Agri-Food Trade between Hungary and the European Union

by

Imre Fertő

A thesis submitted to the University of Newcastle upon Tyne for the degree of Doctor of Philosophy

No portion of the work referred to in this thesis has been submitted in support of an application for any degree or qualification from this, or any other, University or institute of learning

June 2004

Abstract

Hungary becomes a member of the EU in 2004. As a precursor to full accession, an Association Agreement, signed in 1991, has promoted partial liberalisation of bilateral trade. This thesis investigates the pattern of agri-food trade between Hungary and the EU during the 1990s, employing various theoretical concepts and empirical methods.

Hungary is a major agricultural exporter and its pattern of trade over the period remained fairly stable. However, economic and policy changes probably served to worsen the prospects for exports. Indeed, Constant Market Share analysis indicates that Hungary's general competitiveness in EU markets fell. This is also apparent from the indices of Revealed Comparative Advantage which, although suggesting that Hungary has comparative advantage in livestock and arable products, show evidence of an overall decline.

A slight growth in intra-industry trade (IIT) in agri-food products between Hungary and the EU is shown to be not uniform by product group or EU member state, or over time, reflecting different patterns of bilateral integration and suggesting an economic restructuring process that is incomplete. Intra-industry trade is shown to be low and dominated by vertically rather than horizontally differentiated products. In a dynamic context, marginal IIT appears also to be low, but assumes greater significance when the index is broadened to include vertical as well as horizontal marginal IIT.

Accordingly, the structure of the change in agri-food trade between Hungary and the EU during the period is shown to be predominantly either intra–industry of a vertical nature or inter-industry. Both are believed to incur adjustment costs that are higher than with horizontal IIT, but the dominance of vertical IIT suggests that the agri-food industries of Hungary and the EU may be developing in a complementary manner, involving somewhat lower adjustment costs than may have been feared.

Tests for the determinants of Hungary's IIT in agri-food products suggest that separating the measure of IIT into its horizontal and vertical components provides for better estimation and supports the contention that the determinants may differ by type of

trade. The *level* of IIT is found to serve as a better dependent variable than the *degree* or *share* of IIT.

Acknowledgements

I am extremely grateful to my supervisor, Dr. Lionel Hubbard, who carefully reviewed all stages of the manuscript and gave me valuable comments. My postgraduate studies in the University of Newcastle upon Tyne were financed by an ACE-Phare Scholarship. I thank my colleague, Dr. Magdolna Sass (OECD/Institute of Economics) for supplying data. I am also grateful to my director in the Institute of Economics, Hungarian Academy of Sciences , Dr. Jenő Koltay, who granted me leave during my studies. I want to thank my family for their support. Finally, I dedicate the thesis to the memory of my grandparents and aunt.

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Chapter 1: INTRODUCTION

1.1 Opening Statements

For most countries one of the delicate issues about joining the European Union (EU) has concerned the integration of their agricultural sectors. This is particularly true for the countries of Central and Eastern Europe (CEE). First, in this region agriculture plays a more important role, because its weight in the national economy is greater than in most of the EU countries. Second, the enlargement of the Common Agricultural Policy (CAP) to include the CEE countries is especially controversial. Economic preparations for eastward enlargement have a few particularly sensitive areas, especially agriculture. Some of the CEE countries are to join the EU in 2004. Association negotiations with most CEE countries, including Hungary, began in the early 1990s.

During the last several years a great deal of research has been carried out about the effects of the EU enlargement on agriculture. These studies have focused mainly on the costs of extending the CAP. This task is very difficult owing to the complexity of the CAP, lack of accurate data about CEE farms and the changing nature of eastern agriculture. Baldwin et al. (1997) show that the range of early studies about the costs of the so-called Visegrad-4 countries (Hungary, Poland, Czech Republic and Slovakia) acceding to the EU range widely, from ECU4 billion to ECU37 billion. The reasons for the wide range of estimates are different model assumptions, especially concerning farm productivity in the CEE countries, and various scenarios about future reforms in the CAP. Baldwin et al. (1997) concluded that for a Visegrad-4 enlargement, an estimate of ECU10 billion for increased CAP costs seemed the most sensible. There are some more recent studies about the costs of extending the CAP (e.g. Von Witzke et al. 1998, Josling et al. 1998, Banse and Münch 1998 and Münch 1999) in which the estimates have converged considerably. The results reinforce the position of the European Commission that the accession of CEE countries will place a heavy burden on the budget. Hence, the common message of various studies is that the CAP must be reformed before eastern enlargement becomes a reality.

However, these papers have sometimes neglected the possible trade effect of EU enlargement for both sets of partners, which could be also important for the costs of extending the CAP. More generally, there is a large literature on the effects of EU enlargement, but that for agricultural trade between Eastern and Western Europe is sparse. Recent studies on the various aspects of agricultural trade between the EU and CEE countries have been more descriptive than analytical in nature (e.g. Bojnec, 2001a and 2001b, Duponcel, 1998, Tangermann, 2000, and van Berkum, 1999). In other words, surprisingly this topic is underdeveloped in the continuously growing literature on EU enlargement. Consequently, this thesis will attempt to contribute to this research area from the agricultural trade point of view.

1.2 Theoretical Background

A broad range of theoretical concepts are available to explain international trade in agricultural and food products. For many years agricultural trade analyses have been based mostly on the traditional concept of comparative advantage. However, the landscape of agricultural trade has changed; recent empirical studies have highlighted some basic features (van Berkum and van Meijl, 2000):

- A large proportion of agricultural trade is between developed countries.
- The role of trade in processed and manufactured food products has been enhanced at the expense of raw and bulky agricultural commodities.
- Trade in processed food products is concentrated among a few countries.
- There is a growing market concentration in food processing and retailing.
- Finally, agricultural trade is increasingly of an intra-industry nature.

These observations suggest the growing importance of the 'new trade theory' in the explanation of agricultural trade. This thesis will concentrate on both inter-industry and intra-industry features of Hungarian agricultural and food trade with the EU. Before beginning our analysis, it is useful to present a very brief review on the theoretical concepts of international trade and their implications. Due to the richness in availability of international trade textbooks (a few recent examples are; Bhagwati et al. 1998, Borkakoti 1998, Grimwalde 1998, Krugman and Obstfeld, 2000, and Markusen et al.

1995) the goal of this short survey is only to show how many opportunities exist for applications to agricultural trade.

1.2.1 Traditional Trade Theories

Modern international trade theory begins with Ricardo's theory of comparative advantage, developed at the beginning of the 19th century. In the Ricardian model, assuming that labour is the only production factor, differences in labour productivity are the cause of trade. But this model does not explain why labour productivity differs between countries. The Heckscher-Ohlin-Samuelson (HOS) model, developed at the beginning of the 20th century, demonstrates that a country should export the product that is relatively intensive in the factor with which the country is relatively well endowed.

The HOS model of international trade has dominated the subject for many years. However, the implications of the HOS model have not always been confirmed by empirical evidence. Recent studies have identified some additional factors in explaining international trade: inter-country differences in demand and national preferences (Davis and Weinstein 1996, Lundbeck and Torstensson, 1998), technological differences between countries and differences in factor rewards (Davis et al. 1997, Hakura 1997, Helpman 1999, Trefler 1993 and 1995) and differences in country size or market size effect (Torstensson 1998). In short, as Helpman (1998, p. 581) points out:
"My conclusion from the evidence is that we need to model carefully the cross-country differences and differences in factor rewards, in order to close the gap between the theory and the data."

Noteworthy is that analyses of agricultural trade are often considered as an aspect of a specific concern pursued in connection with sector-specific agricultural and trade policies. Furthermore, there are only a few studies which test directly the HOS model in agricultural trade (e.g. Arnade 1994, Lange, 1989, Tobey and Chomo, 1994). Agricultural trade is mainly analysed as an issue of trade liberalisation or enlargement of a custom union, where the research on trade and competitiveness of agri-food chains is important for the decision-makers to foresee the possible implications of policy changes. This thesis is in the tradition of the latter approach.

Traditional trade theory suggests that international trade is determined by country differences in natural resources, technology levels and factor endowments. The main implications of the theory are the following.

- Trade patterns are determined fundamentally by comparative advantage.
- International trade is basically inter-industry in nature.
- The larger the difference in factor endowment, the more trade between countries and the greater the gain from trade.
- International trade leads to a reallocation of resources between industries and increases efficiency, whilst consumers face a new set of relative prices. These benefits are associated with income redistribution, with a deterioration in returns to factors engaged in import-competing industries, but with an overall net gain from trade.

1.2.2 New Trade Theory

In the late 1960s and early 1970s a number of empirical studies (a seminal work is that of Grubel and Lloyd, 1975) showed the simultaneous export and import of products within the same industry to be an important proportion of total world trade, challenging the predictions of classical trade theory. These studies provided motivation for the development of the 'new trade theory' under imperfect competition. This new theory has supplied us with various explanations for the existence of intra-industry trade.

First, there are models that generate intra-industry trade under oligopolistic market structures and homogeneous products (Brander 1981, Brander and Krugman 1983). The main idea of the Brander model is that in the presence of foreign rents, domestic firms have an incentive to capture those foreign rents through exports. Thus, if firms perceive domestic and foreign markets as segmented markets, they have an incentive to penetrate each other's market, which results in intra-industry trade in homogeneous products. Surprisingly, despite an early contribution to the theory of intra-industry trade, the Brander model has been given relatively little attention in recent discussion in this field. Bernhofen (1998) extended Brander's framework and demonstrated that differences in national characteristics, such as in costs, market size and market concentration, tend to reduce the intensity of intra-industry trade.

The second group of models which has dominated the theory of intra-industry trade, has two distinguishing features: demand specifications in terms of differentiated products and an element of monopolistic competition with increasing returns to scale. Product differentiation can be of two types: horizontal and vertical. Horizontal product differentiation can be analysed by using either the Dixit-Stiglitz specification where all varieties of a product enter an individual's utility function symmetrically (love of variety approach) or the Hotelling-Lancaster specification where an agent chooses his or her most preferred variety of a product (ideal variety approach).

Following the first approach, in various models Krugman (1979, 1980, 1981) has proved, assuming a two country, single industry framework, how intra-industry trade occurs between identical economies, each producing a large number of differentiated products with a Dixit-Stiglitz demand specification under monopolistic competition with increasing returns. Venables (1984) has demonstrated that the Krugman model may have multiple equilibria and that not all of them are stable. Weder (1995) extended Krugman's analysis by introducing different country sizes. He has shown that the pattern of intra-industry trade is determined by comparative advantage arising from domestic demand.

A second line of horizontal differentiated models, with the Hotelling-Lancaster demand specification, yields a similar result. In the basic Lancaster model, intra-industry trade occurs as a consequence of preference diversity and decreasing costs. Lancaster (1980) and Helpman (1981) extended this model into an HOS framework which exhibits initial differences in factor endowments between two countries. It is shown that the importance of intra-industry trade relative to that of inter-industry trade depends on the initial differences in factor abundance.

Helpman and Krugman (1985) have combined monopolistic competition with the factor proportion theory generating the co-existence of intra- and inter-industry trade. In the integrated equilibrium, the net factor content of inter-industry trade is positively related with the difference in relative factor endowments between countries, whereas intra-industry trade is negatively related to the latter difference, and will be more developed between similar economies. The main implications of the Helpman-Krugman model are the following.

- The more similar the factor endowments of trading countries, the higher the level of intra-industry trade and the lesser the extent of inter-industry trade.
- Intra-industry trade leads to gains in variety for consumers, and for producers if intermediate goods are traded.
- Economic adjustments take place within industries and not between industries. Therefore, there is no redistribution associated with such trade while economies of scale exists.

Another type of model deals with intra-industry trade in vertically differentiated products, challenging the predictions of the Helpman-Krugman model. The main reference for vertical differentiation is the model developed by Falvey (1981) and complemented by Falvey and Kierzkowski (1987) in the context of comparative advantage theory. Vertical product differentiation means that varieties in intra-industry trade differ in quality. In these models vertical intra-industry trade occurs under perfect competition between two countries with differences in factor endowments, since high-quality products are assumed to require higher capital intensity in their production than low-quality products. Falvey and Kierzkowski (1987) added explicitly a demand specification, with demand for qualities as a function of the quality's relative prices and consumer income. Under these assumptions, capital abundant countries will tend to export high-quality products in exchange for low-quality products from labour abundant countries. Moreover, intra-industry trade is determined by comparative advantage as in the HOS model and, contrary to the prediction of the Krugman model, the level of intra-industry trade is higher when differences in factor endowments between countries are greater.

Vertical differentiation has also been incorporated into intra-industry trade models with an oligopoly context by Gabszewicz et al. (1981) and Shaked and Sutton (1984). On the supply side, the quality of product depends on R&D, reflected in the fixed costs, whilst the demand side is similar to earlier models. The vertical intra-industry trade is the result of a three-stage game, where decisions related to entry, quality of product and price are taken. If the countries differ in income levels, then the countries with the highest average income specialise in the production and export of high quality goods and countries with the lowest average income specialise in the production and export of low quality products.

Some interesting extensions to the theory of intra-industry trade have been developed. Bhagwati and Davis (1994) and Davis (1995) demonstrate that intra-industry trade can occur on the basis of comparative advantage deriving from differences in technology between countries. This model also has a challenging feature, unlike the earlier models, that increasing returns are not necessary to explain intra-industry trade.

In short, recent theoretical developments challenge the main implications of the theory of intra-industry trade based on horizontal product differentiation.

- Inter-industry trade can occur without comparative advantage.
- Intra-industry trade can occur without product differentiation.
- There is not necessarily a negative relation between differences in factor endowments and the of level intra-industry trade.
- Adjustment costs can be high with existence of vertical intra-industry trade.
- Increasing returns are not a necessary condition in explaining intra-industry trade.

We can conclude that an encompassing model is not available to explain intra-industry trade. However, contrary to the implications of earlier empirical studies on intra-industry trade, the traditional comparative advantage theory is not disqualified by the existence of intra-industry trade. The various models of intra-industry trade shed light on the importance the distinction between vertical and horizontal differentiated trade. Recent development suggests that countries with differences in factor endowments will engage in intra-industry trade for vertically differentiated goods, whilst similar ones will engage in intra-industry trade in horizontally differentiated goods.

1.3 Research Questions

The structure of Hungarian agriculture and its external relationships have been transformed fundamentally during the 1990s (Fertő, 1999). One of the key elements of these changes has been that Hungarian agriculture has had to adjust to the basically changing international division of labour. Namely, after the collapse of COMECON the orientation of the Hungarian economy, including agriculture, has moved closer to that of the EU. The strategic aim of Hungary, similar to other CEE countries, has been to join the EU. The first step in this process was the Association Agreement signed between Hungary and the EU in 1991. This has led to partial trade liberalisation and increased competitive pressures for both partners.

The main aim of the thesis is to investigate systematically the pattern of agricultural trade between Hungary and the EU. In other words, what have been the effects of the Association Agreement on the agricultural trade flows between Hungary and the EU, and what are the implications for Hungarian agriculture? The analysed period is 1992 to 1998. We will attempt to address the following specific empirical research questions.

- How has the pattern of Hungarian agricultural trade with the EU developed over the period? What have been the major characteristics?
- Which factors explain Hungary's agricultural trade performance in EU markets? Which product groups have been competitive and which have been uncompetitive in EU member states during the analysed period?
- In which commodities does Hungary have a comparative advantage vis à vis the EU? In addition, are there any dynamics in the pattern of Hungarian comparative advantage over time?
- Which types of trade have been dominant – inter-industry or intra-industry? What might this division imply about the economic adjustment costs from partial trade liberalisation due to the Association Agreement?
- Which factors explain intra-industry trade in agri-food products between Hungary and the EU?

1.4 Plan of the Thesis

According to the research questions listed above, the structure of the thesis is organised as follows.

Chapter 2 provides a context to the analysis of Hungary's agri-food trade with the EU that follows in subsequent chapters. It outlines some important changes that occurred during the 1990s in Hungary's transition from a centrally planned to a market economy, and which are likely to have influenced the pattern of trade. First we report some of the main economic indicators for Hungary over the period 1992-98, including output, employment, unemployment, earnings, productivity, prices and foreign exchange rates, highlighting where appropriate the agricultural and food sectors of the economy. Second, we focus on the changing trade policy environment and the extent of government support to agriculture. Third, we present some evidence on the evolution of competitiveness in Hungarian agriculture. Finally, we provide a short synthesis of these various changes and how they may have had an impact on agri-food trade.

Chapter 3 presents a general description of the agricultural trade of Hungary with the EU. First, we analyse how total Hungarian agricultural trade has developed and describe the most striking features of this trade. Second, we investigate the development of Hungarian agricultural trade with the EU with special attention paid to its geographical distribution and pattern by product groups.

Chapter 4 attempts to account for the sources of Hungary's export performance to the EU, employing a Constant Market Share (CMS) model. First, we present a brief description of the various CMS models. Second, we report our results based on one- and two-stage CMS models. Finally, we test the sensitivity of our calculations under different assumptions.

Chapter 5 examines the comparative advantage in Hungarian agriculture, applying the concept of revealed comparative advantage (RCA). We describe alternative approaches to measuring RCA and some methodological issues. Next, the empirical models and procedures are described. The results are presented and discussed separately in three contexts, with special emphasis on the dynamics in Hungary's RCA. Finally, the effects of policy interventions are discussed.

Chapter 6 presents the concept of intra-industry trade and various versions of its measurement are discussed. We analyse some potential problems of the most common measures and investigate some possible recommendations for their improvement. Finally, we report recent developments in measuring *marginal* intra-industry trade.

Chapter 7 reports an empirical analysis of the intra-industry trade between Hungary and the EU. First, we review the empirical studies on intra-industry trade in agri-food products. Second, we examine the pattern of intra-industry trade, employing the classic Grubel-Lloyd index and other vertical and horizontal intra-industry trade indices and measures. Also, we focus on marginal intra-industry and adjustment problems. Finally, we try to identify the determinants of various types of intra-industry trade.

The main results of the empirical analysis for our research questions are summarised and some conclusions and implications for future research are presented in Chapter 8.

Chapter 2. HUNGARY'S ECONOMY AND AGRICULTURE IN THE 1990s

This chapter aims to provide a context to the analysis of Hungary's agri-food trade with the EU that follows in subsequent chapters. It outlines some important changes that occurred during the 1990s in Hungary's transition from a centrally planned to a market economy, and which are likely to have influenced the pattern of trade. The chapter begins by reporting some of the main economic indicators for Hungary over the period 1992-98. These include output, employment, unemployment, earnings, productivity, prices and foreign exchange rates, highlighting where appropriate the agricultural and food sectors of the economy. The chapter then describes the changing trade policy environment and the extent of government support to agriculture, before presenting some evidence on the evolution of competitiveness in Hungarian agriculture. The final section of the chapter contains a short synthesis of these various changes and how they may have had an impact on agri-food trade.

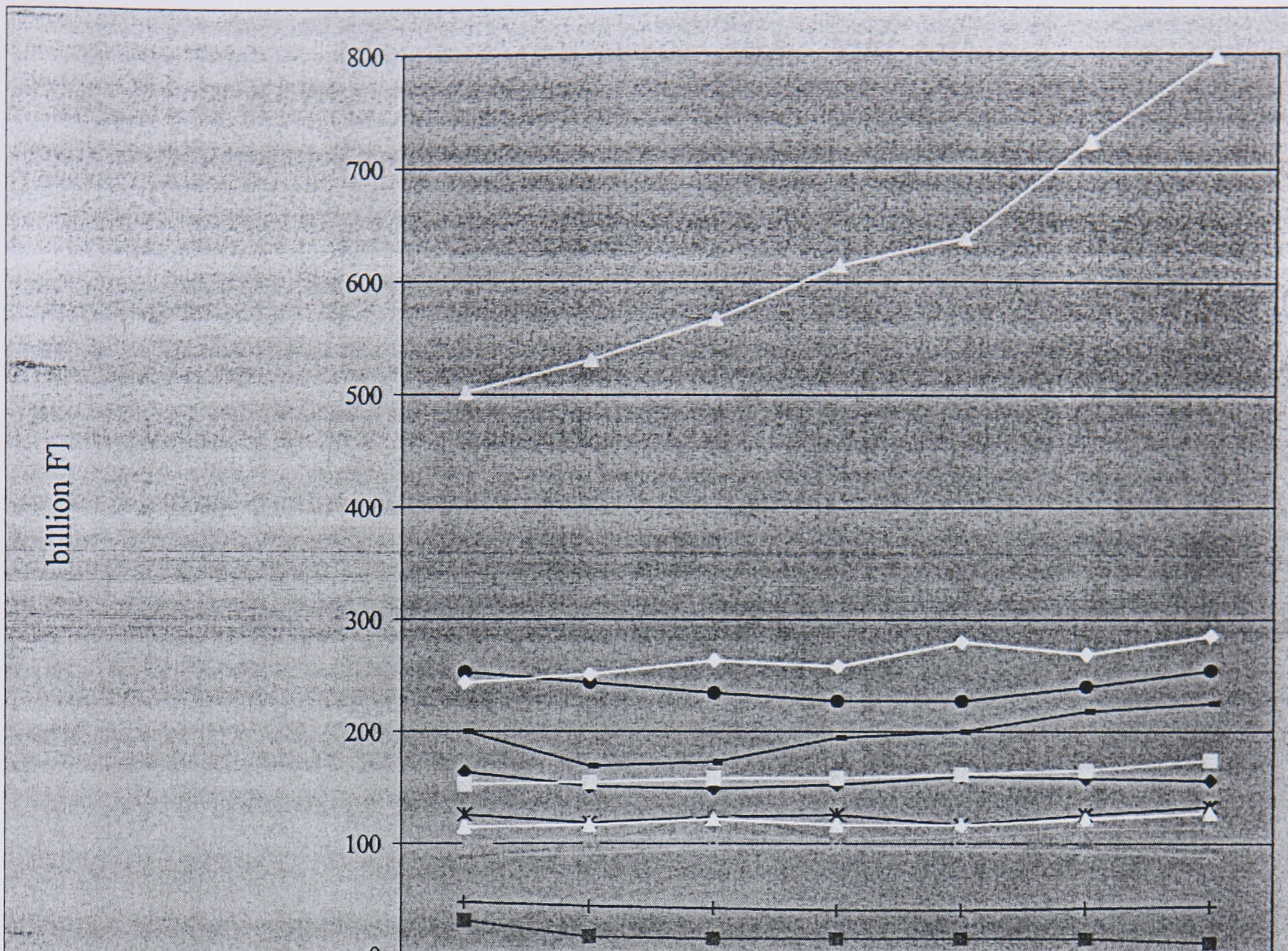
2.1 Main Economic Indicators

2.1.1 Output and employment

Gross Domestic Product (GDP) in Hungary grew by 12%, in real terms, between 1992 and 1998, an average annual rate of 1.6%. By far the largest increase was in manufacturing, where GDP increased by 59%, or 7% per year (Figure 2.1). In other sectors of the economy output was relatively stable over the period, with the exception of mining where it fell markedly. In agriculture, GDP fell slightly from its level in 1992, whilst in food processing (not shown as a separate sector in Figure 2.1) it fell by 18% from 102 to 84 billion Hungarian forints (FT) (in 1991 prices).

The relative growth of GDP in agriculture, manufacturing and the economy as a whole, over the period, is shown in Figure 2.2.

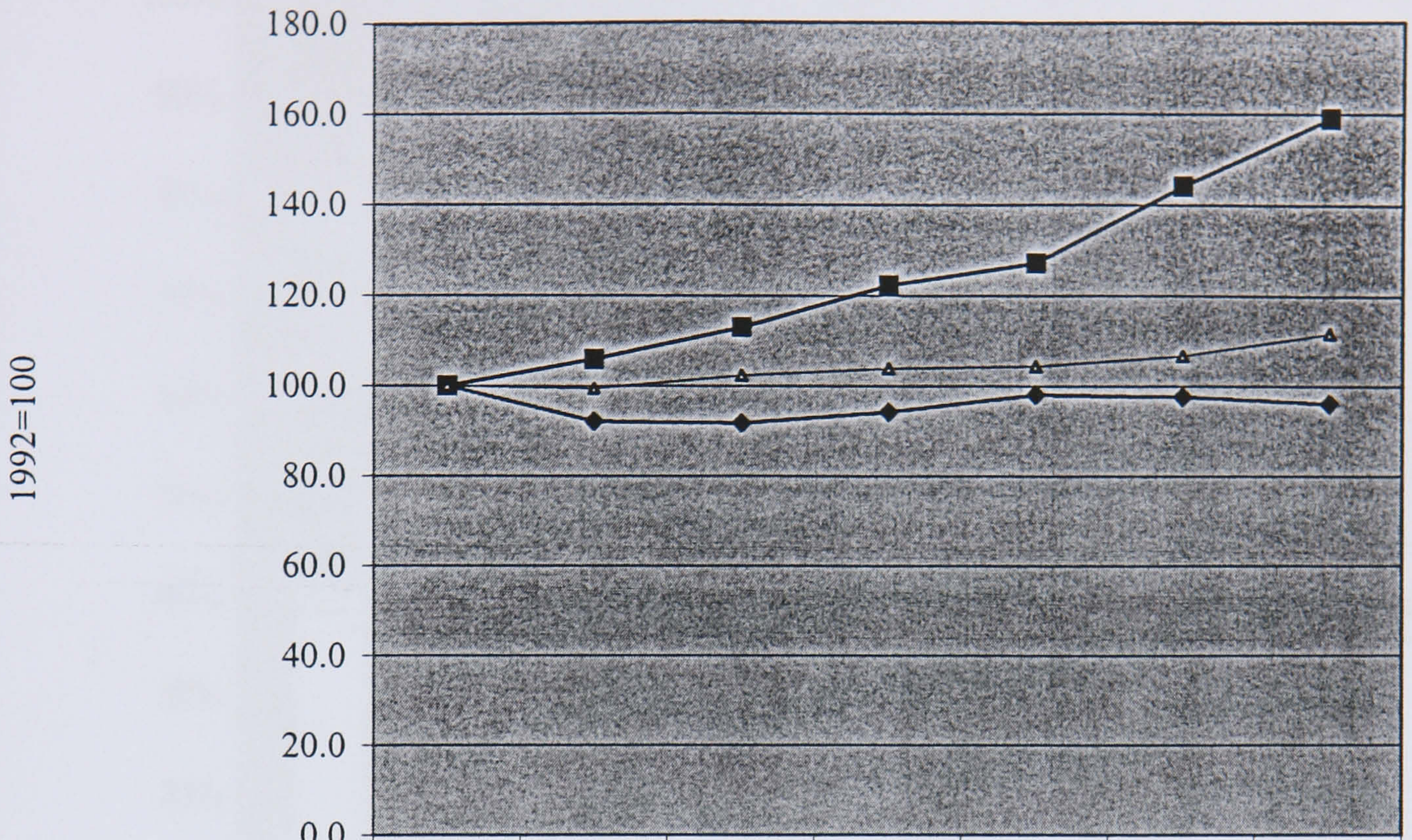
Figure 2.1 Real GDP in Hungary by Industry, 1991-98 (1991 prices)



	1992	1993	1994	1995	1996	1997	1998
Agriculture	163	150	149	153	160	159	157
Mining	30	17	15	15	14	15	11
Manufacturing	502	532	567	614	638	724	799
Electricity, gas, steam	90	92	96	96	95	93	89
Construction	126	119	125	125	116	125	133
Trade	252	244	234	228	226	240	254
Hotels, restaurants	46	43	42	39	39	43	44
Transport, storage	201	170	172	194	200	218	225
Financial intermediation	87	99	127	104	104	99	94
Real estate, renting	243	250	264	258	279	269	285
Public administration	152	155	159	159	162	165	174
Education	115	116	121	117	117	122	127
Health and social work	100	104	108	104	107	113	115
Other services	76	84	89	72	67	65	63

Source: National Bank of Hungary (2000): Annual Report 1999. p. 185. Annex I/2.

