri-Food Sectors. *World Economy* 26, 247-259.

Findlay, R. (1970). Factor Proportions and Comparative Advantage in the Long Run: Comment. *Journal of Political Economy*, 78, 27-34.

Findlay, R. (1995). *Factor Proportions, Trade and Growth*. MIT Press, Cambridge.

Grossman, G. and Helpman, E. (1990). Comparative Advantage and Long-run Growth. *American Economic Review*, 80, 796-815.

Grossman, G. and Helpman, E. (1991). *Innovation and Growth in the Global Economy*. MIT Press, Cambridge.

Gual, J. and C. Martin (1995), 'Trade and Foreign Direct Investment with Central and Eastern Europe: Its Impacts on Spain', in. R. Faini and R. Portes (eds.), *EU Trade with Eastern Europe: Adjustment and Opportunities* (London: CEPR).

Helpman, E. and Krugman, P. (1985). *Market Structure and Foreign Trade*. MIT Press, Cambridge.

Helpman, E. (1981). International Trade in the Presence of Product Differentation, Economies of Scale and Imperfect Competition: A Chamberlain-Heckscher-Ohlin Approach. *Journal of International Economics*, 11, 305-340.

Hillman, A.L. (1980). Observation on the Relation between 'Revealed Comparative Advantage' and Comparative Advantage as Indicated by Pre-Trade Relative Prices. *Weltwirtschaftliches Archiv*, Vol. 116, 315-321. o.

Hinloopen, J. and van Marrewijk, C. (2001). On the Emprical Distribution of the Balassa Index. *Weltwirtschaftliches Archiv*, 137, 1-35.

Iaparde, L.P. (2001). Measuring of International Specialization. *International Applied Economic Review*, 7, 173-183.

Kemp, M. (1969). *The Pure Theory of International Trade and Investment*. Englewood Cliffs, N.J., Prentice-Hall.

Krugman, P. (1987). The Narrow Moving Band, the Dutch Disease, and the Competitive Consequences of Mrs. Thatcher: Notes on Trade in the Presence of Dynamic Scale Economies. *Journal of Development Economics*, 27. 41-54.

Kunimoto, K. (1977): Typology of Trade Intensity Indices. *Hitotsubashi Journal of Economics*, 11, 15-32.

Laursen, K. (1998). Revealed Comparative Advantage and the Alternatives as Measures of International Specialisation. DRUID Working Paper No. 98-30, Aalborg University.

Laursen, K. (2000). *Trade Specialisation, Technology and Economic Growth*. Edward Elgar, Cheltenham.

Lucas, R. (1988). On the Mechanics of Economic Development. *Journal of Monetary Economics*, 22, 3-22.

Marchese, S. and De Simone, F.N. (1989). Monotonicity of Indices of Revealed Comparative Advantage: Empirical Evidence on Hillman's Condition. *Weltwirtschaftliches Archiv*, 125, 158-167.

Proudman, J. and Redding, S. (2000). Evolving Patterns of International Trade. *Review of International Economics*, 8, 373-396.

Redding, S. (1999). Dynamic Comparative Advantage and the Welfare Effects of Trade. *Oxford Economic Papers*, 51. 15-39.

Vollrath, T.L. (1987). *Revealed Competitive Advantage for Wheat*, Economic Research Service Staff Report No. AGES861030, United States Department of Agriculture, Washington, D.C.

Vollrath, T.L. (1989). *Competitiveness and Protection in World Agriculture*, Agricultural Information Bulletin No. 567, Economic Research Service, United States Department of Agriculture, Washington, D.C.

Vollrath, T.L. (1991). A Theoretical Evaluation of Alternative Trade Intensity Measures of Revealed Comparative Advantage. *Weltwirtschaftliches Archiv* Vol. 130. (2) 265-279. o.

Wong, K. (1995). *International Trade in Goods and Factor Mobility*. MIT Press, Cambridge

Yeats, A.J. (1985). On the Appropriate Interpretation of the Revealed Comparative Advantage Index: Implication of a Methodology Based on Industry Sector Analysis. *Weltwirtschaftliches Archiv,* 121, 61-73.

Young, A. (1991). Learning-by-doing and Dynamic Effects of International Trade. *Quarterly Journal of Economics*, 106, 396-406.