Figure 2.2 Relative Growth in Real GDP for Agriculture, Manufacturing and Total Economy in Hungary, 1992-98

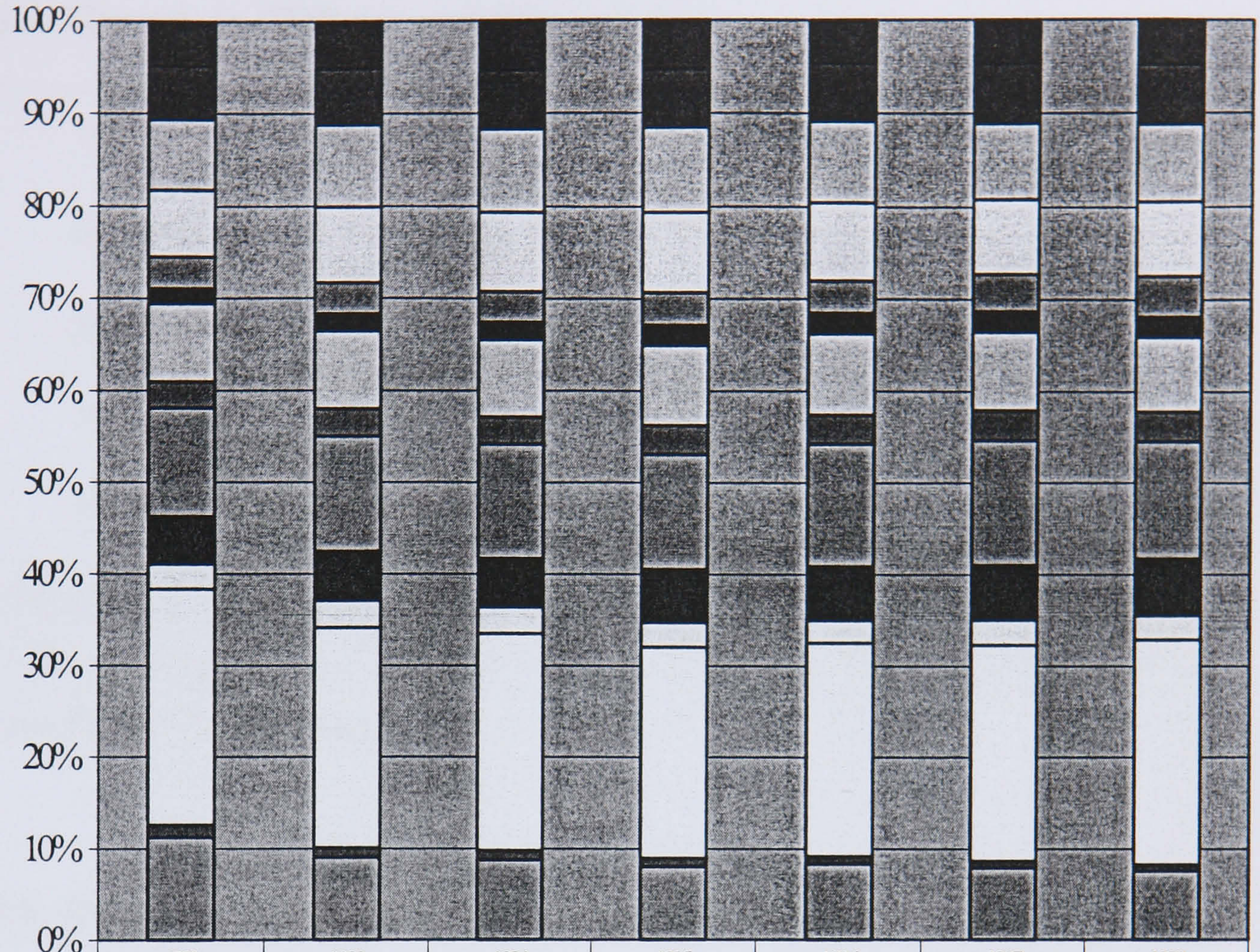


	1992	1993	1994	1995	1996	1997	1998
Agriculture	100.0	92.1	91.7	94.2	98.1	97.6	96.1
Manufacturing	100.0	105.9	113.0	122.3	127.2	144.2	159.0
Total GDP	100.0	99.4	102.3	103.8	104.3	106.6	111.6

Source: National Bank of Hungary (2000): Annual Report 1999. p. 185. Annex I/2.

Total employment in the economy fell by 9% between 1992 and 1998. The largest falls were in mining (-51%) and agriculture (-39%), whilst increases in employment were recorded in some of the service sectors. In manufacturing, where output increased significantly, employment fell by 13%, but was stable at around one quarter of the workforce throughout the period. Aside from the primary sectors, the structural pattern of employment in the economy was relatively stable during the 1990s, which is perhaps surprising given the transition from a centrally planned to market economy (Figure 2.3). In part, this stability was due to Hungary's political and economic liberalisation in the 1980s, which occurred earlier than in most of the other Central and East European countries.

Figure 2.3 Sectoral Employment in Hungary, 1992-98



	1992	1993	1994	1995	1996	1997	1998
Other services	4,9%	5,1%	5,3%	5,2%	4,7%	4,7%	4,8%
Health and social work	5,8%	6,1%	6,4%	6,3%	6,2%	6,4%	6,4%
Education	7,6%	9,0%	9,0%	9,1%	8,8%	8,1%	8,3%
Public administration	7,2%	8,2%	8,5%	8,6%	8,4%	8,1%	8,0%
Real estate, renting	3,4%	3,4%	3,3%	3,6%	3,5%	4,0%	4,4%
Financial intermediation	1,7%	1,9%	1,9%	2,2%	2,3%	2,3%	2,2%
Transport, storage	8,5%	8,4%	8,4%	8,7%	8,8%	8,5%	8,2%
Hotels, restaurants	2,8%	3,0%	2,9%	3,2%	3,1%	3,3%	3,3%
Trade	11,8%	12,5%	12,5%	12,5%	13,3%	13,6%	12,8%
Construction	5,3%	5,4%	5,4%	5,9%	6,0%	6,0%	6,2%
Electricity, gas, steam	2,6%	2,9%	2,9%	2,6%	2,4%	2,7%	2,6%
Manufacturing	25,8%	24,1%	23,7%	23,1%	23,3%	23,7%	24,7%
Mining	1,3%	1,1%	1,0%	0,9%	0,9%	0,7%	0,7%
Agriculture	11,3%	9,0%	8,7%	8,0%	8,3%	7,9%	7,5%

Source: Central Statistical Office (1999): Labour Force Survey 1992-1998. p. 15-16. Table 2.1.

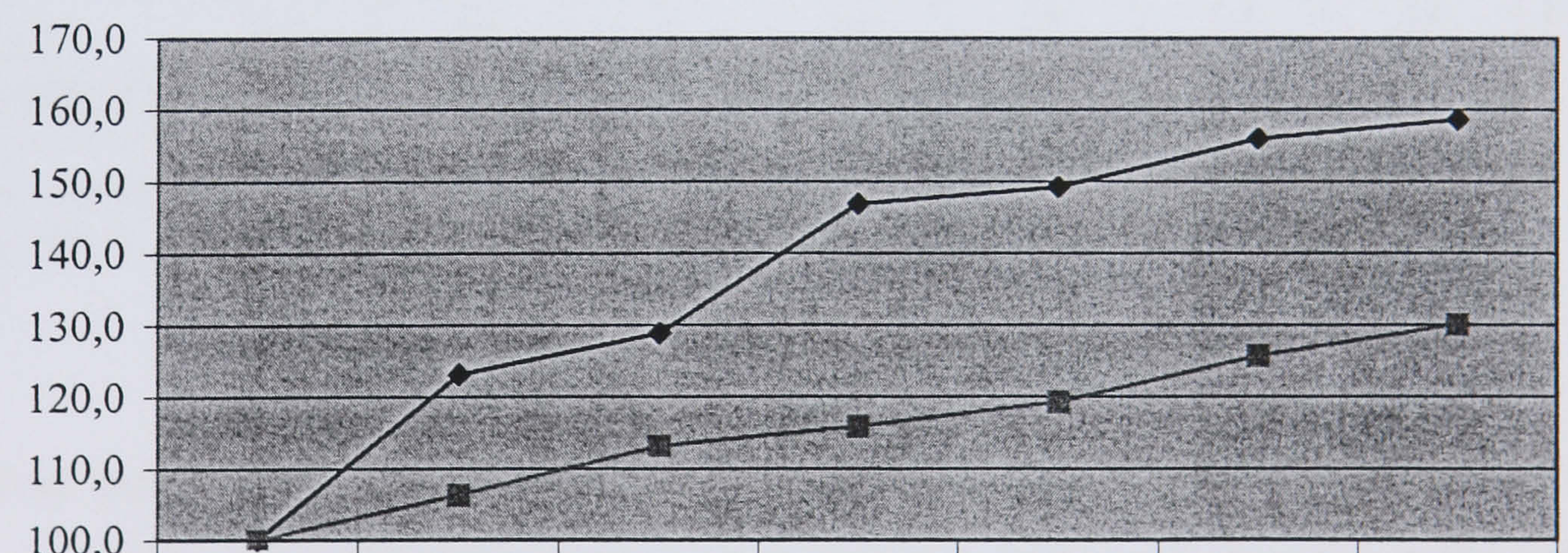
The combined effect of the changes in GDP and employment resulted in an increase in GDP per person employed, for the economy as a whole and for agriculture. GDP per person employed is higher in the general economy than in agriculture (Figure 2.4), but growth in output per person was faster in agriculture (Figure 2.5). This growth in agricultural GDP per person was due almost entirely to the fall in agricultural employment (see Figures 2.1 and 2.3).

Figure 2.4. Growth in GDP per person employed

	1992	1993	1994	1995	1996	1997	1998
Agriculture	354,1	435,8	456,2	520,1	528,3	552,4	561,6
Total	534,4	568,2	604,4	619,1	637,4	671,8	694,9

Source: see Figure 2.1 and Figure 2.3.

Figure 2.5. Growth in GDP per person employed (1992=100)



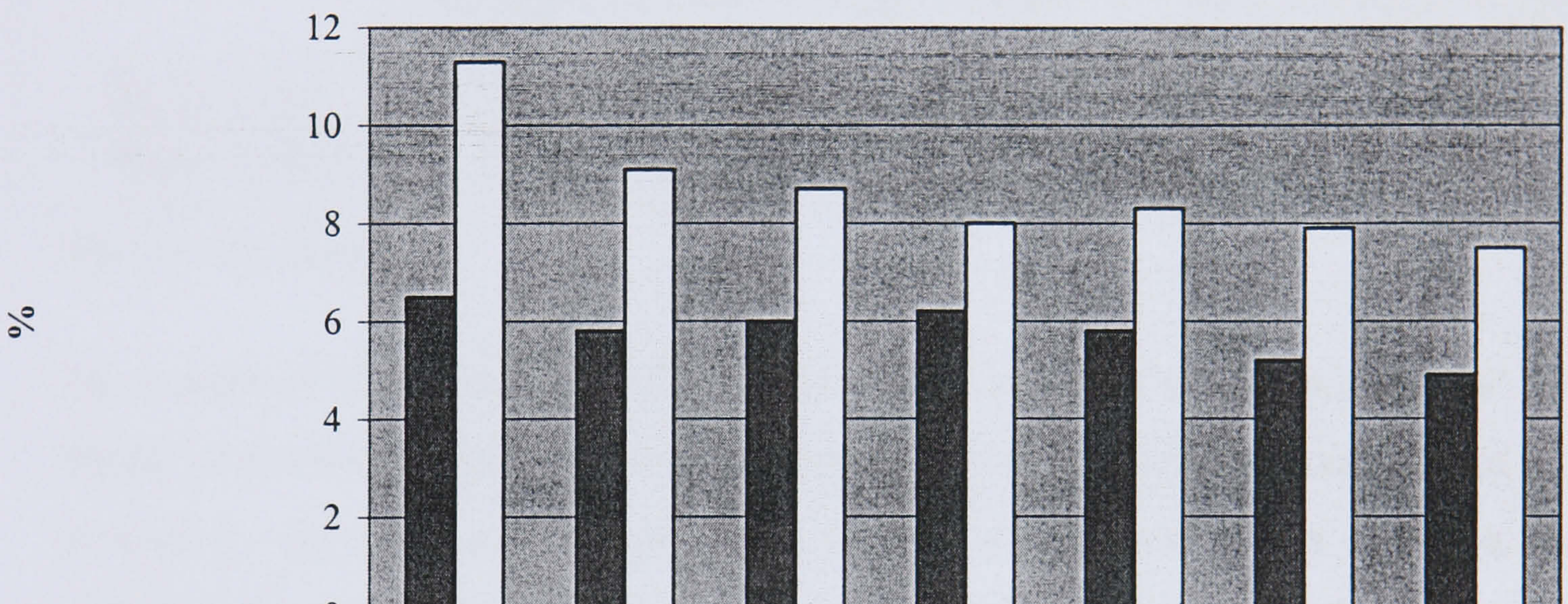
	1992	1993	1994	1995	1996	1997	1998
Agriculture	100,0	123,1	128,8	146,9	149,2	156,0	158,6
Total	100,0	106,3	113,1	115,9	119,3	125,7	130,0

Source: see Figure 2.1 and Figure 2.3.

2.1.1.1 Agriculture and the Food Industry

Between 1992 and 1998, agriculture's share in total GDP fell by a quarter from 6.5% to 4.9%, whilst its share in total employment fell by a third from 11.3% to 7.5% (Figure 2.6).

Figure 2.6. Agriculture's share in GDP and employment

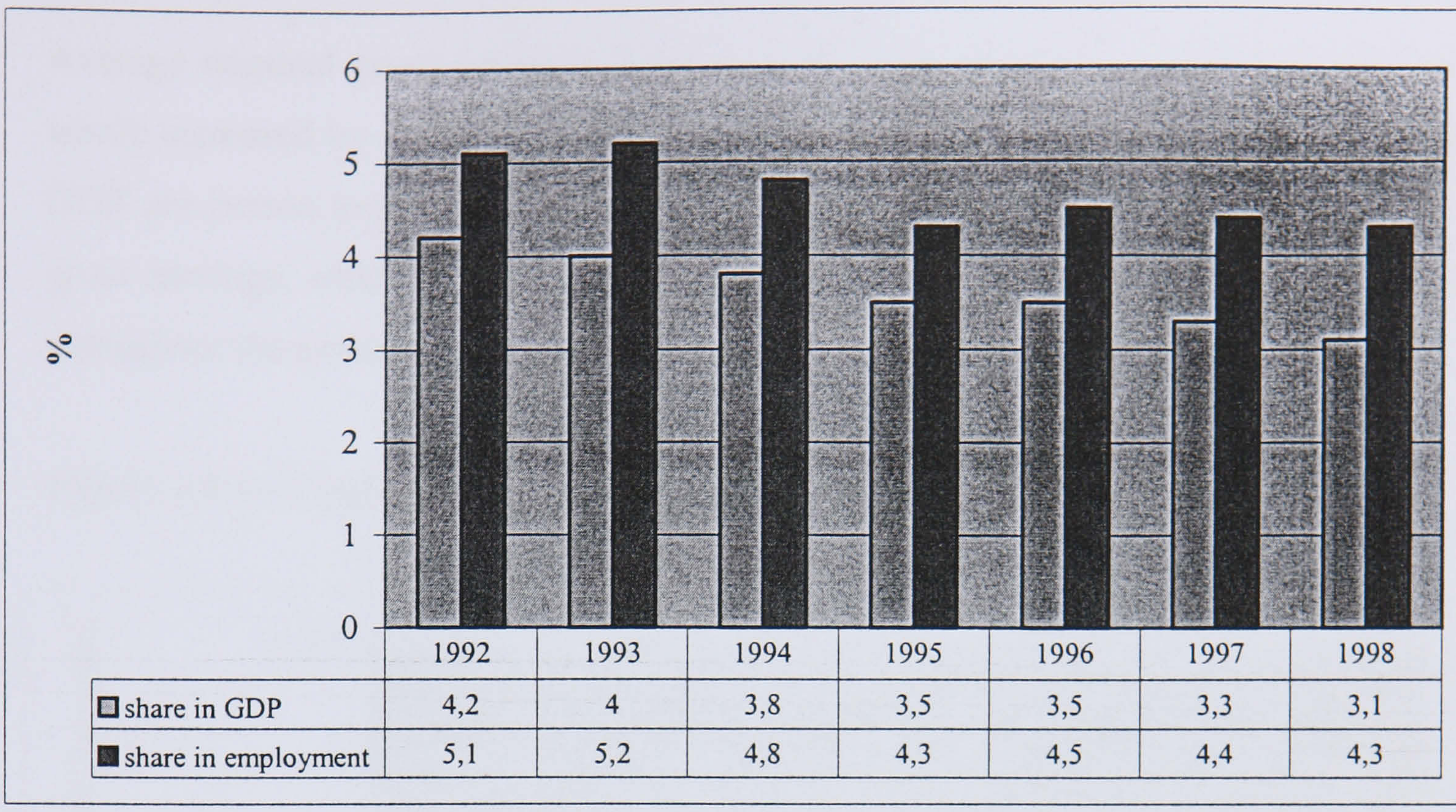


	1992	1993	1994	1995	1996	1997	1998
■ share in GDP	6,5	5,8	6	6,2	5,8	5,2	4,9
□ share in employment	11,3	9,1	8,7	8	8,3	7,9	7,5

Source: Central Statistical Office (2000): Statistical Yearbook of Agriculture 1999. p. 17. and p. 20. Table 1.2 and Table 1.5.

In the food industry, which in terms of both GDP and employment is smaller than agriculture, the share of GDP also fell by a quarter from 4.2% to 3.1%, whilst the share of total employment fell by one sixth, from 5.1% to 4.3% (Figure 2.7).

Figure 2.7 Food Industry' share in GDP & employment

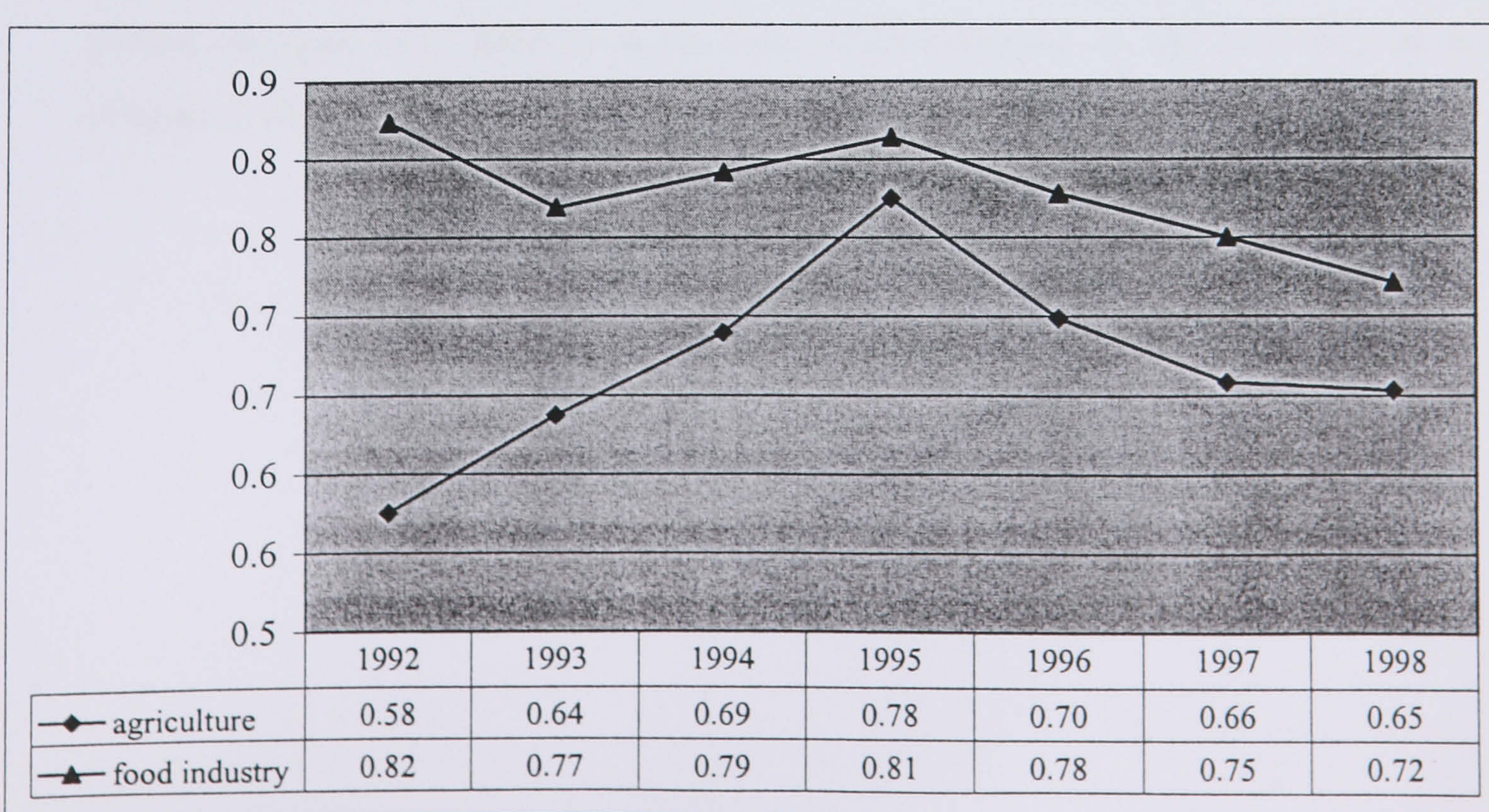


	1992	1993	1994	1995	1996	1997	1998
share in GDP	4,2	4	3,8	3,5	3,5	3,3	3,1
share in employment	5,1	5,2	4,8	4,3	4,5	4,4	4,3

Source: see Figure 2.6

The combined but differential effect of these falls has been to alter the sectors' relative labour productivity, which can be approximated by the percentage contribution to GDP divided by the percentage contribution to total employment. This measure, though higher in the food industry than in agriculture, is less than 1 in both sectors, i.e. the share of employment is higher than the share of GDP (Figure 2.8). In both sectors labour productivity fell after 1995, as falls in GDP share outstripped falls in employment share.

Figure 2.8. Labour productivity - %GDP/%employment

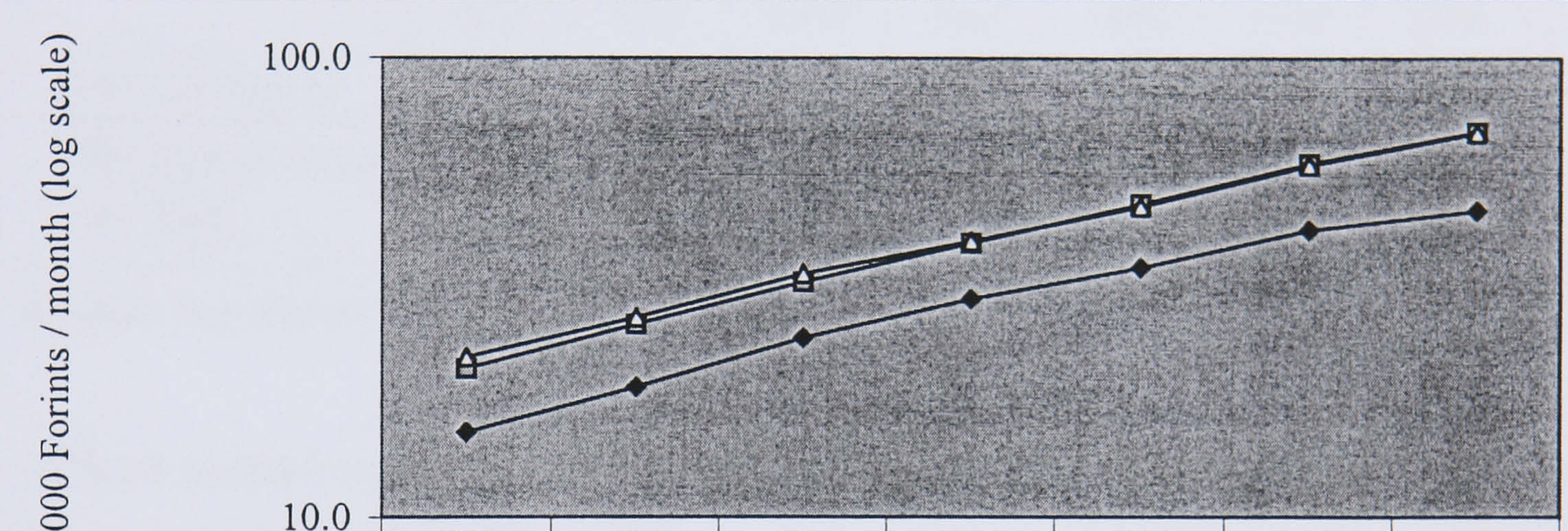


	1992	1993	1994	1995	1996	1997	1998
agriculture	0.58	0.64	0.69	0.78	0.70	0.66	0.65
food industry	0.82	0.77	0.79	0.81	0.78	0.75	0.72

2.1.2 Earnings and unemployment

Average nominal gross earnings in agriculture, manufacturing and the economy as a whole increased by approximately three-fold over 1992 to 1998 (Figure 2.9). Although GDP per person increased faster in agriculture (see Figure 2.5), this is not reflected in gross earnings, which remained at about two-thirds of the level in the general economy throughout the period.

Figure 2.9 Average gross earnings in Hungary (nominal)

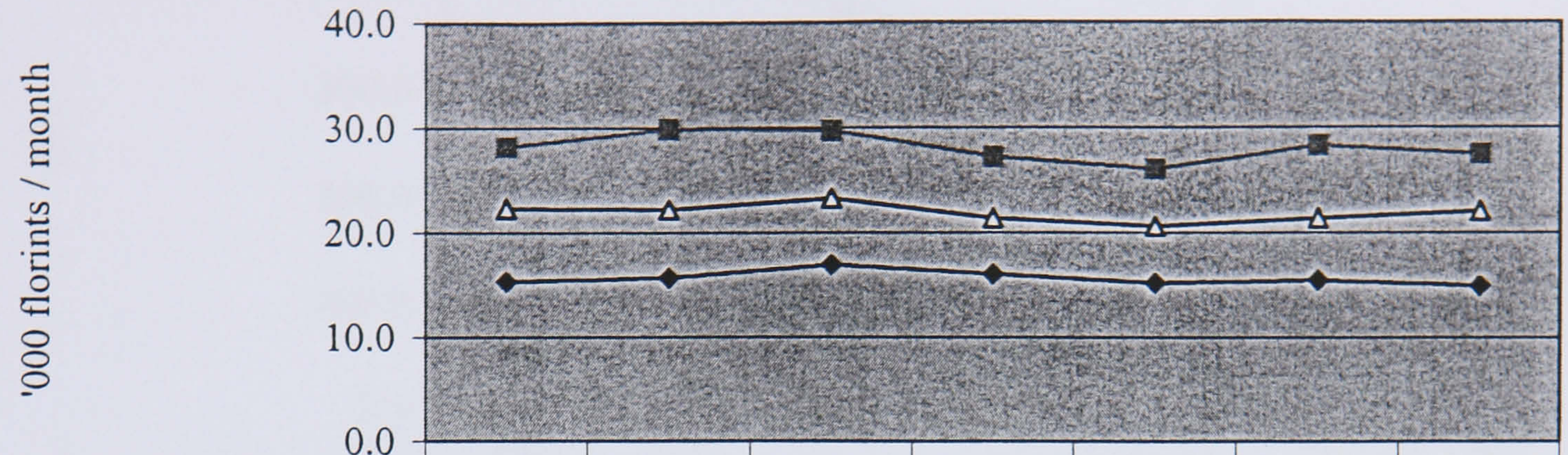


	1992	1993	1994	1995	1996	1997	1998
Agriculture	15.3	19.2	24.6	29.9	35.0	42.2	46.5
Manufacturing	21.1	26.3	32.5	39.6	48.2	58.9	68.9
Total	22.3	27.2	33.9	39.9	47.5	58.3	68.7

Source: Central Statistical Office (2001): Employment and Earnings 1998-2000. p. 32-33. Table 2.2.

Real earnings (i.e., nominal earnings divided by the consumer price index) over the period changed very little in agriculture, manufacturing or the economy as a whole (Figure 2.10).

Figure 2.10 Average gross earnings in Hungary (1992 prices)

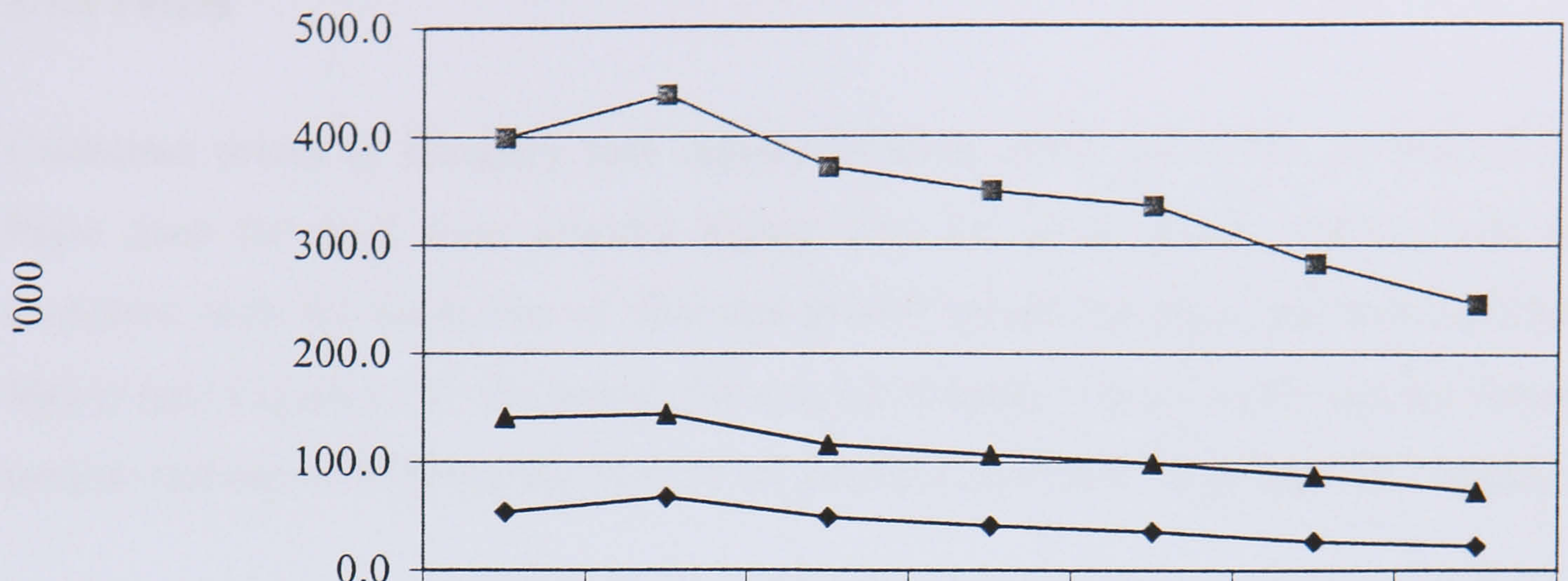


	1992	1993	1994	1995	1996	1997	1998
Agriculture	15.3	15.7	16.9	16.0	15.2	15.5	14.9
Manufacturing	28.2	29.9	29.8	27.2	26.1	28.3	27.5
Total	22.3	22.2	23.3	21.4	20.6	21.4	22.0

Source: See Figure 2.9.

Official unemployment data for Hungary are available by industry of last employment. These data show that total unemployment in the economy fell over the period quite dramatically, by around 40% from 399,000 in 1992 to 246,000 in 1998 (Figure 2.11). The fall in the number of unemployed whose last employment was in agriculture was greater at around 60%. However, these data do not sit easily with the employment data reported earlier. Both employment and unemployment are reported to have fallen over the period, suggesting that (i) persons displaced from their work were not being recorded in the official unemployment statistics, i.e. under-reporting of unemployed persons, or (ii) an increase in under-employment, e.g. people working part-time or within family-run businesses.

Figure 2.11 Unemployment in Hungary by industry of last employment



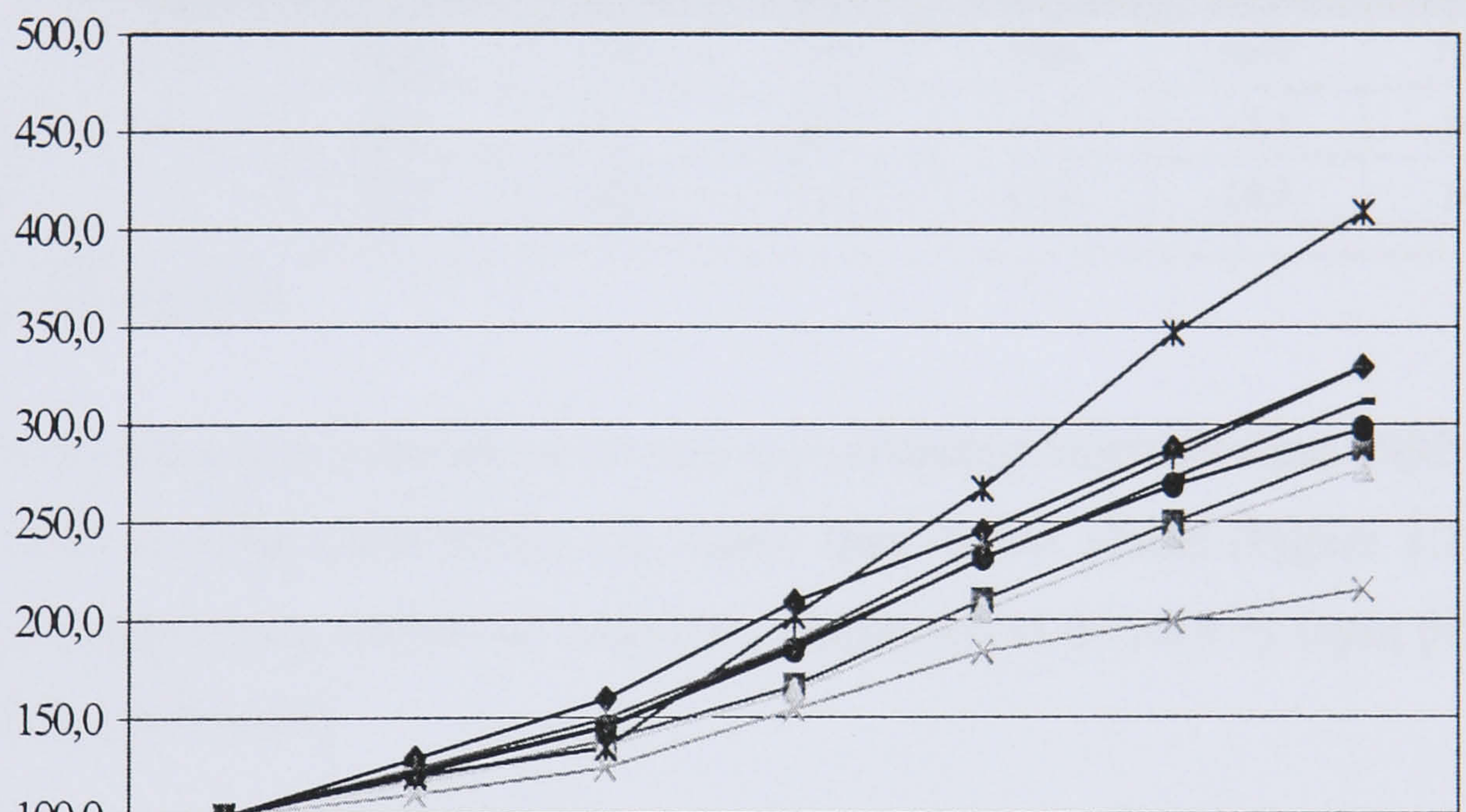
	1992	1993	1994	1995	1996	1997	1998
Agriculture	53.4	66.9	48.8	40.9	35.7	26.9	21.8
Manufacturing	140.7	144.1	115.9	106.8	99.4	87.7	72.7
Total	399.1	437.9	371.5	349.1	335.5	283.0	246.4

Source: Central Statistical Office (1999): Labour Force Survey 1992-1998. p. 42. Table 3.1.

2.1.3 Prices

Consumer prices in Hungary rose rapidly between 1992 and 1998, by around 200%. Price rises for food were slightly higher than for other goods and services in the economy, with the exception of 'fuel and power' where the price rise was significantly higher (see Figure 2.12). However, the rate of increase was generally falling during the period, and especially over the later years, both for food and all goods (see Figure 2.13).

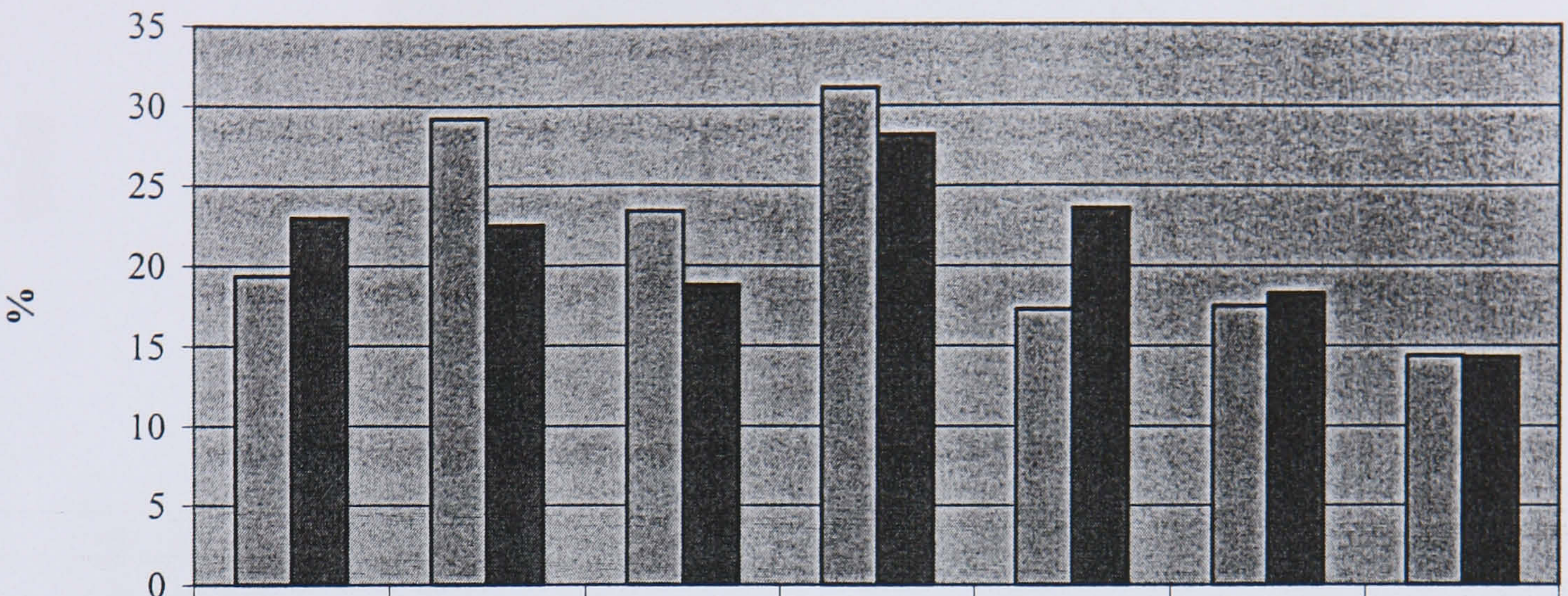
Figure 2.12 Consumer prices in Hungary (1992=100)



	1992	1993	1994	1995	1996	1997	1998
Food	100,0	129,2	159,4	209,0	245,2	288,1	329,6
Beverages, tobacco	100,0	118,6	138,1	165,8	209,9	249,6	287,8
Clothing	100,0	116,7	135,5	162,9	204,5	242,8	277,0
Consumer durables	100,0	111,0	124,1	153,9	183,4	199,0	215,1
Fuel and power	100,0	120,3	134,4	201,6	267,1	346,9	409,0
Other goods	100,0	121,6	144,7	184,2	231,5	268,8	297,6
Services	100,0	124,1	149,3	188,1	237,8	283,4	329,3
All	100,0	122,5	145,5	186,6	230,6	272,8	311,8

Source: National Bank of Hungary (2000): Annual Report 1999. p. 274. Annex VIII/1.

Figure 2.13 Price changes in Hungary year-on-year

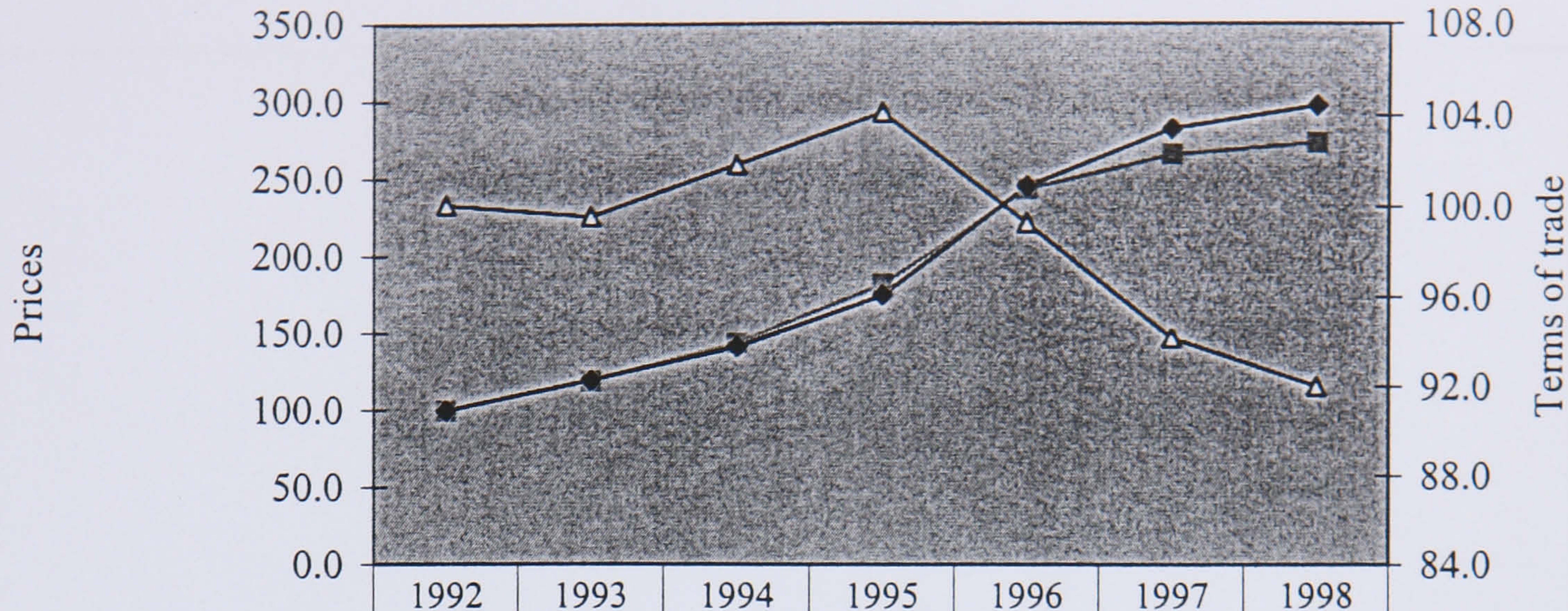


	1992	1993	1994	1995	1996	1997	1998
Food	19,4	29,2	23,4	31,1	17,3	17,5	14,4
All	23	22,5	18,8	28,2	23,6	18,3	14,3

Source: see Figure 2.12.

Agriculture's output and input prices moved approximately together from 1992 to 1995, but from 1996 to 1998 input prices rose faster than output prices (Figure 2.14). As a consequence, agriculture's terms of trade (i.e., output prices divided by input prices) fell to 92 in 1998 (1992=100).

Figure 2.14 Agricultural prices and Terms of Trade (1992=100)



	1992	1993	1994	1995	1996	1997	1998
Output prices	100.0	119.4	144.2	182.5	243.9	266.4	273.8
Input prices	100.0	120.0	141.7	175.3	245.8	282.9	297.6
Agric TOT	100.0	99.5	101.8	104.1	99.3	94.2	92.0

Source: Central Statistical Office (2000): Statistical Yearbook of Agriculture 1999. p. 30-31. Table 1.11.

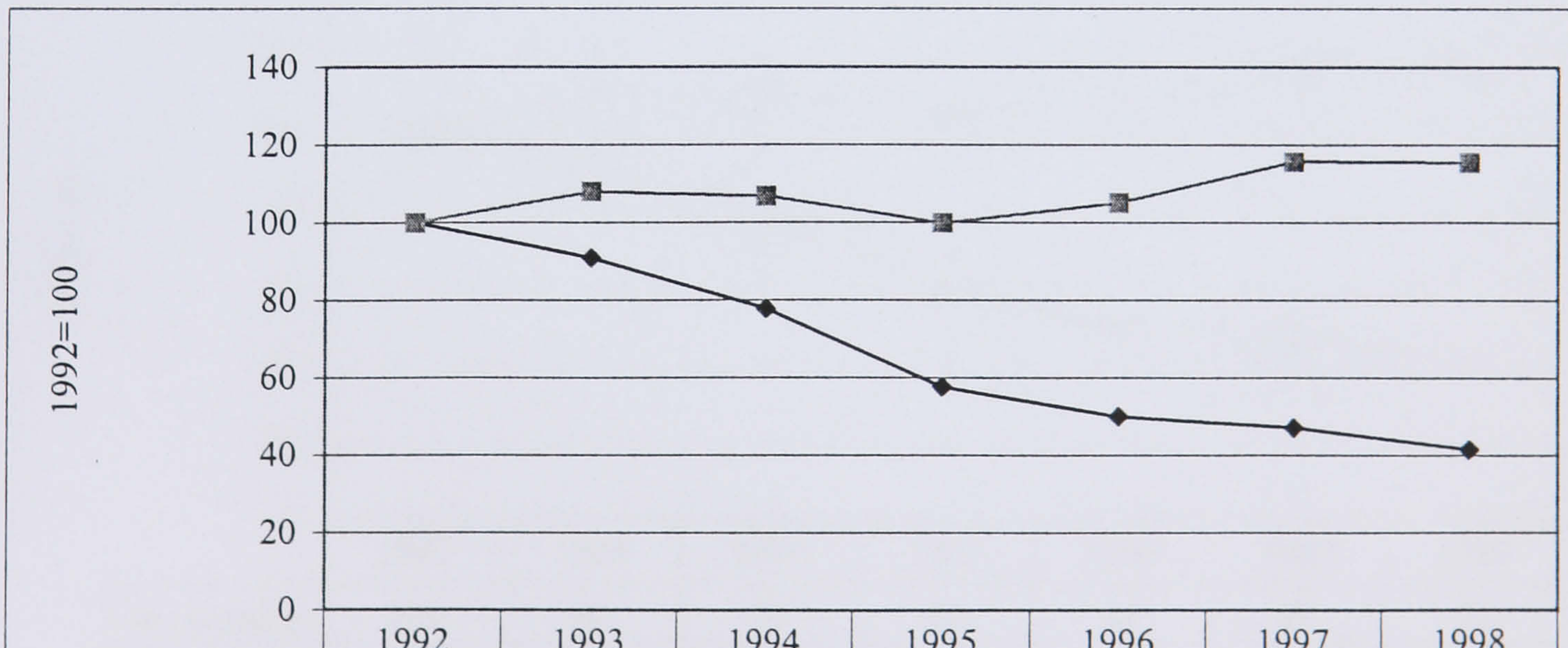
2.1.4 Foreign Exchange Rates

On foreign exchange markets, the Hungarian florint (HF) depreciated significantly in nominal terms between 1992 and 1998. Against the currencies of Hungary's major trading partners the nominal value of the florint fell continuously and by more than a half over the period (Figures 2.15 to 2.20). However, the higher rate of inflation in Hungary compared to the inflation rates in these trading partners, meant that the real rate of exchange (i.e. the nominal rate adjusted by differences in rates of domestic inflation) showed an increase of up to 20%. Against the Euro, the real price of the florint was 15% higher in 1998 than in 1992 (Figure 2.15). The corresponding changes against other currencies were: the Austrian schilling +15%; the Deutchmark +14%; the French Franc +16%; the £ sterling +4%; and the US \$ -1% (Figures 2.16 to 2.20). Thus, the pattern was approximately the same for all of Hungary's major European trading partners, with the possible exception of the UK. The rise in Hungary's real exchange rate will have had the effect of making Hungary's exports less competitive and imports more competitive over the period, *ceteris paribus*.

Figure 2.15 Exchange rate between HF and Euro

Source: National Bank of Hungary (2000): Annual Report 1999. p. 282. Annex IX/1.

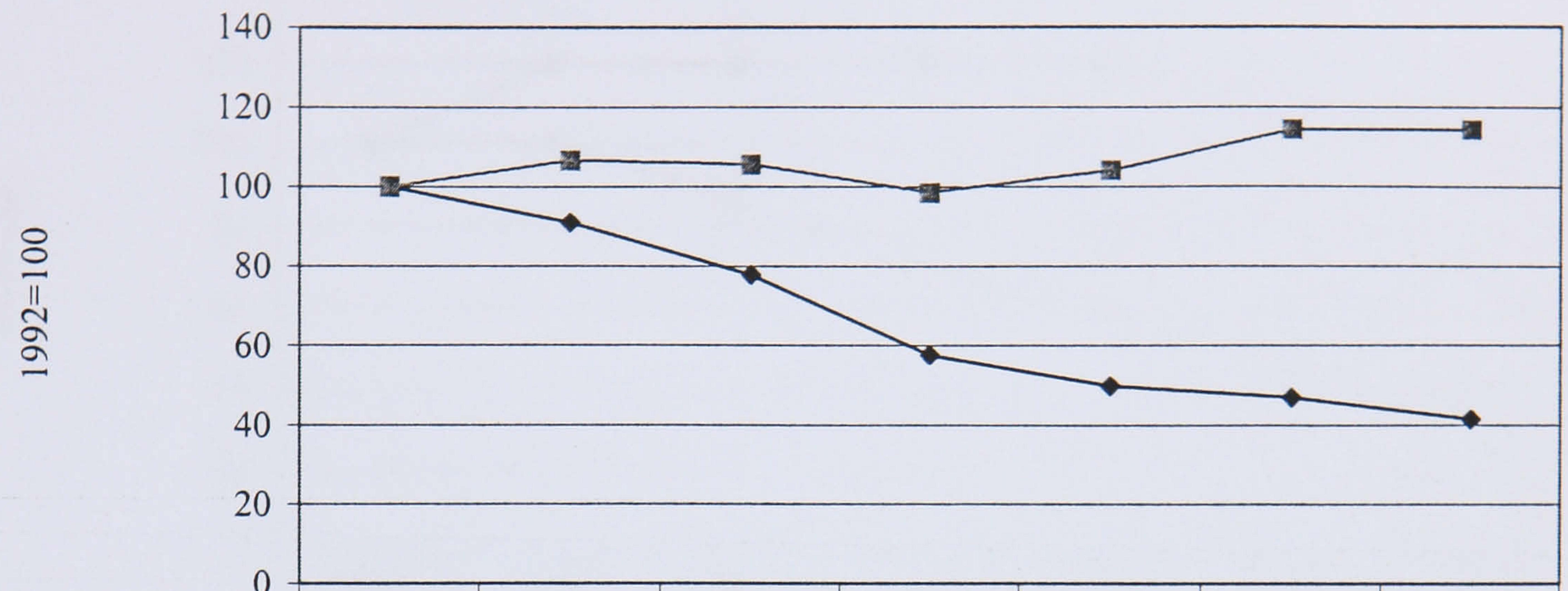
Figure 2.16 Exchange rate between HF and Austrian schilling



	1992	1993	1994	1995	1996	1997	1998
nominal	100	91	78	58	50	47	41
real	100	108	107	100	105	116	115

Source: see Figure 2.15.

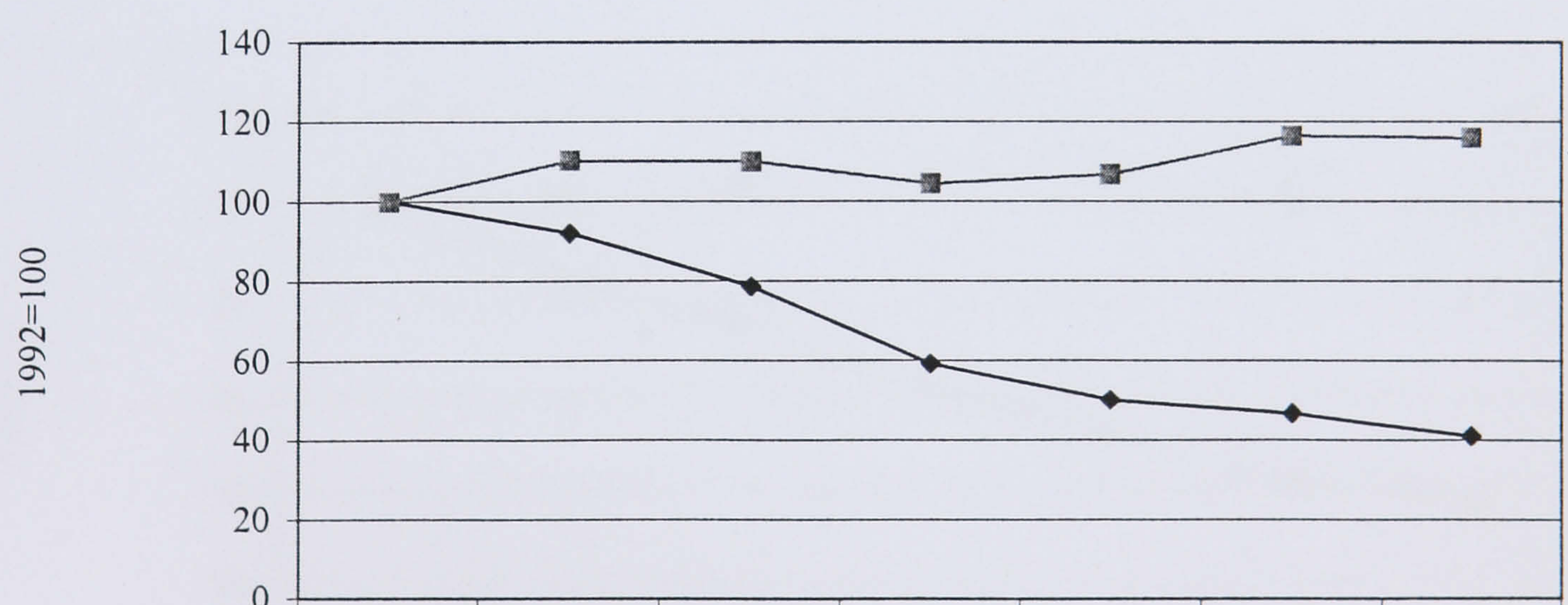
Figure 2.17 Exchange rate between HF and Deutschmark



	1992	1993	1994	1995	1996	1997	1998
nominal	100	91	78	58	50	47	41
real	100	107	106	99	104	114	114

Source: see Figure 2.15.

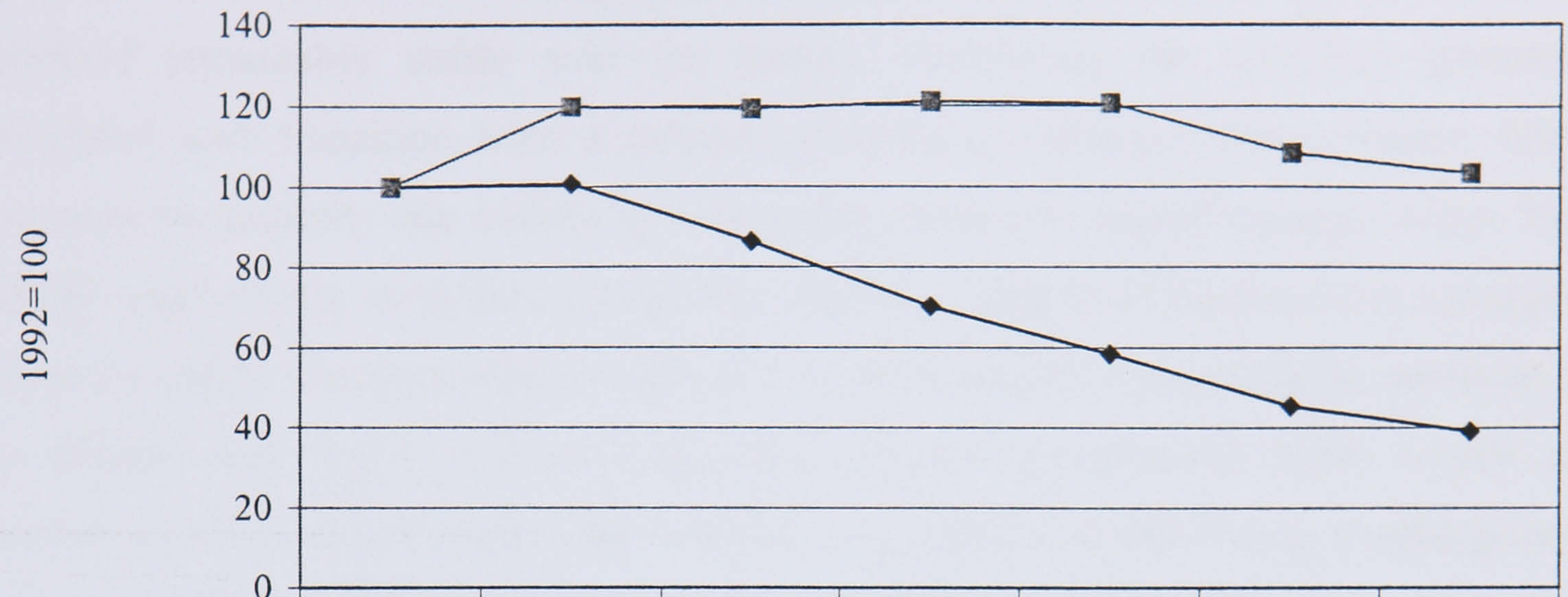
Figure 2.18 Exchange rate between HF and French Franc



	1992	1993	1994	1995	1996	1997	1998
nominal	100	92	79	59	50	47	41
real	100	110	110	104	107	116	116

Source: see Figure 2.15.

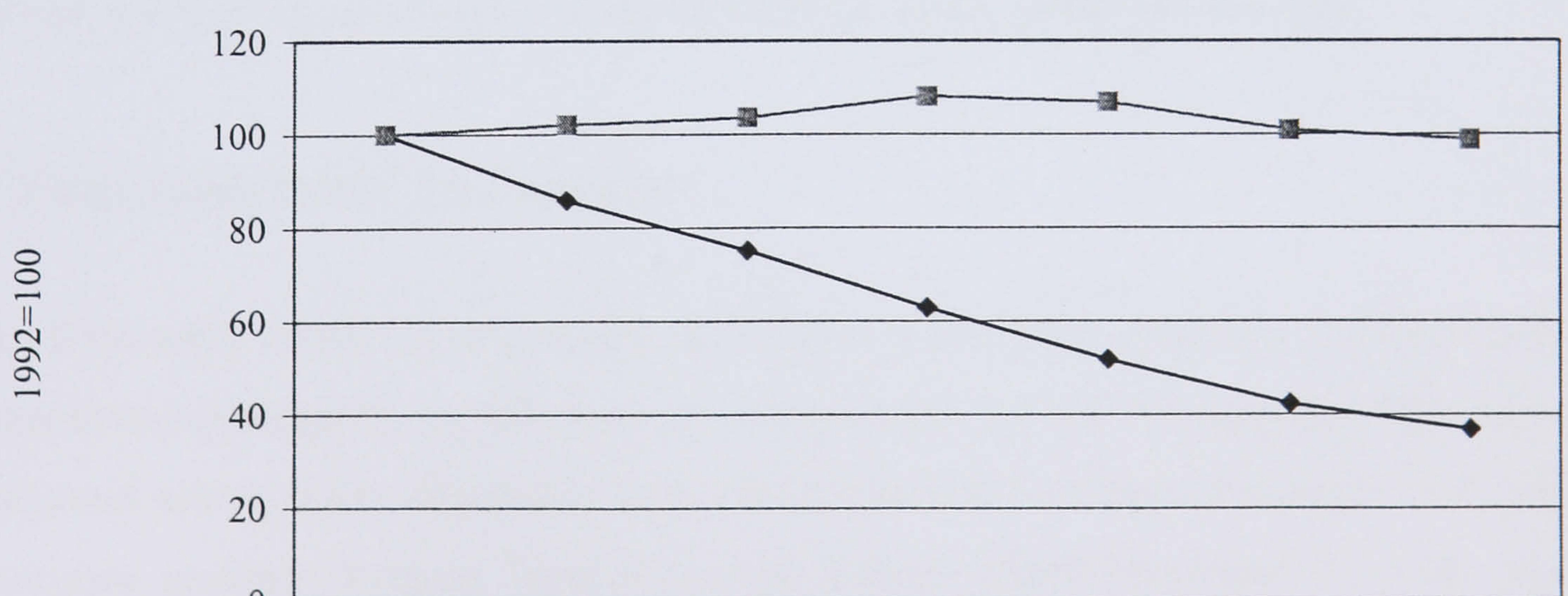
Figure 2.19 Exchange rate between HF and Ł Sterling



	1992	1993	1994	1995	1996	1997	1998
nominal	100	101	86	70	58	46	39
real	100	120	119	121	121	108	104

Source: see Figure 2.15.

Figure 2.20 Exchange rate between HF and US $



	1992	1993	1994	1995	1996	1997	1998
nominal	100	86	75	63	52	42	37
real	100	102	104	108	107	101	99

Source: see Figure 2.15.

2.1.5 Summary of changes in main economic indicators

What do changes in these various indicators tell us about Hungary's economy during the 1990s? Perhaps the most surprising outcome is that the structure of the economy appeared remarkably stable over the period, considering the upheaval generally associated with transition from a centrally-planned to market-driven economy. GDP increased moderately, due mainly to a dramatic increase in manufacturing output. The overall employment level fell, though the structural pattern of employment remained relatively stable. Unemployment statistics also fell markedly, suggesting an anomaly in the official data. Price inflation was high, keeping real earnings static despite an increase in real GDP per head. High inflation also caused the real foreign exchange rate to rise, making Hungarian exports (imports) less (more) competitive.

For agriculture, GDP was virtually unchanged in real terms over the period, though its contribution to the overall economy fell as did its share of total employment. GDP per person increased faster than in the general economy but this was not reflected in higher real earnings. The shares of the food industry in total GDP and employment also fell, and both the agricultural and food sectors had labour productivity less than the national average. Agriculture's terms of trade worsened during the second half of the period, though food prices increased slightly faster than for all goods and services.

2. 2 The Trade Policy Environment

Since the early 1990s the orientation of Hungary's economic and trade policies has been determined principally by the goal of accession to the EU. Meanwhile, Hungary has followed active trade diplomacy with developed and transition countries. All OECD countries granted Hungary Most Favoured Nation (MFN) treatment in 1992, and in addition all, except Turkey, have extended their Generalised System of Preference (GSP) schemes to Hungary. However, during the first half of 1990s Hungary negotiated several agreements that superseded the MFN-GSP system. These agreements are: (i) the Association Agreement (European Agreement) with the EU; (ii) a free trade agreement with countries belonging to the European Free Trade Association (EFTA); and (iii) the Central European Free Trade Agreement (CEFTA), which includes the Visegrad group of countries (the Czech Republic, Hungary, Poland and the Slovak Republic). Moreover, Hungary ratified the Uruguay Round Agreement in 1995. These will be discussed in turn.

2. 2. 1 The Association Agreement with the EU

At the end of 1991 Hungary and the EU signed an Association Agreement providing, among other economic and political aspects, for the establishment of a complete bilateral free-trade area within a period of ten years. After ratification of the Agreement, provisions concerning trade came into force on 1 March in 1992, under an Interim Agreement. The general feature of the Interim Agreement was that liberalisation steps over the period were to be asymmetric, in the sense that EU concessions took place during the first five years, whilst concessions to be granted by Hungary were for the second five year period.

Industrial products were divided into three categories accounting for roughly equal shares of total imports. Hungary removed all tariffs on the first category on 1 January 1994 and on the second category on 1 January 1997. The remaining category concerned politically sensitive products including chemicals, textiles, clothing products and steel products. Duties on these products were eliminated more gradually and finished on 1 January 2001. Quantitative restrictions on all textile and clothing imports, and 40 per cent of other restrictions were eliminated on 31 December 1997. The remaining restrictions were removed by 1 January 2001.

The main schemes implemented for Hungarian agricultural exports under the Agreement are as following:

- asymmetric concessions in the form of increased tariff quotas (see Table 2.1);
- unlimited tariff preferences for some products, (ranging from live horses to goose and duck livers);
- the gradual elimination of the "nonagricultural component" duty and reduction of the agricultural component within quota limits for processed products which are not listed in Annex II of the Treaty Rome;
- a minimum import price for soft red fruits for processing.

Table 2.1 Agricultural Concessions under the Association Agreement

	Base	1992	1993	1994	1995	1996
EU imports:						
duty/levy	100	80	60	40	40	40
quota	100	110	120	130	140	150
Hungarian imports:						
duty/levy	100	90	80	70	70	70
quota	100	105	110	115	120	125

Source: EC (1995): Agricultural Situation and Prospects in the Central and Eastern European Countries. Hungary. p. 48. Table 6.6.

The provisions of the Agreement have distinguished raw materials and processed products. Duties on value added at the processing stage will be gradually removed. For raw materials, levies and tariffs within quotas will not be eliminated, but reduced by a predetermined percentage (generally, 50 or 60 per cent). These levies are variable and outcomes depend on the evolution of world prices; thus there is no guarantee that the effective level of protection, including concessions, will decrease (OECD, 1998). Furthermore, quotas and ceilings on unprocessed agricultural products will grow by about 50 per cent on average, and will still apply after the transition period.

Finally, under the Agreement two general clauses apply. First, there is a safeguard clause, in the case of serious disruptions of agricultural markets. Second, a standstill clause applies, which means no increase of duties for any products. But this provision does not restrict the pursuance of the respective agricultural policies of Hungary and the EU. Thus, while the Agreement increases access to the EU for Hungarian agri-food products, it does so within the framework of the existing CAP.

Since the outset, the Association Agreement has been modified for several reasons. First, the EU's schedule was advanced by six months in 1993 in order to improve the preference utilisation. Second, partners took into account the Uruguay Round Agreement of the GATT (General Agreement on Tariffs and Trade) in 1994. Therefore, preferential tariff rates were fixed at 20 per cent of MFN rates instead of 40 per cent. Third, in respect of the EU enlargement to include Austria, Finland and Sweden, additional quantities and new quotas were opened in order to avoid preference erosion (Duponcel, 1998a). Fourth, the EU decided in 1995 to increase tariff quotas by 25 per cent over a period of five years for all associated countries. Finally, with regards to soft fruit, the minimum import prices, which had an adverse effect on Hungarian exports, were decreased by 20 per cent, tariffs have been reduced by 50 per cent and an early warning system set up.

Besides the Association Agreement, two agreements were conducted between Hungary and the EU in 1993: on the reciprocal protection and the control of wine names; and on the reciprocal establishment of tariff quotas for given wines. These quotas were fixed for a five year period ending in 1998.

Hungary, like other associated countries, was not able to fully utilise most of its preferential quotas in the first years of the Association Agreement's implementation (Duponcel, 1998b). Quota utilisation has improved over time for beef and pork products, and the situation became more favourable for the main agricultural products (EC, 1998). However, Duponcel (1998a) showed that the potential maximum gain arising from the full utilisation of preferences is rather limited. This stems partly from the sharing of quota rents between Hungarian exporters and EU importers, which is more favourable to the latter. Overberg and Tangermann (1997) estimated the effects of the Association Agreementon trade for Czech Republic, Hungary and Poland and concluded that trade preferences in agriculture for these countries were more limited than in the industrial sector. In particular, they have been constrained by quotas. However, the authors argued that in spite of these constraints, Central European countries could experience a significant expansion of exports to the EU if they were able to utilise fully their preferential quotas. Indeed, there is a consensus in related literature that the very restricted nature of the preferences is not responsible for the low level of utilisation. The main reasons pertain to the supply side, namely, limited competitiveness and insufficient export surplus availability (Frohberg and Hartman 1997; Overberg and Tangermann 1997; EC 1998; Duponcel 1998a and b).

2. 2. 2 The EFTA Agreement

Hungary signed a free trade agreement with countries of the European Free Trade Association (EFTA) in 1993, similarly modeled on the structure, content and timetable of the Association Agreement with the EU. The main aim of this agreement was to establish identical or at least similar horizontal rules across free trade agreements in Europe. However, there were some differences. The EFTA agreement covered only industrial and processed agricultural products. Agricultural raw materials were subject to bilateral negotiations. Liberalisation schedules for industrial products for Hungary are the same in the Association Agreement and the EFTA Agreement. Most duties and quantitative restrictions applying to Hungarian industrial product exports were abolished on 1 January 1997, while all duties and quantitative restrictions affecting EFTA exports to Hungary were removed by 1 January 2001. As far as trade in agri-food products is concerned, the EFTA agreement is of little importance.

2. 2. 3 The CEFTA Agreement

The Central European Free Trade Agreement (CEFTA) was signed in December 1992 between Poland, Hungary and the former Czechoslovakia. Other members of CEFTA are Slovenia (since 1 January 1996), Romania (since 1 July 1997) and Bulgaria (since 1 July 1998). Although CEFTA is a multilateral agreement, bilateral negotiations took place to decide on the products to be included in the various liberalisation schedules that were then negotiated multilaterally. This means that the pace and degree of trade liberalisation differs between countries depending on the sensitivity of respective products. The CEFT Agreement covers all merchandise trade. A major difference with the Association Agreement and EFTA Agreement is that the CEFTA Agreement takes a symmetrical approach to concessions.

Trade barriers on mutual trade have been eliminated over a maximum period of eight years, the deadline being 1 January 2001. But a large share of products was dealt with in the first years of liberalisation. For industrial products the liberalisation process was accelerated, with almost all duties removed by 1 January 1997, and remaining parts of tariffs eliminated by 2001. However, in contrast, free trade in agricultural and food products is still a long way off. The proportion of agri-food trade covered by CEFTA is small: about one-quarter compared to at least two-thirds under the Association Agreement. The initial agreement introduced a system of preferential quotas for agricultural and food commodities. Preferences were given for selected products on a bilateral basis, for which partners had to reduce tariffs by 10 per cent annually, until a 50 per cent preference was reached. Since 1 January 1996 further liberalisation has taken place. Agricultural and food products were classified into three groups with varying degrees of preference. The first category, accounting for about 45 per cent of total mutual agricultural trade, benefits from duty-free and quota-free treatment. The second group is also quota-free, but subject to common preferential tariffs. For the third category, comprising the most sensitive commodities, concessions were granted on a bilateral basis and may be subject to quotas.

2. 2. 4 The Uruguay Round Agreement

Before 1994, Hungarian import protection was based mainly on quantitative measures, such as import licenses and global quotas for consumption goods, of which food products accounted for roughly one third by total imports. Of the tariffs and levies that were applied, all were on an *ad valorem* basis.

Under the Uruguay Round Agreement (URA) the global quota for food commodities and the licensing system have been dismantled via the tariffication process. The tariffs have remained *ad valorem.* Nearly 96 per cent of all Hungarian tariffs lines are bound (Daly and Kuwahara, 1999). As a consequence of tariffication, the simple average of applied MFN tariffs on agricultural commodities increased from 22 per cent to 45 per cent between 1993 and 1995, which is low in comparison with the EU (WTO, 1998). Although the average applied MFN tariff decreased to 37 per cent in 1997, it is still more than four times the average for industrial products. Furthermore, applied tariffs are on average higher for processed products than for staple agricultural goods, suggesting the existence of tariff escalation.

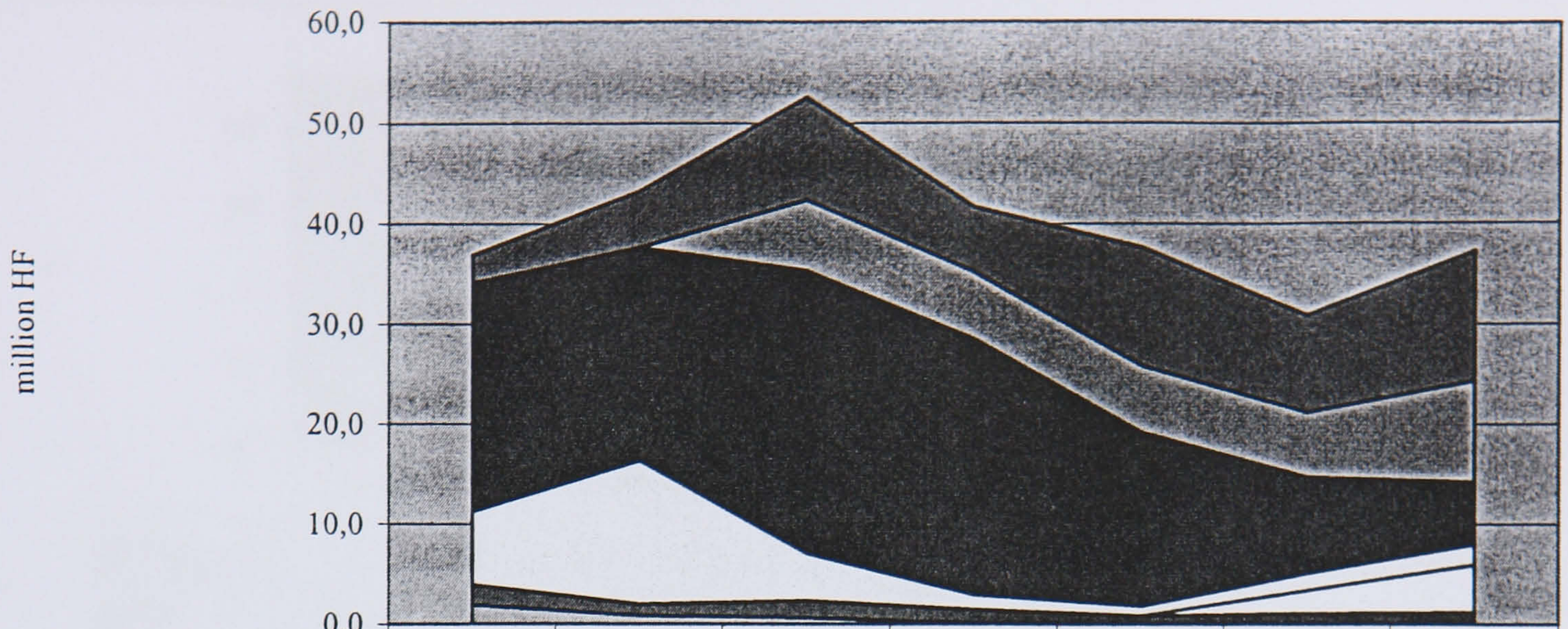
In accordance with the URA, Hungary had to reduce expenditures on export subsidies by 36 per cent, and quantities of subsidised exports by 21 per cent, with reference to the period 1986-1990. However, the Hungarian government made serious mistakes in the calculation of these commitments. First, the data on subsidised exports to former COMECON countries during the base period were not included. Second, Hungary expressed its commitments in Hungarian forints, resulting in a very severe constraint due to the high domestic inflation rate. As a consequence of this miscalculation, Hungary subsidised its exports above the committed level in the first two years of implementation. The outcome was a dispute with several WTO members (Argentina, Australia, New Zealand and the United States). This was resolved in October 1997, along the following lines. First, the basis for export commitments, generally, is the actual situation of 1995 in terms of product coverage and outlays. Second, for certain commodities (pigs, poultry, wine and beverages) the quantity limitations indicated in the scheduled are retained. Third, Hungary committed itself not to use the flexibility granted under the resolution for exports to non-traditional markets, which means markets where subsidised exports did not exist between 1994 and 1996. The resolution ended on 1 January 2002.

Under the URA, Hungary had to reduce domestic support by 20 per cent over the six year period, with reference to the base period 1986-1988. Hungary notified its level of domestic support for 1995 under the *de minimis* provision, i.e. it was estimated as a proportion of the total value of production rather than by an explicit calculation of the AMS (Aggregate Measure of Support). However, it has not yet notified the WTO regarding current support measures and associated decreases therein.

2.3 Government Support of Agriculture

The budgetary cost of government support of agriculture in Hungary was the same in 1998, in real terms, as in 1992, having risen to a high in 1994 and then fallen to a low in 1997 (Figure 2.21). By 1998, target supports and production supports were the most important in terms of budgetary outlay. The cost of export subsidies increased to 1994 to around 54% of support costs, but by 1998 had fallen to only 17% of the total.

Figure 2.21 Agricultural Support in Hungary, 1992-1998 (1992 prices)

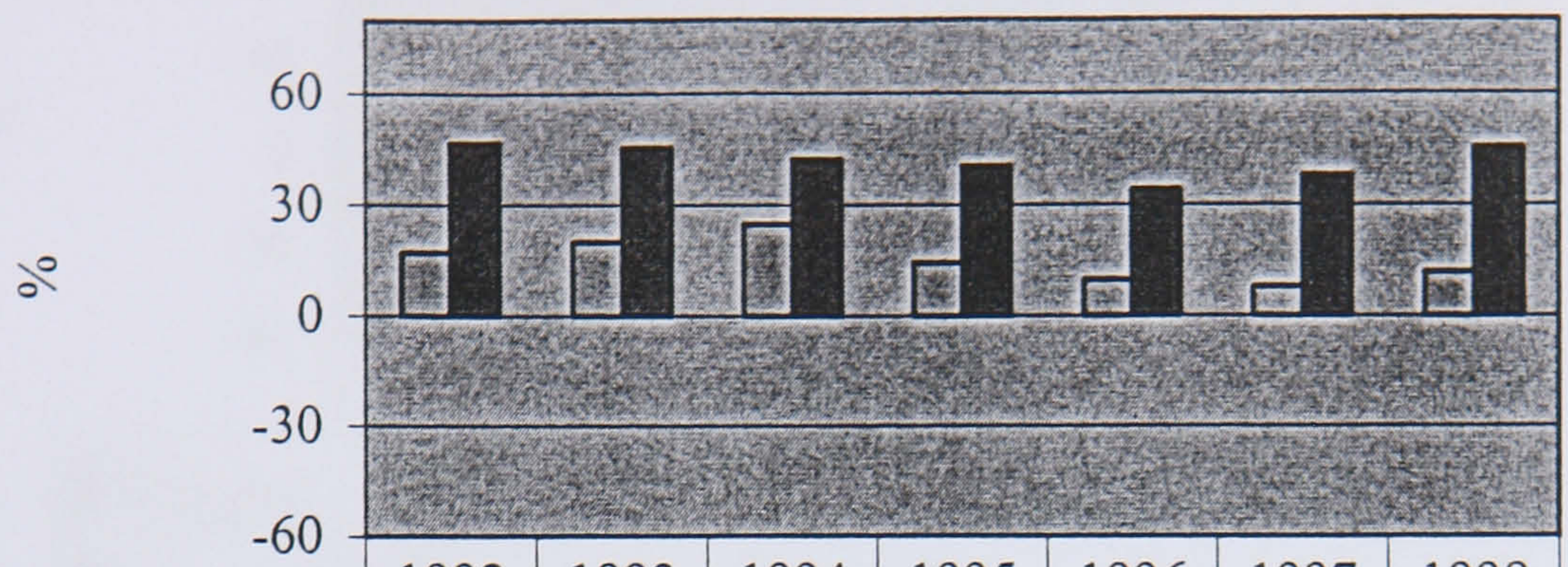


	1992	1993	1994	1995	1996	1997	1998
target supports	2,8	5,6	10,1	6,4	11,8	9,6	12,9
production supports	0,0	0,0	7,0	6,6	6,7	6,5	10,1
export subsidy	22,9	21,3	28,3	25,7	17,5	9,6	6,3
market subsidy	7,3	14,3	4,7	1,4	0,9	1,7	2,0
market access supports	0,0	0,0	0,0	0,0	0,0	2,3	4,8
investment subsidy	2,1	1,2	1,7	1,4	0,9	1,1	1,2
other corporate subsidy	1,9	0,9	0,7	0,1	0,0	0,0	0,0

Source: Central Statistical Office (2000): Statistical Yearbook of Agriculture 1999. p. 74-75. Table 2.22.
Note: The deflator used is the agricultural inputs price index.

The extent of government support of agriculture is conveniently measured by the Producer Support Equivalent (PSE), which is defined as the monetary value of support from taxpayers and consumers to producers, measured at farm-gate level. For Hungary, the total percentage PSE over the period, as calculated by the OECD (1999), was considerably lower than that for the EU; Hungary's total PSE averaged 15% between 1992 and 1998, whilst the EU's total PSE averaged 42% (Figure 2.22).

Figure 2.22 Total PSE % in Hungary and EU



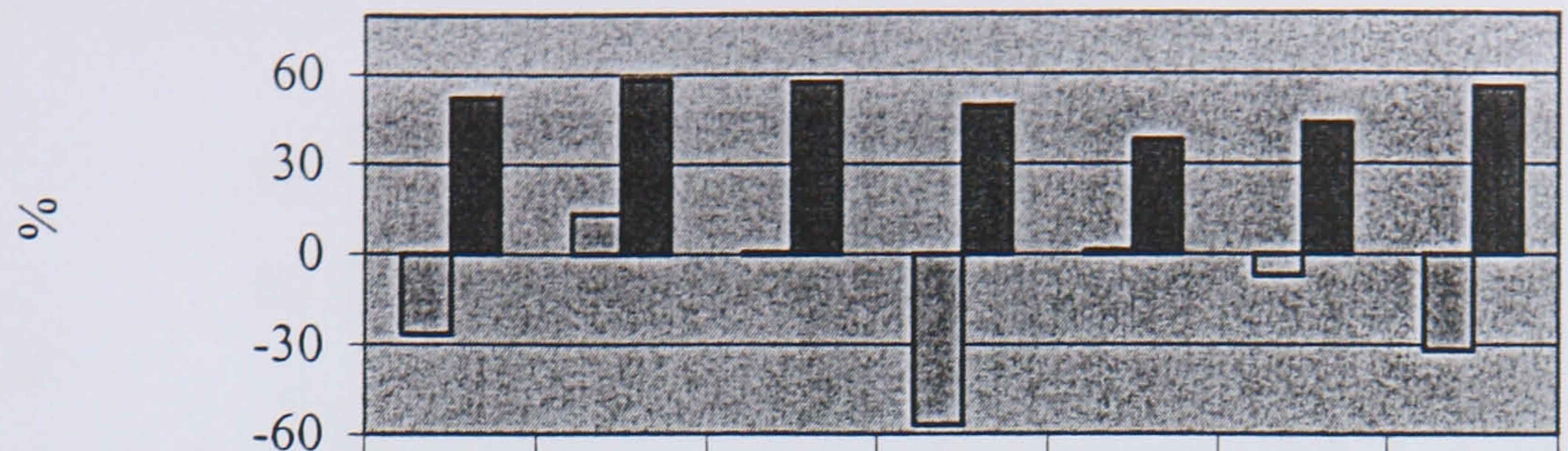
	1992	1993	1994	1995	1996	1997	1998
Hungary	17,1	20	24,8	14,3	9,7	7,7	11,8
EU	46,5	45,3	42,3	40,5	34,2	37,9	45,3

Source: OECD (2000): Producer and Consumer Support Estimates. OECD Database 1989-1999. cd.

Figures 2.23 to 2.35 show the percentage PSE for Hungary and the EU for 13 main commodities over the 7-year period. Two general points stand out from these figures. First, the level of support in Hungary is lower than that in the EU for all of the commodities except pigmeat, poultrymeat and eggs. Second, levels of support in Hungary are negative for a number of commodities (mainly cereals) in a number of years.

Levels of PSE in Hungary are highest for sugar, milk and eggs. Levels of PSE are high in the EU for all commodities, except the 'landless' enterprises of pigmeat, poultrymeat and eggs.

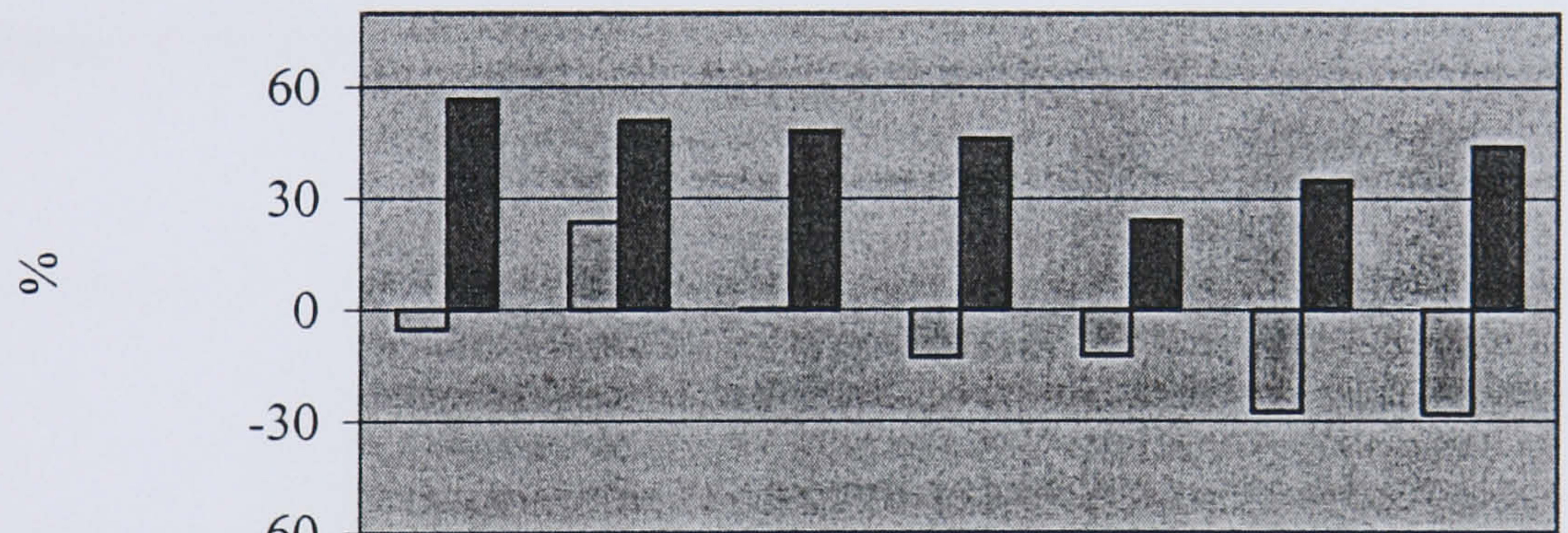
Figure 2.23 PSE % for Wheat in Hungary and EU



	1992	1993	1994	1995	1996	1997	1998
Hungary	-26,8	13,5	0,6	-57	1,1	-7,1	-31,9
EU	52,2	58,3	57,3	49,4	38	43,6	55,5

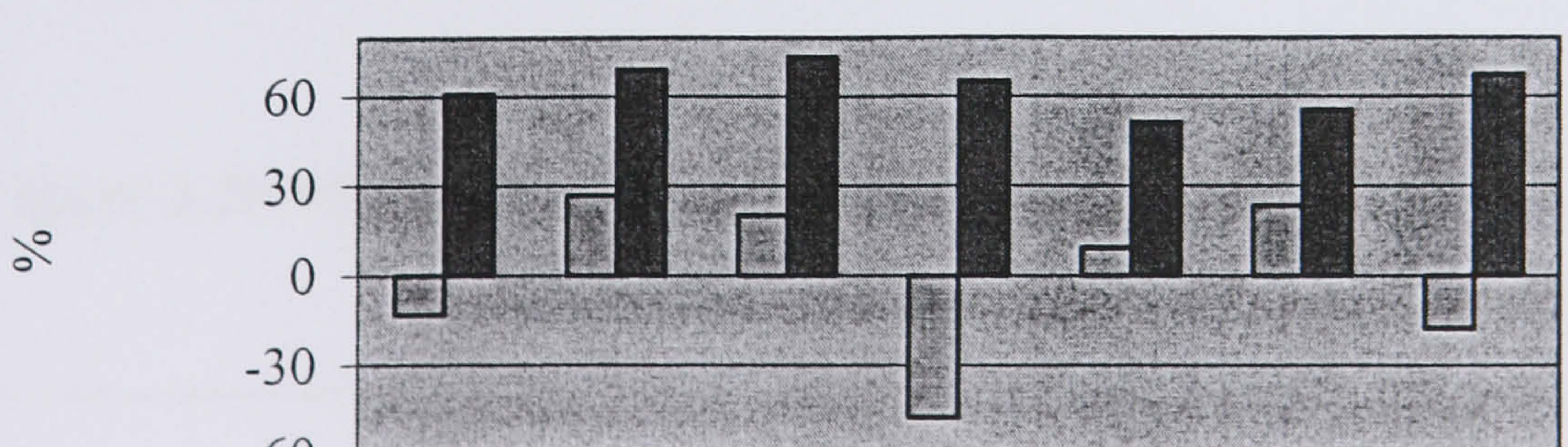
Source for Figures 2.23 to 2.35: see Figure 2.22.

Figure 2.24 PSE % for Maize in Hungary and EU



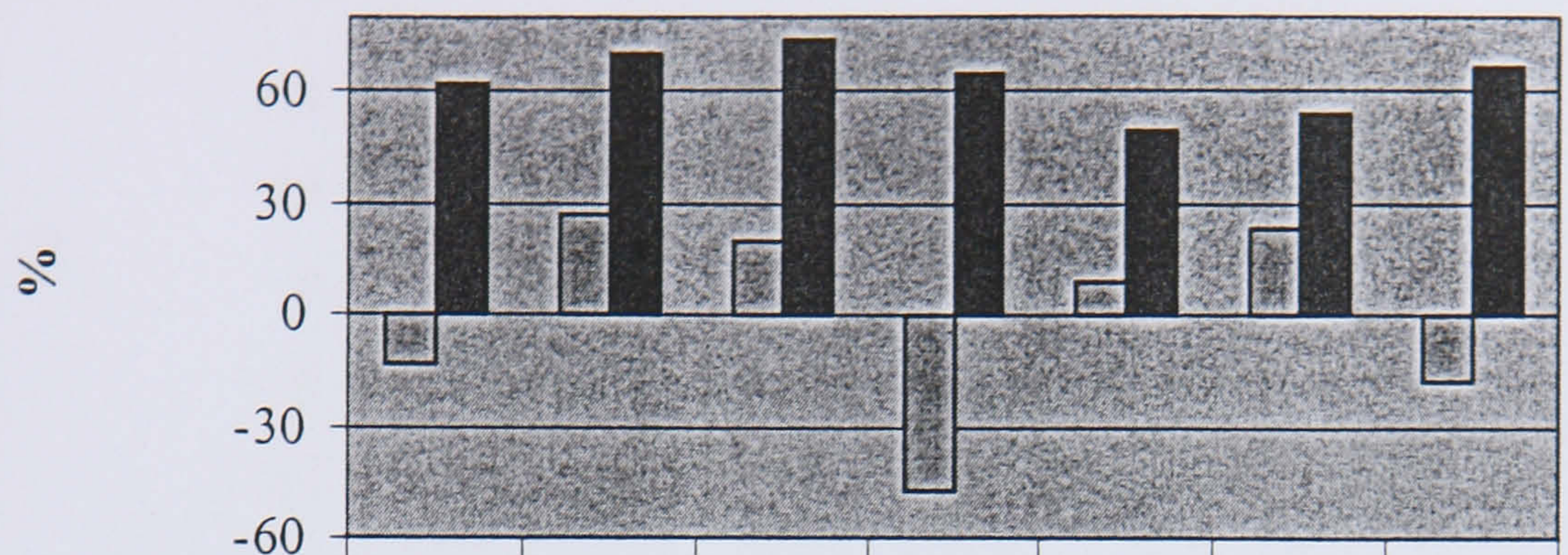
	1992	1993	1994	1995	1996	1997	1998
Hungary	-5,2	23,6	0,3	-12,5	-12,1	-27,4	-28,2
EU	56,7	50,9	48,2	46,1	24	35	44

Figure 2.25 PSE % for Other Grains in Hungary and EU



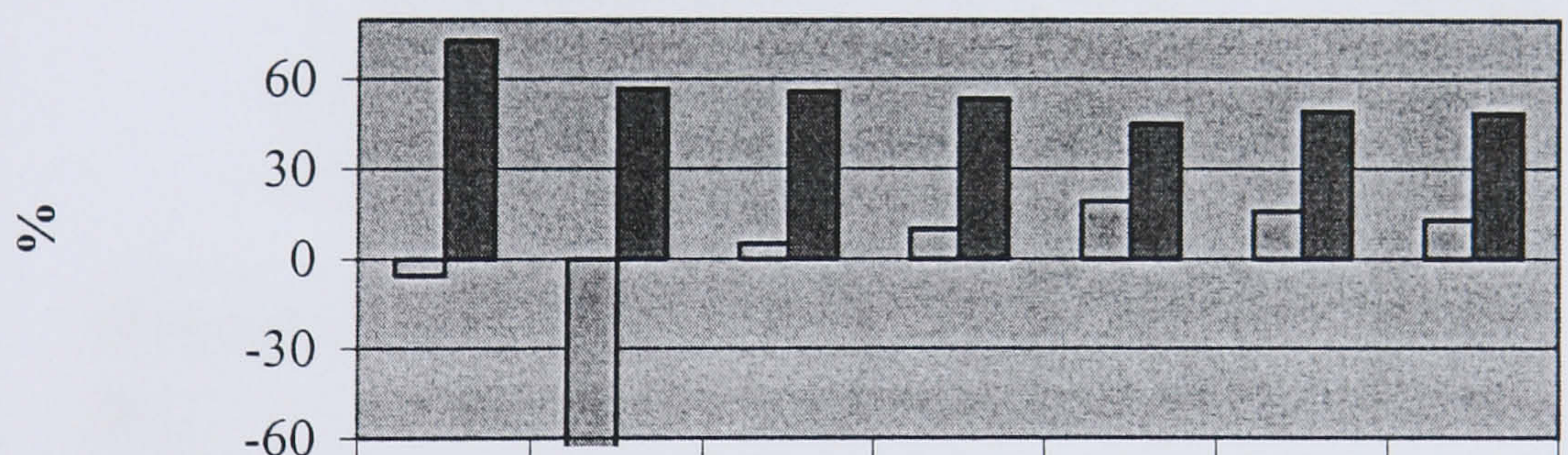
	1992	1993	1994	1995	1996	1997	1998
Hungary	-13,2	26,7	20,1	-47,4	9,1	23,4	-17,8
EU	60,9	69,2	73,4	65,3	51,4	55,5	67,5

Figure 2.26 PSE % for Barley in Hungary and EU



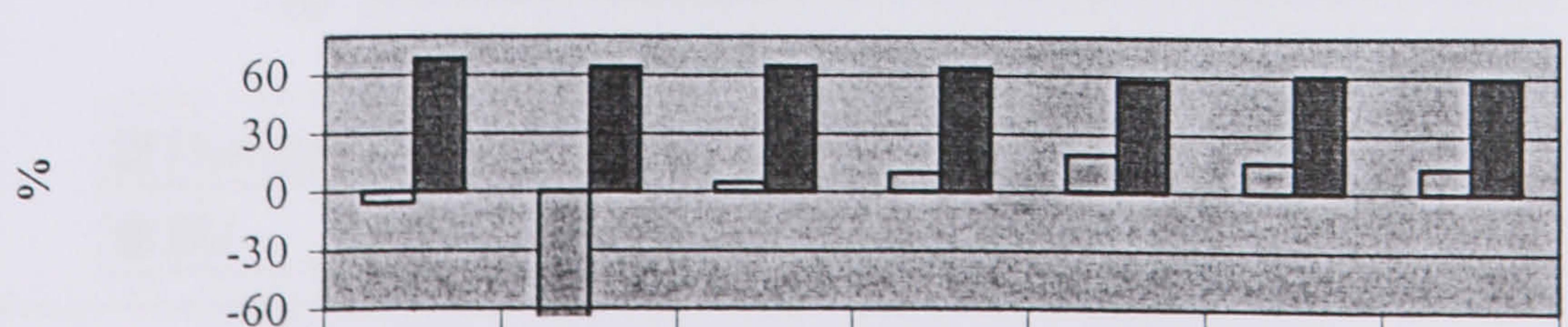
	1992	1993	1994	1995	1996	1997	1998
Hungary	-13,2	26,7	20,1	-47,4	9,1	23,4	-17,8
EU	61,8	70,4	74,1	64,5	49,1	54	66,8

Figure 2.27 PSE % for Oilseeds in Hungary and EU



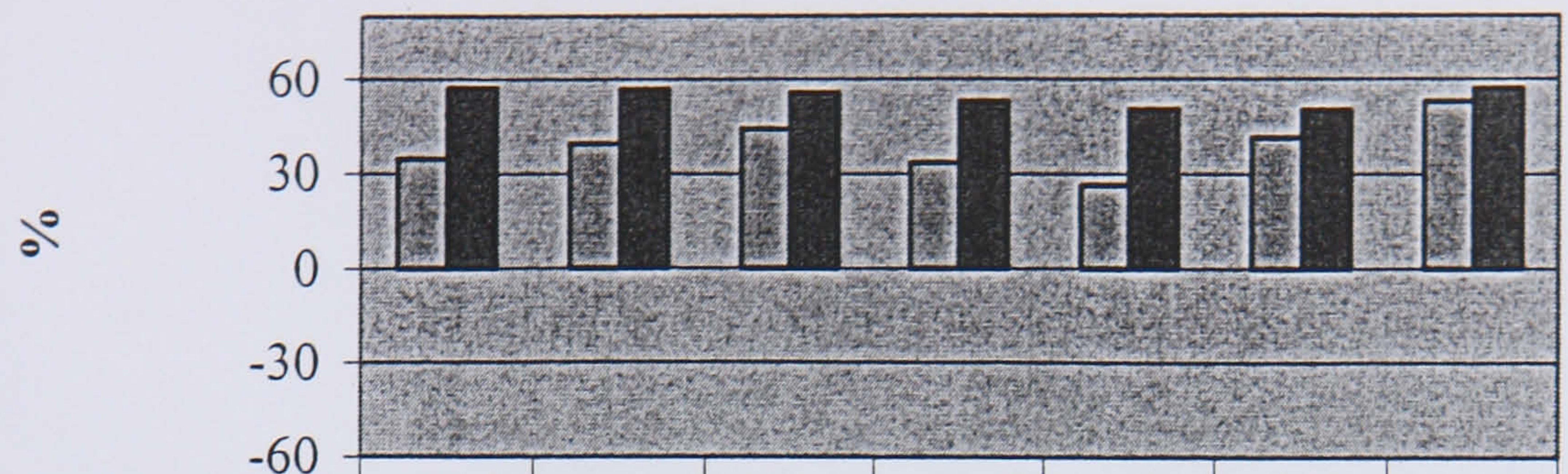
	1992	1993	1994	1995	1996	1997	1998
Hungary	-5,7	-66,9	5,1	9,9	19,3	15,9	13
EU	73	56,9	56,1	53,5	45,2	49,4	48,7

Figure 2.28 PSE % for Sunflower in Hungary and EU



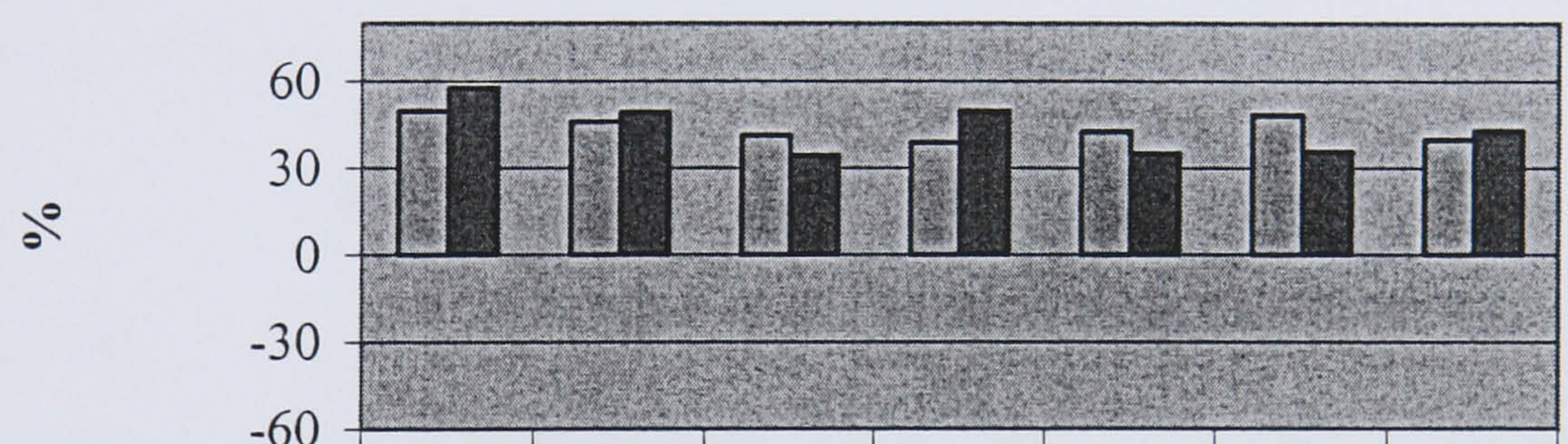
	1992	1993	1994	1995	1996	1997	1998
Hungary	-5,7	-66,9	5,1	9,9	19,3	15,9	13
EU	68,6	64,1	64,6	63,6	57,4	60,1	59,3

Figure 2.29 PSE % for Refined Suger in Hungary and EU



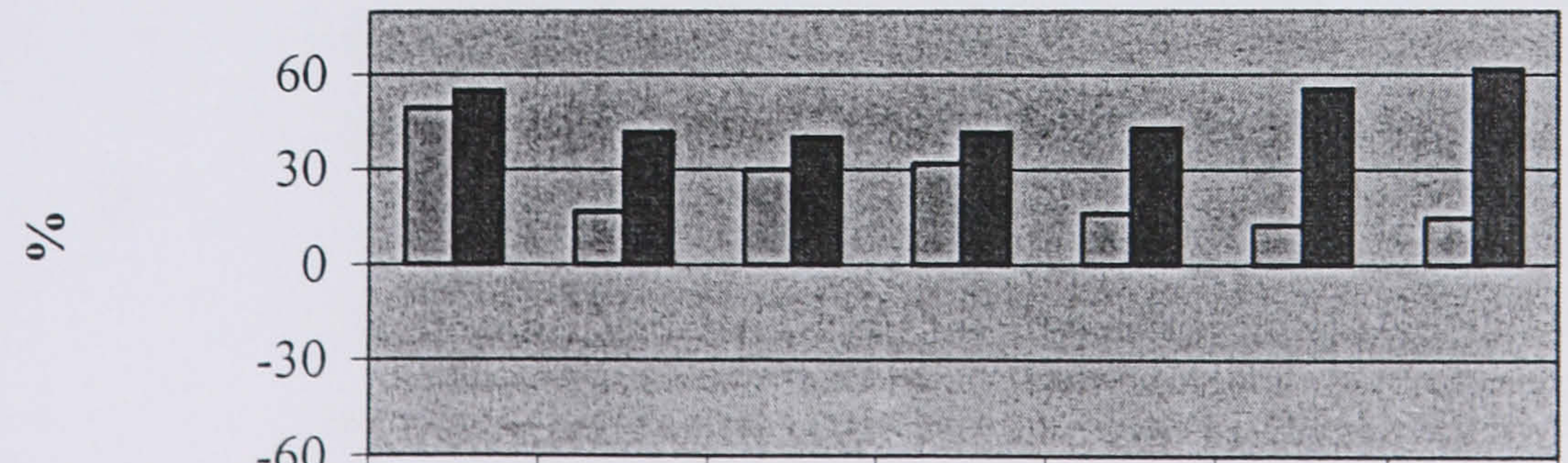
	1992	1993	1994	1995	1996	1997	1998
Hungary	34,7	39,5	44,3	33,5	26,5	41,4	53
EU	57,3	56,9	55,7	53,1	50,5	50,2	57

Figure 2.30 PSE % for Milk in Hungary and EU



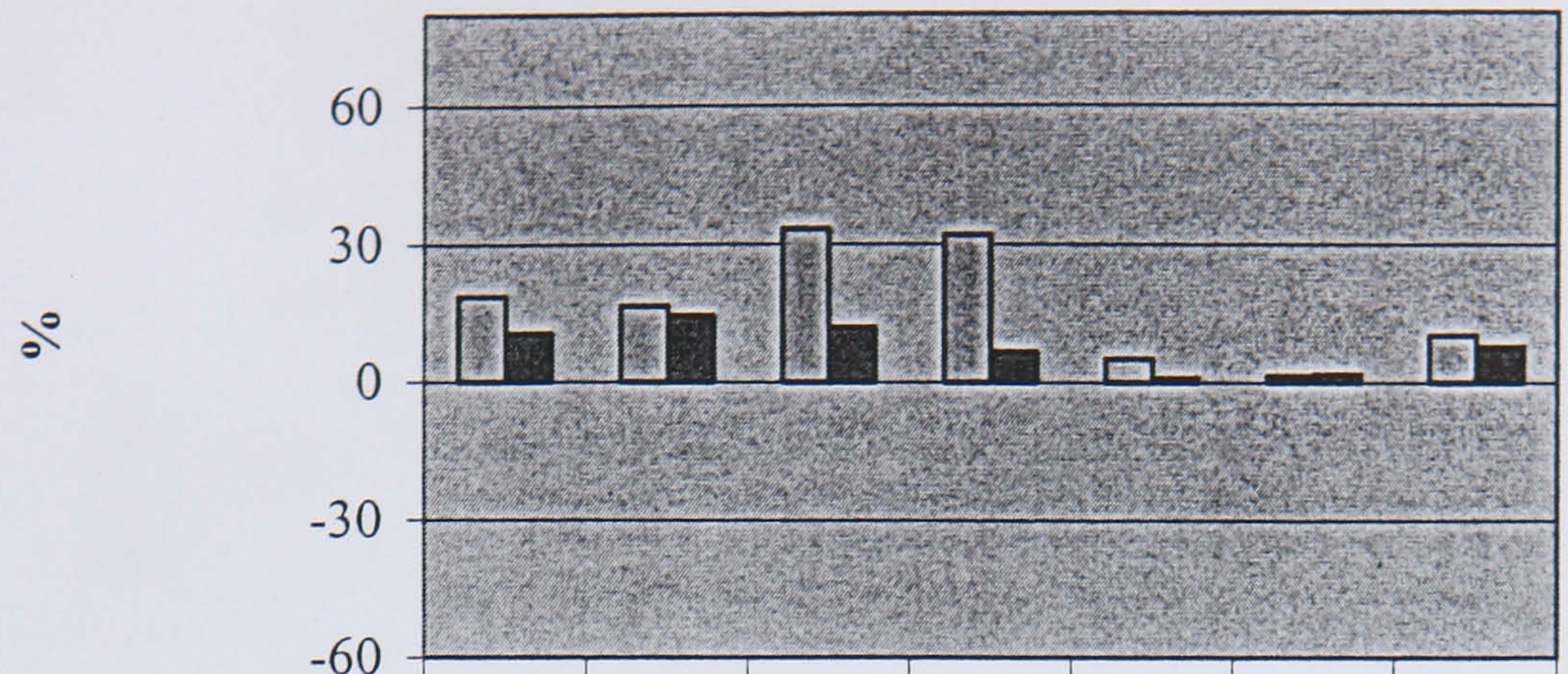
	1992	1993	1994	1995	1996	1997	1998
Hungary	49,8	45,9	41,2	38,8	42,6	48,2	39,7
EU	57,6	49,3	34,4	49,5	35,2	35,6	43

Figure 2.31 PSE % for Beef and Veal in Hungary and EU



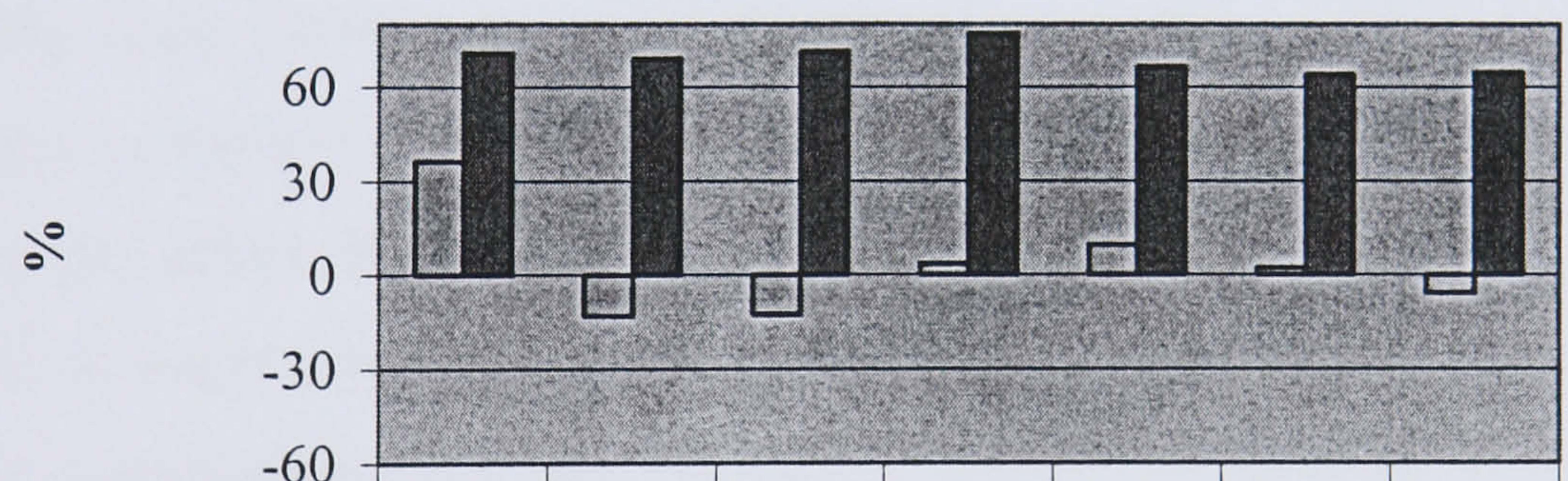
	1992	1993	1994	1995	1996	1997	1998
Hungary	49,4	16,6	30	31,9	16,1	12,4	14,7
EU	54,9	41,8	40,3	41,6	43	55,4	61,7

Figure 2.32 PSE % for Pigmeat in Hungary and EU



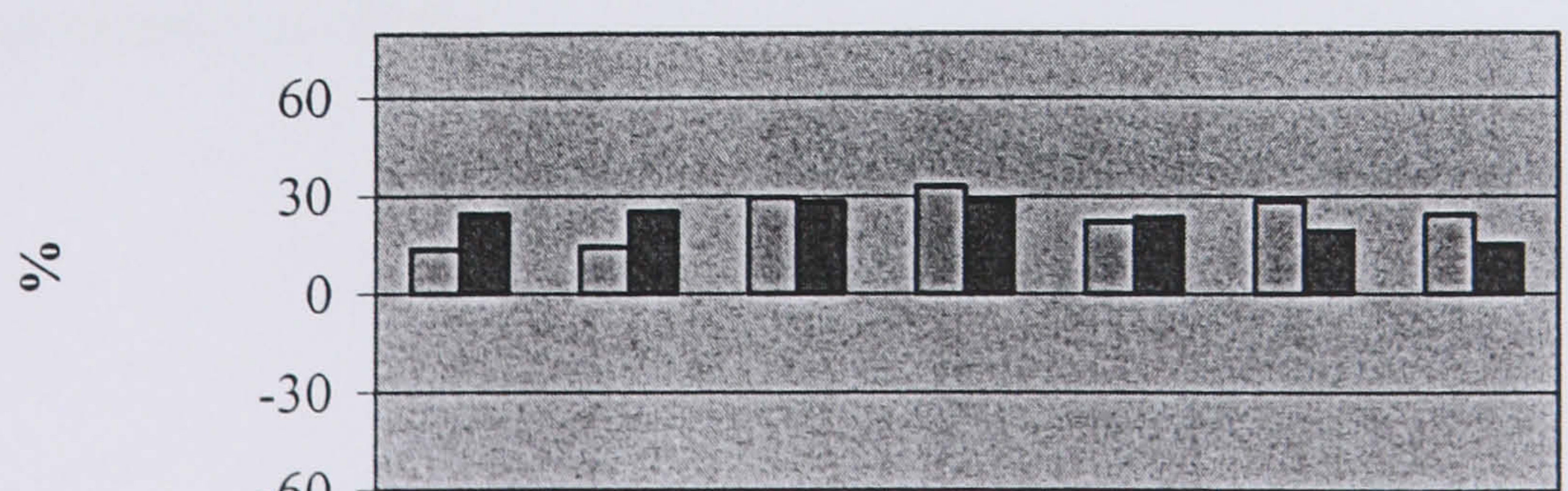
	1992	1993	1994	1995	1996	1997	1998
Hungary	18,7	16,6	33,3	32	5,2	1,5	10,4
EU	10,6	14,5	12,1	6,6	1	1,8	7,8

Figure 2.33 PSE % for Sheep Meat in Hungary and EU



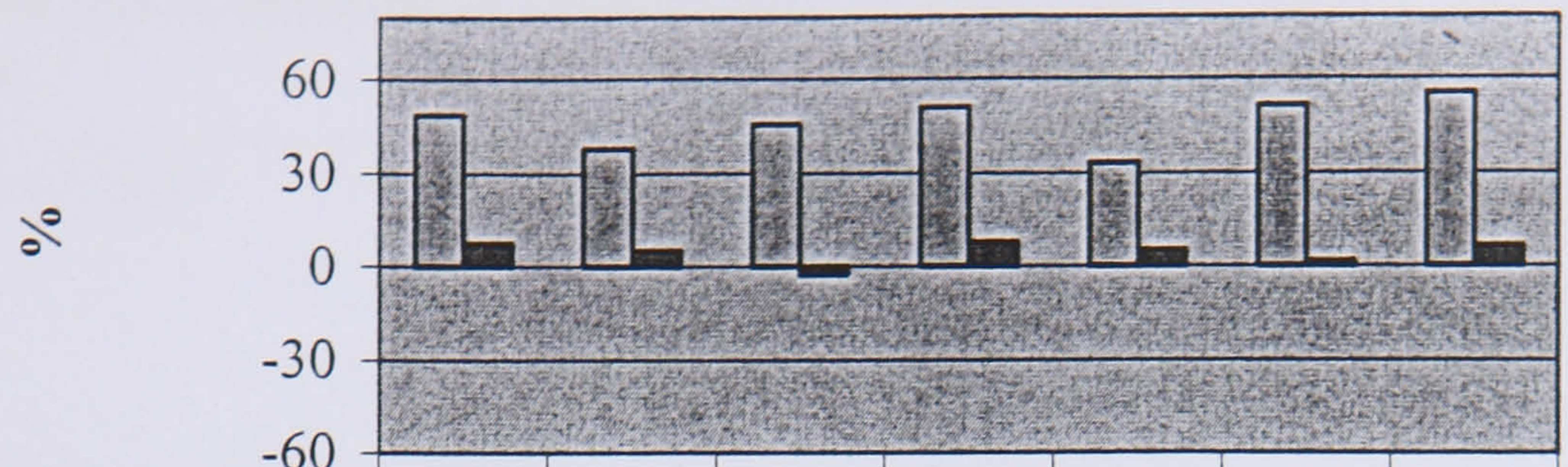
	1992	1993	1994	1995	1996	1997	1998
Hungary	36,4	-13	-12,6	3,4	9,5	2,3	-5,8
EU	70,9	69	71,3	76,8	66,4	63,9	64,7

Figure 2.34 PSE % for Poultry Meat in Hungary and EU



	1992	1993	1994	1995	1996	1997	1998
Hungary	13,6	14,3	29,4	33,1	22	28,2	24,3
EU	24,4	25,1	28	28,5	23,4	19,2	15,2

Figure 2.35 PSE % for Eggs in Hungary and EU



	1992	1993	1994	1995	1996	1997	1998
Hungary	48,6	37,9	45,5	51	33,2	51,3	55,5
EU	7,5	5,4	-2,5	7,8	5,3	1,4	6,5

Another feature of these PSE measures is that the pattern (rather than the level) of support in Hungary does not mirror that in the EU, either by commodity (over the seven years) or by year (over the 13 commodities). This is confirmed by the simple correlation coefficients in Table 2.2. The largest positive coefficients by commodity are for pigmeat (0.60), milk (0.49) and maize (0.46). One might expect to identify some degree of positive correlation by commodity over time, since a change in the (common) world price will affect the PSE calculations for both Hungary and the EU in the same way, e.g. a fall in world price will increase the PSE, *ceteris paribus*. Even so, the coefficients for most commodities are low. Moreover, all of the correlation coefficients by year are negative, emphasising the lack of similarity in the patterns of support between Hungary and the EU.

The simple correlation coefficient over all 13 commodities and all 7 years (91 observations) is –0.37.

Table 2.2 Correlation coefficients of PSEs for Hungary and EU by commodity and year

Commodity	Correlation coefficient (n=7)	Year	Correlation coefficient (n=13)
Wheat	0.01	1992	-0.31
Maize	0.46	1993	-0.30
Other grains	-0.05	1994	-0.63
Barley	-0.03	1995	-0.56
Oilseeds	-0.37	1996	-0.02
Sunflower	-0.43	1997	-0.18
Refined sugar	0.29	1998	-0.46
Milk	0.49		
Beef and veal	-0.07		
Pigmeat	0.60		
Sheep meat	0.12		
Poultry meat	0.11		
Eggs	0.07		

Source: derived form OECD (2000).

2. 4 Competitiveness in Hungarian agriculture

It is likely that macroeconomic developments, the changing trade policy environment and government support policies have had an impact on the competitiveness of Hungarian agriculture. Although the main aim of this thesis is not the analysis of competitiveness and its determinants *per se*, the evolution of competitiveness may have had an influence on Hungary's agri-food trade. This section provides some evidence about the competitiveness of Hungarian agriculture, after a brief discussion of the conceptual and definitional issues surrounding competitiveness[1].

2. 4. 1 Defining competitiveness

The term competitiveness is commonly used in economic research and in public debate. However, there is little agreement on its definition among scholars. One can observe an explosion of interest in the concept of competitiveness from various points of view over the last decade, resulting in considerable confusion in relation to the scope of the term (Pitts and Lagnevik 1998). Thus, Kennedy *et al.* (1997, p. 386) note that "much of the diversity concepts and measures of competitiveness emanates from the variety of perspectives and objectives of the relevant research".

Competitiveness can be analysed at three different levels: (i) competitiveness of nations (macroeconomic level); (ii) competitiveness of industries (mesoeconomic level); and (iii) competitiveness of firms (microeconomic level). Another aspect of competitiveness exists with regards to the spatial dimension of the investigation. Competitiveness of enterprises can be compared within a region of a particular country, or between countries.

Defining the competitiveness of nations is a controversial issue. Researchers interested in analysing a nation's competitiveness have defined it as the ability of a nation to sustain an acceptable growth rate and real standard of living for its people while efficiently providing employment without reducing growth potential and the standard of living of the next generation[2]. However, other authors emphasise that the term competitiveness of a nation makes no sense (e.g. oft cited references are Porter, 1990 and Krugman, 1994).

National competitiveness is related to the concept of comparative advantage. The theory of comparative advantage predicts that trade flows exist as a result of relative cost differences between trading partners. It suggests that countries are competitive in goods and services in which they have a relative cost advantage. The only difference between comparative advantage and competitiveness is that the latter includes market distortions, whereas the former does not. Barkema *et al.* (1991) emphasised the role of distortion in

[1] Detailed discussion on the concepts of competitiveness applying to agri-food sectors can be found in Abbott and Bredahl (1994) and Pitts and Lagnevik (1998).
[2] Aiginger (1998) provides a reasonable collection of definitions of national competitiveness.

agricultural markets and thus asserted that competitiveness takes a more realistic view about the world. Lafay (1992) sheds light on two additional differences between comparative advantage and competitiveness. First, competitiveness usually involves a cross-country comparison for a particular product, whilst comparative advantage is measured between products within a country. Second, competitiveness is subject to changes in macroeconomic variables, whereas comparative advantage is structural in nature.

Both comparative advantage and competitiveness are based on the concept of general equilibrium. McCorriston and Sheldon (1994) point out the necessity of a general equilibrium framework to evaluate competitiveness, because only this approach can take into account all interdependencies of an economy. Although such analyses are highly desirable, they are not too frequently carried out because of the complexity involved and the data constraints. A considerable part of the research in this area investigates only one part of the economy, e.g. an industry or a company, and it approximates or neglects any economy-wide interdependencies.

Moreover, Aiginger (1998) and McCorriston and Sheldon (1994) emphasise the dynamic aspects of competitiveness. The main reason for this is that these authors define competitiveness as being strongly linked to economic growth and the concept of welfare maximisation in the long run. However, traditional trade theory does not address the dynamics of competitiveness and trade patterns, and therefore is deficient from this point of view.

Martin *et al.* (1991) define <u>competitiveness at the industry level</u> as the sustained ability to profitably gain and maintain a share of domestic and export markets. Competitiveness is defined at the <u>firm level</u> as the ability to deliver goods and services at the time, place and form sought by buyers at prices as good as or better than other suppliers, while earning at least opportunity costs on resources employed (Sharples and Milham 1990, Cook and Bredahl 1991).

This thesis is concerned with the mesoeconomic level, therefore the definition of competitiveness most appropriate is that pertaining to the industry level. The ability to compete in international and domestic markets depends on price competitiveness and/or product quality. Previous studies focusing on the competitiveness of Hungarian agriculture (see section 2.4.2) have employed various indices of international price competitiveness. However, without examining both price and non-price determinants of competitiveness, one can analyse changes in an industry's export shares as *ex post* reflections of changes in competitiveness. Clearly, changes in market shares are not entirely synonymous with changes in competitiveness, but they still provide a commonly accepted measure of changes in an industry's performance against a reference market (e.g. the world market or a particular region, like the EU). Therefore, analysing trade data can contribute to a better understanding of the evolution in the competitiveness of Hungarian agriculture and food processing.

2. 4. 2 Recent Studies on the Competitiveness of Hungarian Agriculture

Notwithstanding the definitional controversies, an important aspect of international competitiveness is the level of prices across countries and a number of studies have adopted this position. It is a common assumption that price differences between the EU and the Central and Eastern European Countries (CEECs), including Hungary, will remain significant until eastern enlargement. However, Orbánné (1998) shows that between 1990 and 1996 prices of food have increased faster in Hungary than in the EU, and consequently consumer price differentials have declined. With regards to agricultural prices, she points out that between 1994 and 1996 these have fallen in the EU, while in Hungary they have risen. Hence, price differences at farm-gate level have also declined. In exceptional cases, for example chicken and pork, producer prices in Hungary have exceeded those in parts of the EU (Austria, France, Germany and Netherlands), but in general they remain at a lower level.

Orbánné (2000), extending her previous study, investigates the price competitiveness of Hungarian agricultural products on the EU market over the period 1990 to 1998, by comparing the prices for 20 products at various stages in the agri-food chain. She finds that the gap between Hungarian and EU producer prices has declined for all products in question, except potatoes. The price gaps have remained significant (35-50 per cent) for cereals, sugar beet and vegetables, whilst they have been almost eliminated (0-7 per cent) for oil seeds, lamb, pork and broiler. The price gaps are more considerable at the consumer retail level than at farm gate level.

Heinrich *et al.* (1999) determine the competitiveness of Hungarian agriculture for some important products. Using farm account survey data, they compare Hungarian and German average unit costs and revenues for 1992 to 1998. They find that Hungarian producer prices were below German prices by between 20 and 50 per cent, except for pork. In terms of unit costs, they find all products are competitive compared to Germany, although in the cases of sugar beet and beef, unit costs exceeded unit revenues, i.e. profits were negative.

Hughes (1998) calculates cross sectional Total Factor Productivity (TFP) indices for different types of farms and analyses international competitiveness using Domestic Resource Costs (DRC). The TFP analysis indicates that smaller farms have higher productivity than larger farms, especially for crop production, but the DRC results suggest that the larger farming companies and co-operatives are the most internationally competitive.

Banse *et al.* (1999a) analyse the price competitiveness of Hungarian agriculture in the main commodity markets for the period 1990 to 1997, using DRC, private resource costs (PRC) and bilateral (to the EU) resource cost indices. They conclude that crops are more competitive than livestock and also that, in general, arable production is internationally competitive. In spite of significant year-to-year fluctuations, the results indicate that after 1993 some improvement occurred in crop production, while the competitiveness of livestock declined. Overall, their results are consistent with those of Hughes (1998), i.e., under DRC conditions crop production is more competitive than animal production.

Banse *et al.* (1999b) also investigate the international and private competitiveness of different agricultural and food processing activities in Hungary. Applying DRC analysis they find that crop production is competitive and, with the exception of egg production, that livestock is not competitive. The PRC measure produces a similar result; livestock production is not competitive, except for beef, and arable production is competitive, except for vegetables. In contrast to agricultural production, most food processing is found to be competitive, except the milk, sugar and tobacco industries.

In summary, the results of these recent studies show that, in Hungary, crops are more competitive than livestock production. Furthermore, most of the arable production is internationally competitive. However, as Heinrich *et al.* (1999) point out, it is questionable as to whether Hungary's competitive advantage could be sustained if input prices were to adjust to the EU level.

2.5 Synthesis of Changes to the Economic Environment

As already mentioned, perhaps one of the most surprising outcomes of the various changes that took place in Hungary during the 1990s, is that the structure of the economy remained remarkably stable considering the upheaval generally associated with transition from a centrally-planned to market-driven economy. As also noted, this was due, at least in part, to Hungary's 'early start' in the transition process. As a consequence of various steps in trade liberalisation, the Hungarian economy became more open during the 1990s. However, the level of protection in agriculture remained higher than in the industrial sectors. Government support of agriculture, in terms of budgetary cost, remained at a considerable level during the period, although the importance of export subsidies was reduced significantly. Official PSE calculations by the OECD show that the level of government support in Hungary was lower in the later years, as well as considerably lower than in the EU throughout the period. These PSE measures also show that the pattern of support between Hungary and the EU was dissimilar, both across commodities and years.

As for implications for international trade in agricultural and food products with the EU, the various indicators and policy measures suggest that changes taking place in the Hungarian economy over the period probably served to worsen the prospects for Hungarian exports. Agriculture and food processing are declining sectors within the Hungarian economy, and in the second half of the period the agricultural terms of trade worsened. The real exchange rate rose, making Hungarian exports less competitive and imports from the EU (and elsewhere) more competitive. Only for poultry, eggs and pigmeat were levels of support in Hungary generally higher than in the EU, though in the case of pigmeat, an important enterprise in Hungarian agriculture, they were nevertheless at very low levels by the end of the period. Studies of the competitiveness of Hungarian agriculture show that arable production is more competitive than livestock production, and that the former is competitive in the international arena. Whether this is borne out by the trade data is one of the objectives of the analyses that follow in subsequent chapters.

CHAPTER 3 HUNGARIAN AGRICULTURAL TRADE WITH THE EU

The external and internal market environment of the Hungarian economy has changed fundamentally over the past decade. It was the dissolution of the COMECON and the anticipated accession to the European Union and, within that, the conclusion of the Association Agreement that constituted the most important changes. Very soon after the Association Agreement came into force in 1992 concerns were articulated primarily by agricultural interest groups about the impact of the partial liberalisation of trade on Hungarian agriculture. Enough data are now available to analyse its effects on an objective basis. This chapter looks at the evolution of Hungary's agricultural trade with the EU and describes the most important features of this trade. Then, we look at how agricultural trade with the EU developed in comparison to total agricultural trade. Following this, we focus in more detail on the structure of agricultural trade with the EU.

3.1 Data

Before presenting the results, a few words should be said about the database used in this analysis. The data come from the OECD database using the Standard International Trade Classification (SITC) system. Unless otherwise specified in the text, the results are based on a four-digit breakdown. Agricultural trade is defined in the manner usual within the EU (see EC [1999]). This means that in the four-digit breakdown of the SITC code, 253 product groups belong to agricultural trade. Corn and wheat starch were also added to this (SITC 59211/12), so the complete sample included 255 product groups. Whilst the analysis is carried out at the disaggregated level, for purposes of presentation the 253 four-digit product groups are aggregated to 21 two-digit SITC product groups. Since data for 1999 were not available at the time of writing, our analysis is limited to the period between 1992 and 1998. Finally, we note that unless otherwise specified, data concerning the EU relate to the 15 member states throughout the thesis.

3.2 Total Hungarian Agricultural Trade

Table 3.1 shows that Hungarian food exports fluctuated between USD (United States' Dollars) 2.1 billion and 3 billion; in contrast, agricultural imports increased until 1994, then decreased by some USD 200 million in the next two years. After that, imports increased again and exceeded the highest level in 1994 by 1998.

Table 3.1 Hungarian agri-food trade 1992-1998 ('000 USD)

	1992	1993	1994	1995	1996	1997	1998
Export	2,811,217	2,104,297	2,422,846	3,019,560	2,884,378	2,996,108	2,898,196
Import	842,168	929,290	1,335,915	1,192,353	1,146,628	1,292,367	1,394,823
Balance	1,969,049	1,175,007	1,086,931	1,827,207	1,737,750	1,703,741	1,503,373
Total trade balance	-382,887	-3,596,538	-4,169,140	-2,599,197	-3,064,236	-2,134,196	-2,701,031

Source: The author's calculations based on the OECD database

The surplus of foreign trade in food was between USD 1.1 billion and 2 billion. Primarily the change in imports and exports in opposite directions explains this large fluctuation. We may also note that the foreign trade balance of agriculture has been positive throughout the period, while the total foreign trade balance showed a considerable deficit. In other words, Hungarian agricultural trade played an important role in preventing further deterioration of the foreign trade balance.

At the same time, a restructuring of the role played by food trade in overall trade also took place. On the one hand, agricultural exporting has lost some of its significance over recent years. In 1992 Hungarian agricultural exports made up 26.3 per cent of total exports, while this proportion dropped to 12.6 per cent by 1998. On the other hand, the trend of increasing value in food imports was accompanied by a decrease in the proportion of food imports. This proportion was 7.5 per cent in 1992, while only 5.4 per cent in 1998. In summary, we might say that total exports and imports increased more than the export and import of food.

3.2.1 Trade by Product Group

Table 3.2 shows that Hungarian agricultural exports are focused on only a few product groups. The market share of the three largest product groups in total agricultural exports was between 53 and 61% (meat, cereals, vegetables and fruits). Looking at the six largest product groups, it is apparent that the proportion of these was between 71 per cent and 79 per cent.

Table 3.2 Structure of Hungarian agricultural exports by product group (percentage)

	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	5.59	5.77	5.42	4.26	4.94	4.52	3.86
01: Meat and meat preparations	23.92	26.82	24.92	22.74	27.69	26.42	23.40
02: Dairy products and birds' eggs	2.62	3.12	1.97	2.01	2.70	2.63	3.82
03: Fish, crustaceans, molluscs and preparations thereof	0.24	0.22	0.34	0.28	0.38	0.20	0.28
04: Cereals and cereal preparations	19.05	5.58	8.26	19.56	6.24	13.77	16.74
05: Vegetables and fruits	16.79	21.01	23.78	18.91	20.13	17.82	17.81
06: Sugar, sugar preparations and honey	2.65	1.43	1.19	1.85	1.98	1.94	2.89
07: Coffee, tea, cocoa, spices, and manufactures thereof	2.12	2.38	2.98	2.59	2.96	2.46	2.25
08: Feedstuff for animals (excluding unmilled cereals)	2.44	2.10	1.41	1.62	2.58	1.94	2.27
09: Miscellaneous edible products and preparations	1.77	2.51	2.24	1.92	2.35	1.94	2.23
11: Beverages	4.57	8.59	7.35	8.56	8.15	5.99	5.91
12: Tobacco and tobacco manufactures	1.11	1.10	0.58	0.36	3.07	2.67	1.07
21: Hides, skins and furskins, raw	0.53	0.58	0.69	0.36	0.49	0.52	0.34
22: Oil seeds and oleaginous fruits	2.61	4.33	4.09	3.38	4.20	2.84	2.71
23: Crude rubber (including synthetic and reclaimed)	0.00	0.06	0.03	0.03	0.00	0.00	0.00
24: Cork and wood	5.23	4.92	4.78	4.61	4.30	4.33	5.06
26: Textiles fibres and their wastes	0.50	0.44	0.62	0.43	0.35	0.51	0.37
29: Crude animal and vegetable materials, n.e.s.	3.66	4.82	5.52	3.63	4.14	3.78	3.97
41: Animal oils and fats	0.69	0.69	0.57	0.30	0.46	0.31	0.23
42: Fixed vegetable oils and fats, crude, refined or fractionated	3.85	3.48	3.20	2.58	2.83	5.34	4.71
43: Processed Animal and vegetable oils and fats	0.02	0.03	0.04	0.05	0.03	0.05	0.08
59211/59212: Wheat/Maize starch	0.05	0.02	0.02	0.01	0.02	0.02	0.00
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: The author's calculations based on the OECD database.

The proportion of the major product groups may be considered to be relatively stable in the period analysed. The only exception to this is cereals where there are extreme fluctuations from one year to the next. The strong concentration of agricultural exports implies that the contribution of other product groups is low. Thus, the proportion of fish, raw hide, raw rubber, textile fibre and waste, animal oil and grease, processed plant oil and grease and starch did not exceed one per cent.

The structure of imports was much less concentrated in the given period. The weight of the three largest product groups in total agricultural imports was between 33 per cent and 40 per cent (vegetables and fruits, animal feed, wood and cork) (Table 3.3). The proportion of the six most important products was between 57 per cent and 63 per cent. Out of the predominant product groups, the share of vegetables, wood and cork, and of raw materials of animal and plant origin, showed stability. In terms of raw rubber, animal oil and fat, and starch, the proportion of total imports did not exceed one per cent. The above data imply that the structure and concentration of exports and imports are very different.

The foreign trade balance of agricultural goods by product group shows a highly variabled picture. Given the positive foreign trade balance in agriculture, seven of the 22 product groups show a negative balance (fish, coffee and tea, animal feed, raw hide, raw rubber, textile fibre and waste, and processed animal and plant oil and grease). However, these product groups have a relatively low share of Hungary's foreign trade in foodstuffs. On the other hand, the major exports all show a significant surplus.

Table 3.3 Structure of Hungarian agricultural imports by product group (percentage)

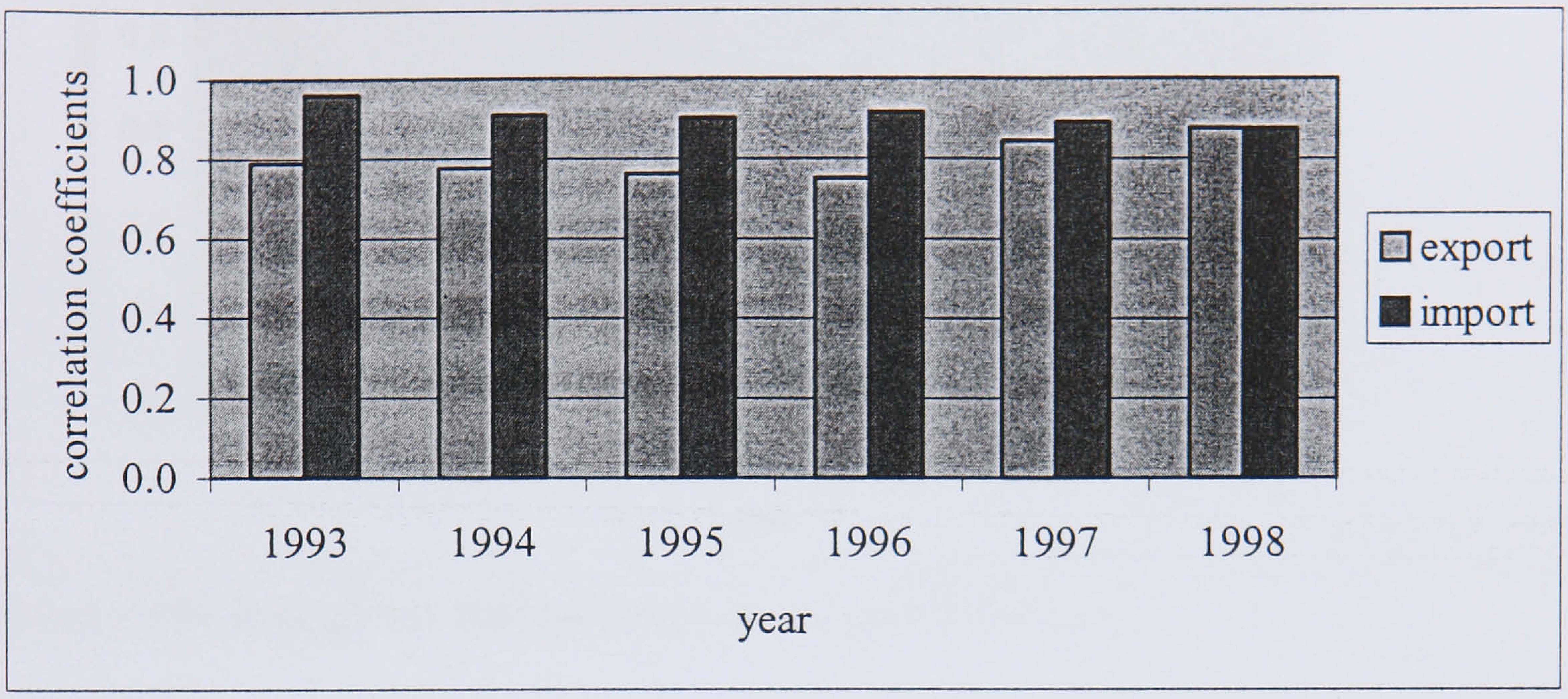
	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	1.68	0.81	0.81	0.73	0.86	1.16	1.29
01: Meat and meat preparations	3.11	5.23	8.34	6.41	3.29	4.83	5.57
02: Dairy products and birds' eggs	5.83	5.16	3.82	2.37	2.02	3.35	2.95
03: Fish, crustaceans, molluscs and preparations thereof	1.86	1.70	1.98	1.62	1.70	1.81	2.04
04: Cereals and cereal preparations	4.23	5.07	5.60	2.97	4.37	3.67	3.72
05: Vegetables and fruits	11.72	10.31	10.46	11.75	11.20	10.80	10.32
06: Sugar, sugar preparations and honey	1.11	4.61	1.73	1.81	1.64	1.28	1.32
07: Coffee, tea, cocoa, spices, and manufactures thereof	9.10	10.04	11.30	13.31	13.34	11.53	11.92
08: Feedstuff for animals (excluding unmilled cereals)	16.73	16.71	12.92	15.69	18.98	18.30	17.93
09: Miscellaneous edible products and preparations	7.12	8.07	7.26	4.83	4.01	3.96	4.45
11: Beverages	4.19	2.85	2.44	2.52	2.50	2.05	1.93
12: Tobacco and tobacco manufactures	5.44	3.15	4.52	4.27	6.22	5.95	5.32
21: Hides, skins and furskins, raw	2.20	2.16	2.91	2.73	2.96	2.53	1.24
22: Oil seeds and oleaginous fruits	1.38	1.23	2.36	2.12	1.57	1.98	2.91
23: Crude rubber (including synthetic and reclaimed)	0.82	0.66	0.55	0.86	1.02	0.52	0.65
24: Cork and wood	11.15	10.02	9.27	11.67	9.78	8.70	8.74
26: Textiles fibres and their wastes	4.27	3.54	3.64	4.32	4.45	4.52	3.32
29: Crude animal and vegetable materials, n.e.s.	6.30	6.22	5.29	5.44	5.68	5.28	5.57
41: Animal oils and fats	0.38	0.27	0.22	0.19	0.17	0.21	0.08
42: Fixed vegetable oils and fats, crude, refined or fractionated	0.80	1.53	3.83	2.71	2.34	5.75	6.74
43: Processed Animal and vegetable oils and fats	0.54	0.61	0.72	1.61	1.80	1.76	1.95
59211/59212: Wheat/Maize starch	0.03	0.06	0.03	0.05	0.10	0.04	0.03
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: The author's calculations based on the OECD database.

The data described so far point out two important features of Hungarian foreign trade in food. The structure of trade is relatively stable, while there is a considerable concentration, at the two-digit level, in exports.

The first characteristic may be checked statistically by calculating the correlation coefficient between the product structures in each year. Taking the year 1992 as the base, we look at the relationship between the product structures of each year to the base year. The correlation coefficients are calculated using the four-digit data.

Figure 3.1 The Structure of the Hungarian agricultural trade (base year 1992)

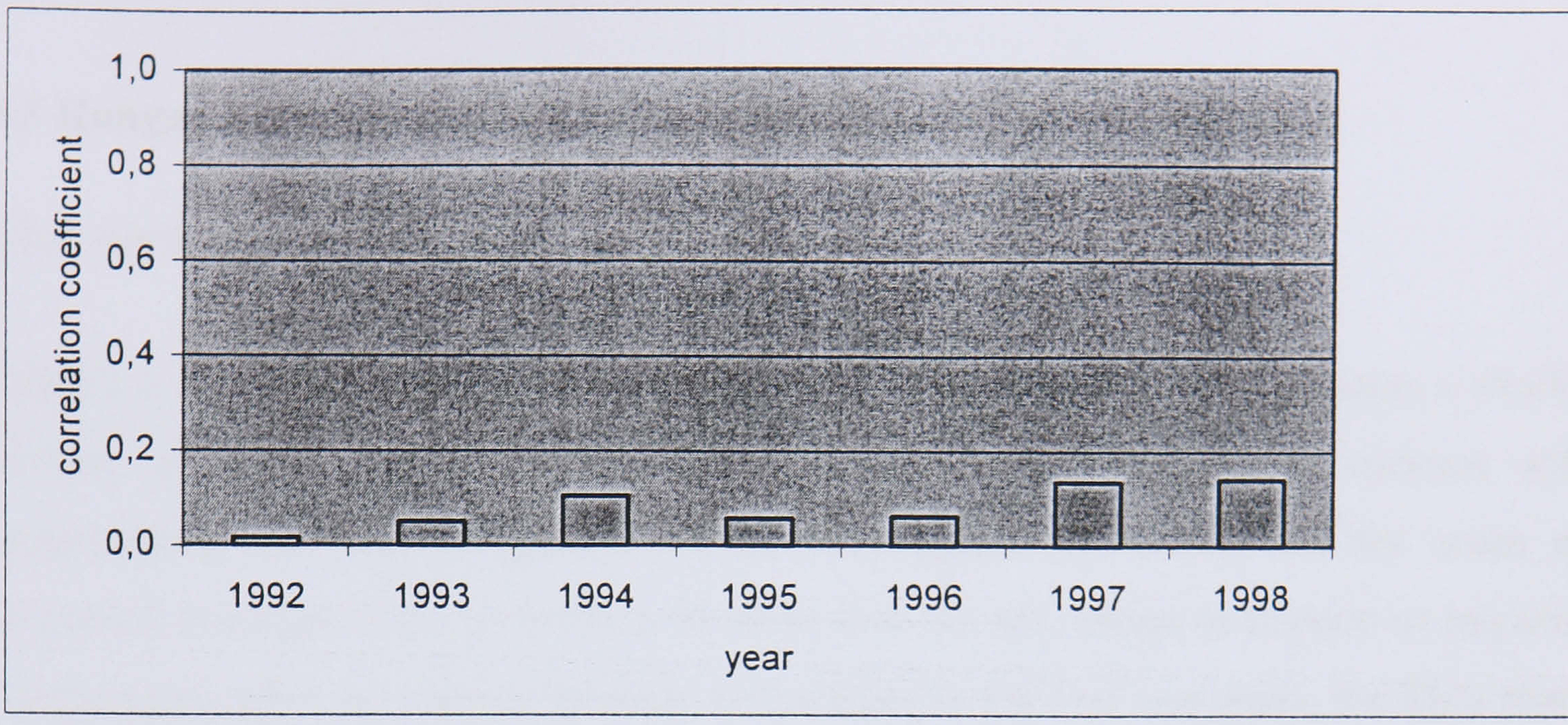


Source: The author's calculations based on the OECD database.

Figure 3.1 shows that the correlation coefficients are rather high in terms of both export and imports. This means that the structure of foreign trade in food by product group has changed little. At the same time, Figure 3.1 also shows that the structure of imports proved to be somewhat more stable than that of exports during the period analysed.

To analyse how the structures of agricultural imports and exports are similar to one another, we calculate the correlation coefficients between the structure of exports and imports in each year of the analysis. Figure 3.2 shows that the bar charts indicate a low correlation coefficient. Therefore, in line with our earlier comment, we may say that the structures of exports and imports are very different.

Figure 3.2 Similarity between Hungarian agricultural exports and imports



Source: The author's calculations based on the OECD database.

The high correlation indices in Figure 3.1 imply that the change that has occurred in the structure of trade was very small. However, this does not exclude a change in the relative weights of each product group. This may happen because exports and imports increased in certain product groups while they decreased in others. These changes, however, may influence the concentration of exports and imports. In industrial economics the Herfindal-Hirschman index[3] is often used to measure concentration in a market. As with the correlation coefficients, the value of the index is calculated using the two-digit data.

Table 3.4 Herfindahl-Hirschman indices for Hungarian agricultural trade

	1992	1993	1994	1995	1996	1997	1998
export	0.14	0.14	0.14	0.14	0.14	0.14	0.13
import	0.09	0.08	0.08	0.09	0.09	0.09	0.09

Source: The author's calculations based on the OECD database.

[3] The Herfindahl-Hirschman index is calculated by taking the square of each company's market share, in our case, product group, and adding up the values thus calculated. Formally: H-H= $\sum_i s_i^2$, where s_i is the market share of the given company (product group). Accordingly, the value of the index is between 0 and 1. Higher values indicate a higher degree of concentration. A relatively recent example of applying the Herfindahl-Hirschman index to international trade is Sapir [1996].

Table 3.4 shows that the value of the Herfindahl-Hirschman index is higher for exports than imports. The other important finding is that the concentration of foreign trade in food has barely changed over the years.

3.3 Hungarian Agricultural Trade with the EU

3.3.1 Agricultural Trade with the EU in General

Table 3.5 shows that agricultural trade between Hungary and the EU presents a similar picture, whether in respect of only 12 or all 15 member states. In contrast with expectations, the benefits granted by the Association Agreement did not mean an automatic increase in the proportion of trade with the EU, either in exports or imports. Furthermore, after the modest increase of the share in the first two years, the EU's share in the total agricultural trade of Hungary shows a decreasing trend. Despite the drop, the EU's share in Hungarian agricultural trade continued to be significant (exports 45 per cent and imports 37 per cent in 1998). It should be noted that the proportion of exports continuously exceeded that of imports throughout the period analysed.

Hungary's trade with the three member states that joined the EU in 1995 (Austria, Finland and Sweden) decreased somewhat following this accession. The share of these three countries in total Hungarian agricultural exports dropped from 11 per cent to seven per cent, and in imports from 10-12 per cent to eight per cent. The analysis of the 12 member states shows that their share of imports stabilised around 31 per cent after a decrease, while there is a continuous decrease in respect of all 15 countries. As far as exports are concerned, the EU's share of total Hungarian agricultural trade shows similar dynamics in both breakdowns. The share of the three new member states decreased at a slightly higher rate than the other 12 member states together.

Table 3.5 Hungary's agricultural trade with the EU as a proportion of total agricultural trade (percentage)

EU15	1992	1993	1994	1995	1996	1997	1998
Export	51.1	54.2	53.1	44.6	47.0	41.5	44.6
Import	42.4	47.0	45.8	40.9	38.2	37.9	37.2
Balance	54.8	60.0	62.0	47.0	52.8	44.2	51.4
EU12							
Export	41.4	44.0	43.4	37.1	38.1	34.0	36.0
Import	30.1	36.1	36.3	31.3	30.7	30.6	30.6
Balance	46.2	50.2	52.2	40.8	43.0	36.6	41.0

Source: The author's calculations based on the OECD database.

During the period analysed, the value of Hungarian agricultural exports delivered to today's EU was over USD 1.1 billion (Table 3.6). It should be noted, however, that exports fluctuate from year to year within a relatively broad range of USD 300 million. In contrast, imports increased dramatically until 1995, when the value exceeded USD 600 million. After this, presumably due mostly to the restrictions of the "Bokros package"[4], the value of imports dropped for a while, but started to increase again after 1997 following the lifting of restrictions. However, the value of imports still did not exceed the highest level achieved in 1994 prior to the restriction, not even as late as 1998.

The balance of agricultural trade with the EU fluctuated considerably. It reached its highest value, over USD 1 billion, in 1992, while the lowest value was USD 674 million in 1994. It should be noted that Hungary was the only Central and Eastern European country that continuously achieved a positive balance in agricultural trade with the EU, after the Association Agreement.

[4] In 1995 the Hungarian government introduced a stabilisation programme, called the Bokros package after the finance minister. The main elements of this programme were fiscal constraints, the introduction of additional import levies and a floating exchange regime.

Table 3.6 Hungarian agri-food trade with the EU ('000 USD)

EU15	1992	1993	1994	1995	1996	1997	1998
Export	1,435,907	1,141,514	1,285,988	1,346,942	1,355,669	1,242,978	1,291,642
Import	356,675	436,731	612,031	487,381	437,753	489,962	519,275
Balance:	1,079,232	704,783	673,957	859,561	917,916	753,016	772,367
Export/ Import	4.0	2.6	2.1	2.8	3.1	2.5	2.5
EU12							
Export	1,163,203	925,612	1,051,600	1,118,798	1,098,747	1,018,570	1,042,734
Import	253,578	335,234	484,723	373,100	351,905	395,247	426,841
Balance:	909,625	590,378	566,877	745,698	746,842	623,323	615,893
Export/ Import	4.6	2.8	2.2	3.0	3.1	2.6	2.4

Source: The author's calculations based on the OECD database.

Ever since the beginning of debates on the impacts of the Association Agreement, the export/import ratio has had a great domestic political significance. The deterioration of this index is used to support claims of the growing disadvantageous position of Hungarian producers compared to their competitors operating in the EU (see e.g., Kiss, 1993, 1994). Table 3.6, however, shows that after the one-time decrease in 1992, the export/import ratio stabilised between 2:1 and 3:1 in terms of either today's EU or the 12 member states. These ratios illustrate the situation that has evolved after the partial liberalisation of trade arising out of the Association Agreement. In other words, while the more favourable export/import ratios before 1992 were the product of an age of trade highly distorted by the communist regime, the situation after the Association Agreement may be considered to be the result of more realistic, although still distorted, competition (Meisel-Mohácsi, 1999). On the other hand, it is worth stressing that the EU's share of Hungary's total agricultural imports decreased after 1994 (see Table 3.5), that is, it lost markets in Hungary despite the benefits granted under the Association Agreement. This also casts doubts on the traditional complaints from the domestic agricultural lobby.

3.3.2 Agricultural Trade by Member State

The analysis of the geographical distribution of Hungarian agricultural exports to the EU immediately shows its high concentration (Table 3.7). Hungary's most important markets are Austria, Germany and Italy, and their share of the agricultural exports going to the EU has exceeded 70 per cent throughout the period. The proportion of Hungarian agricultural exports to Austria did not decline after it became a member of the EU. The next two most important countries for Hungarian agricultural exports are France and the Netherlands and their shares were between 12-14 per cent. Based on the above, therefore, we find that over 80 per cent of Hungary's agricultural exports to the EU are concentrated in five countries.

Table 3.7 Distribution of Hungarian agricultural exports to the EU by member state (percentage)

	1992	1993	1994	1995	1996	1997	1998
Austria	13.8	14.8	13.7	13.4	14.5	14.2	15.3
Belgium	3.0	2.4	2.4	2.7	4.7	4.6	2.8
Denmark	0.7	0.6	0.7	0.7	0.7	0.7	0.6
United Kingdom	1.8	2.3	2.7	2.7	3.3	3.6	3.1
Finland	1.0	0.9	1.2	1.0	1.2	0.9	1.1
France	6.1	7.5	7.5	6.7	6.2	6.5	6.0
Greece	1.9	1.2	0.7	0.7	1.1	1.1	1.1
Netherlands	5.1	5.8	5.6	6.8	5.5	5.0	5.0
Ireland	0.0	0.0	0.0	0.1	0.0	0.2	0.1
Germany	37.6	39.5	40.9	40.6	38.3	38.0	38.1
Italy	22.3	19.6	19.8	20.4	18.4	18.5	16.9
Portugal	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Spain	2.9	2.6	2.0	2.0	3.8	4.6	7.5
Sweden	3.7	2.8	2.9	2.1	2.4	2.2	2.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: The author's calculations based on the OECD database.

On the other hand, Hungarian agricultural products barely appear in several countries such as Denmark, Finland, Ireland and Portugal; their shares rarely exceed one per cent. The proportions for the United Kingdom and Spain show an increasing trend, while Italy's share has decreased considerably. The proportion of southern member states in Hungary's agricultural exports to the European Union was between 22-27 per cent.

The geographical distribution of agricultural imports to Hungary from the EU shows a somewhat different picture to that of exports (Table 3.8). Austria, Germany, and Italy, of course, play an important role. However, the proportion of these three countries in agricultural imports from the EU has decreased significantly. It was 60 per cent in 1992, but only 45 per cent in 1998. While the proportions of Austria and Germany declined, considerably, Italy was able to double its share of imports.

Table 3.8 Distribution of Hungarian agricultural imports from the EU by member state (percentage)

	1992	1993	1994	1995	1996	1997	1998
Austria	25.4	19.4	16.1	18.8	14.9	14.2	13.0
Belgium	2.8	3.5	4.3	4.6	4.3	4.3	4.5
Denmark	2.1	4.8	4.1	4.1	4.5	4.5	4.7
United Kingdom	3.8	2.5	3.4	3.0	3.0	3.4	3.3
Finland	0.5	0.9	1.4	0.8	0.8	1.2	1.1
France	5.7	10.3	9.8	7.0	7.8	8.1	8.8
Greece	5.0	3.8	3.1	4.3	4.2	5.1	4.7
Netherlands	13.0	14.5	15.6	15.8	15.3	14.8	18.0
Ireland	1.9	2.1	2.9	5.2	1.4	1.7	1.8
Germany	29.6	28.2	27.1	22.4	25.3	22.3	20.8
Italy	5.4	5.3	7.0	8.5	12.7	12.6	11.0
Portugal	0.1	0.0	0.1	0.2	0.1	0.2	0.2
Spain	2.8	3.0	3.0	2.7	3.1	4.8	5.5
Sweden	2.0	2.0	2.2	2.5	2.9	2.9	2.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: The author's calculations based on the OECD database.

The Netherlands became the second most important member state in terms of imports, with a proportion of between 13-18 per cent. Other important trading partners in terms of imports are: Belgium, Denmark, France, Greece, and Spain. The share of these five member states has been 18-20 per cent in recent years. In imports, the proportion of southern member states increased from 12 to 20 per cent, mostly due to the dynamic development in Italy.

It is worth noting that the proportion of southern member states is higher in exports than in imports. In other words, though Italy is one of the most important trading partners, Hungary's agricultural trade conducted with southern member states is low, although the proportion of agriculture in the economy is relatively high in these countries.

Hungary's foreign trade balance in agriculture fluctuated very much year on year with each member state, and deteriorated in respect of the most important trading partners - except for Austria - throughout the period analysed. The trade balance with Ireland was negative throughout the period, but at a very low level, and in the case of Denmark, the Netherlands and Greece the former positive trade balances in agriculture turned negative.

3.3.3 Agricultural Trade by Product Group

Similar to the geographical distribution, the structure of Hungarian agricultural exports to the EU is highly concentrated by product group (Table 3.9). In terms of market shares, the proportion of the three most important product groups (meat, vegetables, cork and wood) comes to 61 per cent.

Table 3.9 Distribution of Hungarian agricultural exports to the EU by product group (percentage)

	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	7.9	7.5	7.2	6.4	5.7	6.3	4.4
01: Meat and meat preparations	33.2	34.5	32.8	33.3	35.4	35.4	30.5
02: Dairy products and birds' eggs	1.9	2.0	1.0	0.9	1.0	0.6	1.5
03: Fish, crustaceans, molluscs and preparations thereof	0.4	0.4	0.5	0.5	0.6	0.3	0.4
04: Cereals and cereal preparations	3.3	2.6	4.2	6.9	3.8	4.7	9.6
05: Vegetables and fruits	20.4	18.6	19.7	18.6	18.2	18.3	19.9
06: Sugar, sugar preparations and honey	1.3	1.6	1.3	1.8	2.0	1.3	2.0
07: Coffee, tea, cocoa, spices, and manufactures thereof	2.8	2.2	2.5	2.9	2.2	2.1	1.9
08: Feedstuff for animals (excluding unmilled cereals)	2.5	2.0	1.6	2.2	2.8	1.8	2.1
09: Miscellaneous edible products and preparations	1.7	1.4	1.1	0.6	0.5	0.4	0.3
11: Beverages	2.5	2.6	2.6	2.9	3.2	4.0	4.2
12: Tobacco and tobacco manufactures	0.7	0.7	0.5	0.1	2.1	2.2	0.1
21: Hides, skins and furskins, raw	0.8	0.8	1.0	0.6	0.7	0.9	0.6
22: Oil seeds and oleaginous fruits	3.1	6.4	6.4	6.1	6.7	4.3	4.5
23: Crude rubber (including synthetic and reclaimed)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24: Cork and wood	9.1	7.9	7.6	8.7	7.7	9.0	10.1
26: Textiles fibres and their wastes	0.7	0.4	0.8	0.6	0.4	1.0	0.6
29: Crude animal and vegetable materials, n.e.s.	5.3	6.8	8.0	6.2	6.3	6.5	6.4
41: Animal oils and fats	1.1	1.0	0.7	0.5	0.6	0.4	0.3
42: Fixed vegetable oils and fats, crude, refined or fractionated	1.0	0.6	0.3	0.1	0.1	0.3	0.4
43: Processed Animal and vegetable oils and fats	0.0	0.0	0.1	0.1	0.1	0.1	0.1
59211/59212: Wheat/Maize starch	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: The author's calculations based on the OECD database.

If we include live animals and crude animal and vegetable materials, the proportion of the five major product groups exceeds 70 per cent. This implies that the share of some product groups in exports is very low, e.g. the proportion of fish, raw hide, raw rubber, plant oil and grease, processed plant oil and grease, and starch has not exceeded one per cent during the period. It should be noted that the share of crops is relatively low in Hungary's agricultural exports to the EU, although they are deemed to be a predominant product group in total agricultural exports. Agricultural exports to the EU are based primarily on raw materials and products that are processed at a low level, which are highly sensitive to economic conditions.

The situation is fundamentally different in imports. On the one hand, there is no stable and predominant product group as in the case of exports. The largest market share has not exceeded 15 per cent in any of the product groups (Table 3.10). The structure of imports is much more balanced. During the given period, the weight of the five major product groups in all imports has remained below 60 per cent. At the same time, there are only a few product groups that have a relatively stable market share: vegetable and fruit, drinks, raw materials of plant and animal origin. However, the proportion of some product groups has not exceeded one per cent of total imports: raw rubber, animal oil and grease, and starch.

Table 3.10 Distribution of Hungarian agricultural imports from the EU by product group (percentage)

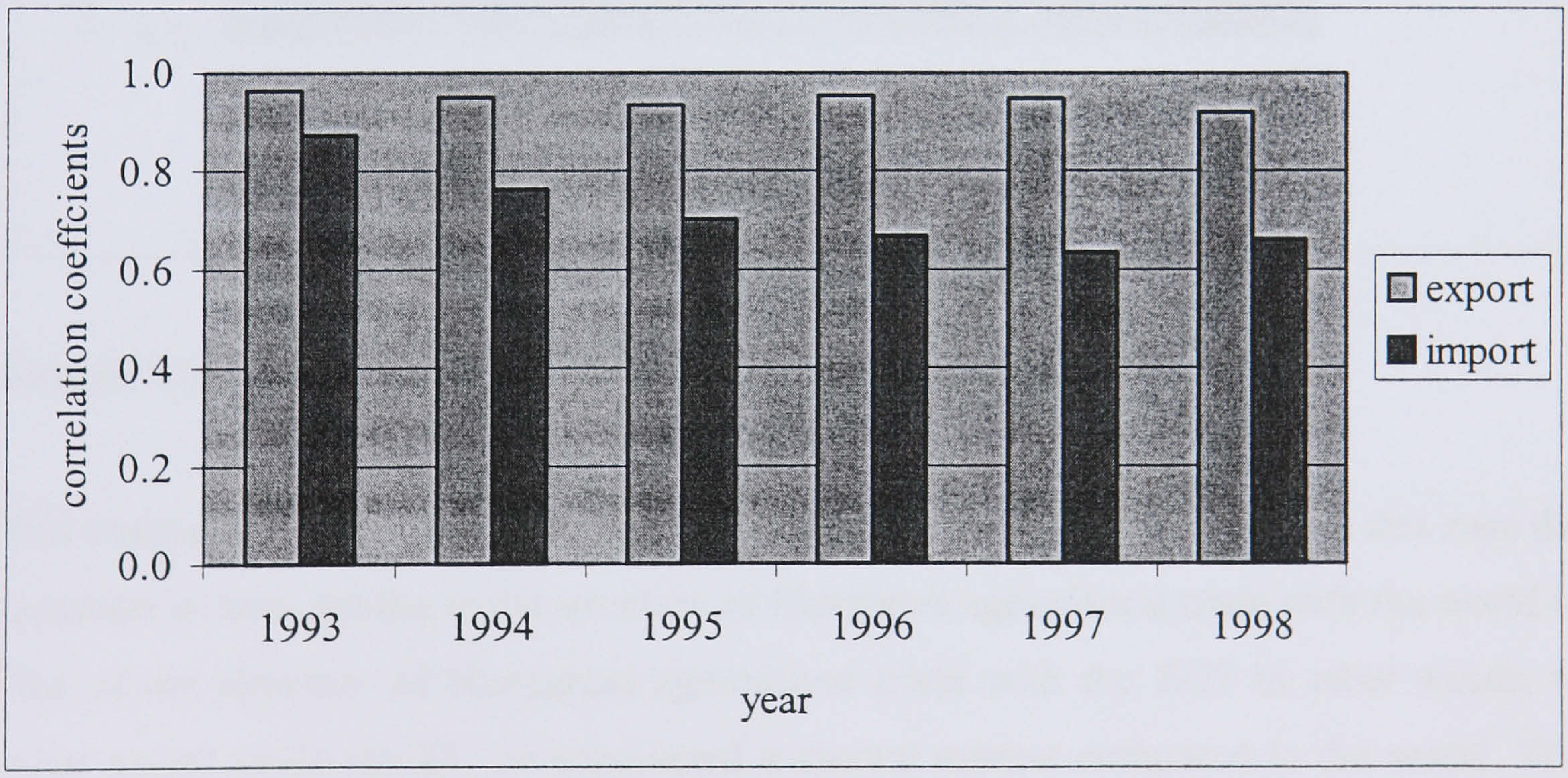
	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	1.9	0.9	1.1	1.0	1.1	1.1	1.8
01: Meat and meat preparations	3.0	8.7	14.6	10.8	4.9	8.9	8.7
02: Dairy products and birds' eggs	10.4	6.7	5.4	2.5	2.2	2.6	3.5
03: Fish, crustaceans, molluscs and preparations thereof	1.7	1.2	1.4	1.3	1.1	1.3	1.4
04: Cereals and cereal preparations	3.6	6.1	7.6	3.7	5.9	4.8	4.0
05: Vegetables and fruits	12.8	11.5	11.4	12.4	12.7	11.7	11.6
06: Sugar, sugar preparations and honey	0.8	6.1	1.6	2.5	2.5	1.8	1.4
07: Coffee, tea, cocoa, spices, and manufactures thereof	8.4	9.1	7.7	8.5	10.5	9.0	8.3
08: Feedstuff for animals (excluding unmilled cereals)	7.1	8.4	7.1	8.9	10.1	10.1	12.7
09: Miscellaneous edible products and preparations	14.4	13.0	11.5	8.7	7.3	7.6	7.9
11: Beverages	5.6	5.0	4.5	5.4	5.6	4.4	4.0
12: Tobacco and tobacco manufactures	3.4	1.6	2.4	3.2	5.6	3.7	2.5
21: Hides, skins and furskins, raw	2.1	2.0	2.8	3.8	5.0	3.8	1.4
22: Oil seeds and oleaginous fruits	0.7	1.3	1.6	3.0	1.0	0.9	2.8
23: Crude rubber (including synthetic and reclaimed)	0.5	0.2	0.1	0.1	0.1	0.1	0.1
24: Cork and wood	5.5	3.6	3.2	4.6	3.7	3.6	4.2
26: Textiles fibres and their wastes	3.5	0.7	2.3	2.5	2.7	2.5	2.6
29: Crude animal and vegetable materials, n.e.s.	11.5	10.7	9.0	10.2	10.6	10.1	10.8
41: Animal oils and fats	0.4	0.6	0.5	0.6	0.6	0.5	0.1
42: Fixed vegetable oils and fats, crude, refined or fractionated	1.2	1.1	2.3	2.0	1.9	6.5	4.4
43: Processed Animal and vegetable oils and fats	1.5	1.4	1.8	4.2	5.0	4.9	5.7
59211/59212: Wheat/Maize starch	0.1	0.1	0.1	0.1	0.2	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: The author's calculations based on the OECD database.

During the period analysed, the foreign trade balance deteriorated for all major product groups. The trade balance was negative for some product groups: crude rubber, processed animal and plant oil and seed, and miscellaneous edible products and preparations. For other product groups, a positive foreign trade balance turned negative: coffee, tea, cocoa, animal feed, plant oil and grease.

The analysis so far has indentified two important features of Hungary's agricultural trade with the EU: the relatively stable product structure for exports, and their concentration. Similar to the analysis performed for total agricultural trade, we also calculate the correlation coefficient in this respect for trade with the EU between 1992 and subsequent years. The main finding apparent from Figure 3.3 is that the structure of imports compared to 1992 changed to a much greater extent than that of exports (i.e., the correlation coefficients for imports are lower than for exports). On the other hand, the findings confirm our intuition on the basis of the earlier analysis: the structure of Hungarian agricultural exports by product group has been extremely stable throughout the period. It is worthwhile to compare the above results with the conclusion that may be drawn from Figure 3.1. We can see that while for Hungary's total agricultural trade the structure of imports was more stable, in trade conducted with the EU the structure of exports was more stable.

Figure 3.3 The Structure of Hungarian agri-food trade with the EU

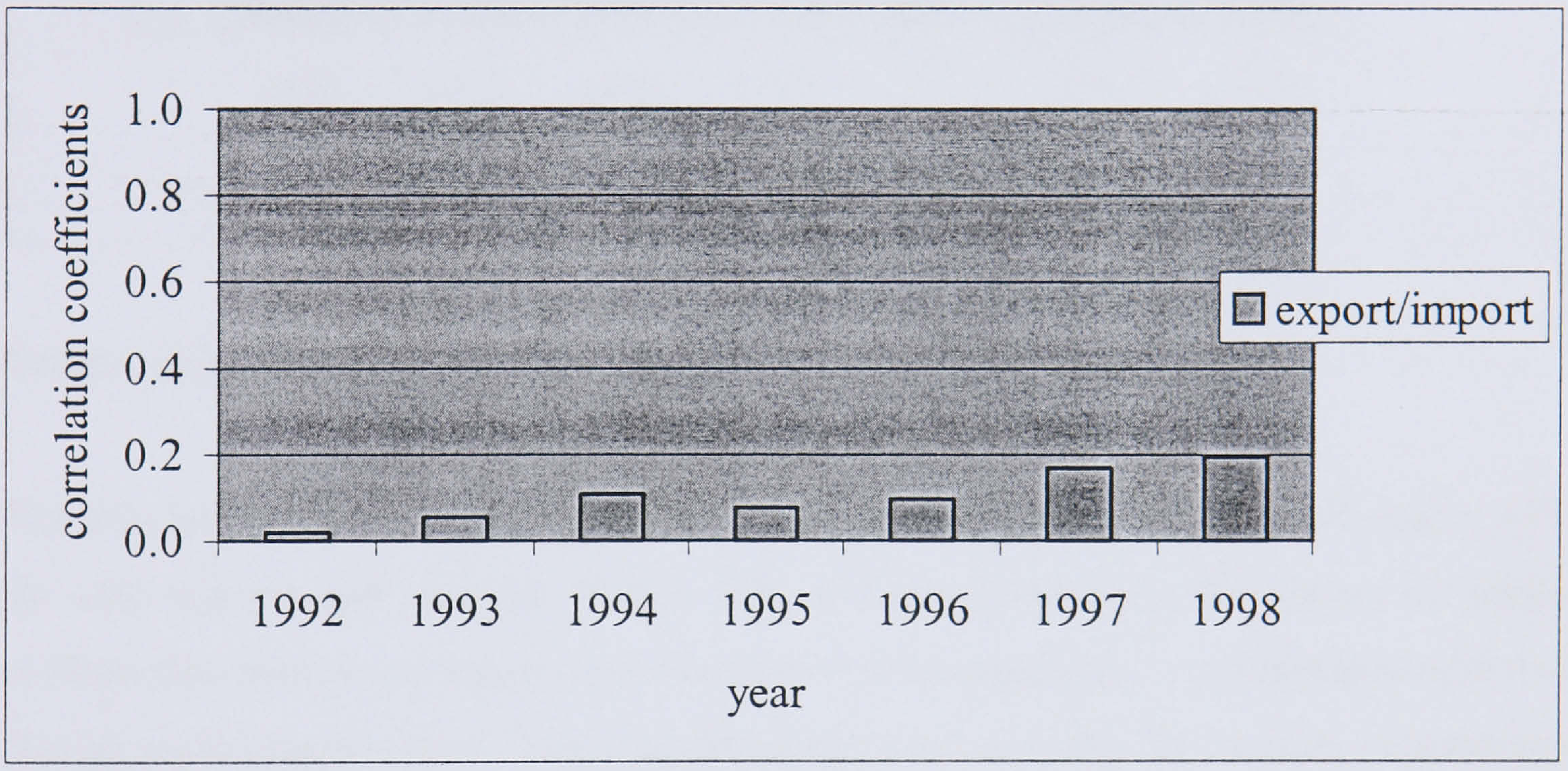


Source: The author's calculations based on the OECD database.

We next analyse the extent to which the structure of Hungarian agricultural exports to, and agricultural imports from, the EU is similar. In other words, whether agricultural trade with the EU is complementary or competitive in nature. Therefore, we calculated the correlation coefficients between the structure of exports and imports for each year of the analysis.

It appears from Figure 3.4 that the correlation coefficients are very low. This implies that Hungary's agricultural trade with the EU is rather of a complementary nature. However, the results imply that differences between the structures of exports and imports decreased over the period in question. A comparison of total agricultural trade gave a similar picture (see Figure 3.2).

Figure 3.4 Similarity between Hungarian agricultural exports to and agricultural imports from the EU

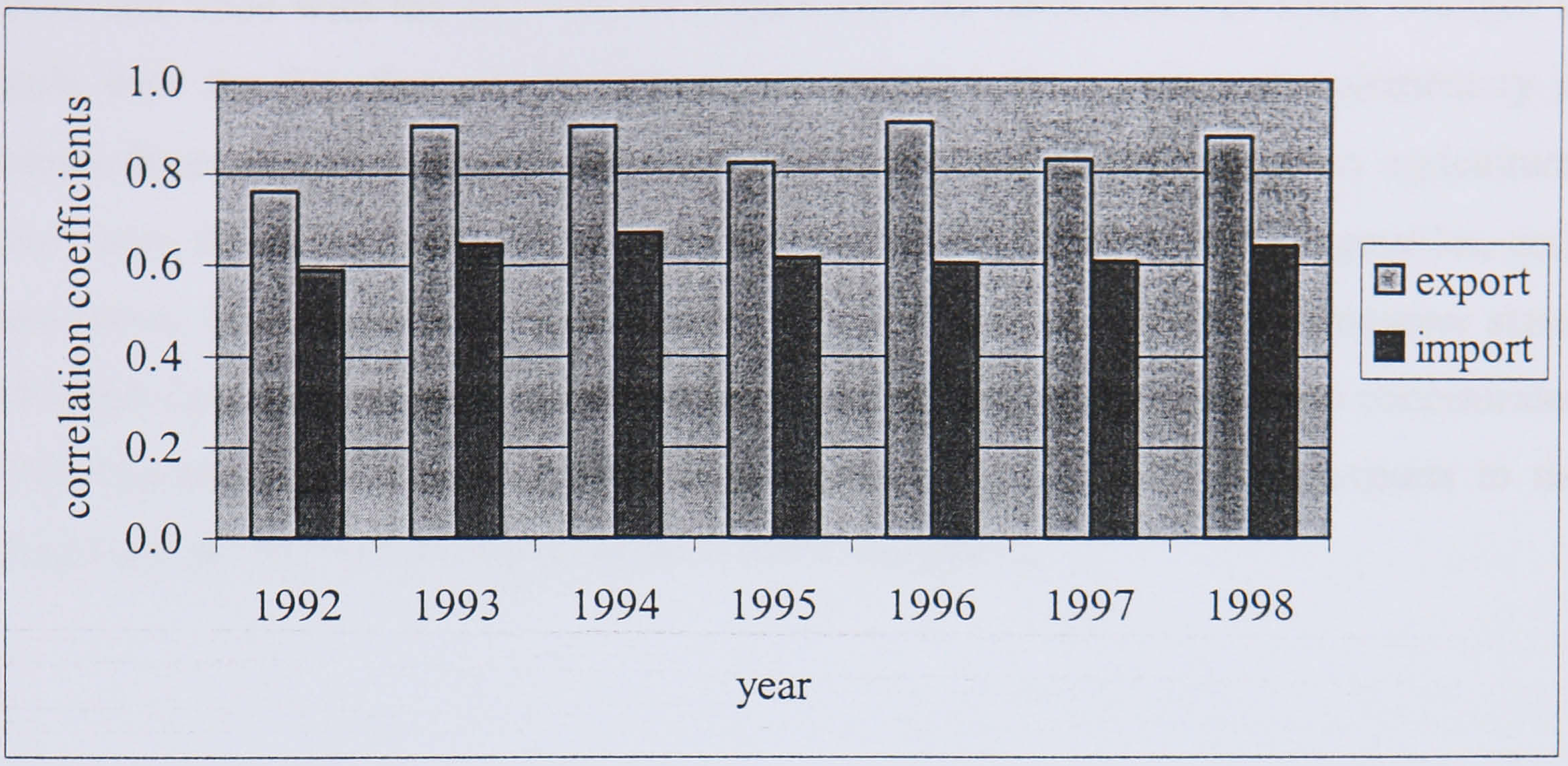


Source: The author's calculations based on the OECD database

The comparison with total agricultural trade may be phrased differently. In this case the question is: how similar is the structure of Hungary's agricultural trade with the world to that of the structure of Hungarian agricultural trade with the EU? In other words, to what extent could the EU be considered a special market compared to the world. The method of analysis is as before: correlation coefficients are calculated between the structure of total agricultural trade and of agricultural trade with the EU.

It follows from Figure 3.5 that the structure of total exports is quite similar to exports to the EU. The similarity between import structures is not so marked. On the other hand, the extent of similarity is more stable for imports than for exports.

Figure 3.5 Similarity between Hungary's total agricultural trade and agricultural trade with the EU



Source: The author's calculations based on the OECD database.

The conclusion that may be drawn from Table 3.11 is that concentration is fairly stable for both exports and imports. In line with our previous results, the values of indices confirm that exports are much more concentrated than imports. In comparison with total foreign trade in agriculture, it may be found that trade with the EU is more concentrated on the export side, while it is nearly the same for the import side (see Table 3.4).

Table 3.11 Herfindahl-Hirschman indices for Hungarian agricultural trade with EU

	1992	1993	1994	1995	1996	1997	1998
Export	0.17	0.18	0.17	0.17	0.18	0.18	0.16
Import	0.09	0.08	0.08	0.07	0.08	0.07	0.08

Source: The author's calculations based on the OECD database at the four-digit level.

3.4 Summary

In this chapter we have investigated the pattern of Hungarian agricultural trade with special emphasis on trade with the EU. Our main findings are as follows. First, despite the fundamental transformation of Hungarian agriculture (changes in farm structures, the food industry, food retailing, price and import liberalisation, agricultural policy, etc.) the pattern of Hungarian agricultural exports has remain fairly stable for both total trade and trade with the EU. On the import side we have observed some changes in trade with the EU. Second, Hungarian agricultural trade is rather complementary in nature from both the world and the EU point of view. Third, Hungarian agricultural exports to the EU are strongly concentrated by product groups (meat, vegetables, cork and wood, live animals and crude animal and vegetable materials) and member states (Austria, Germany, Italy). Fourth, Hungarian agricultural exports are more concentrated than imports. Finally, there is similarity in the pattern of agricultural exports to the world and the EU, whilst this is not so evident for imports.

CHAPTER 4 CONSTANT MARKET SHARE ANALYSIS OF HUNGARIAN AGRICULTURAL TRADE WITH THE EU

The previous chapter presented a detailed description of the development of Hungarian agricultural trade with the EU and identified the most important features of this trade. As we have seen, agricultural trade between the two partners increased only slightly during the period 1992-1998. How can we evaluate this performance? Did it reflect changes in international competitiveness?

One approach in identifying the causes of changes in exports is by the use of the Constant Market Share (CMS) model. The CMS model was first applied to trade in manufactured commodities by Tyszinski (1951), then Rigaux (1971) and Sprott (1972) gave early examples of applications for agricultural trade. It has again become popular for agricultural trade analysis in the last decade (e.g. Ahmadi-Esfahani, 1995; Ahmadi-Esfahani and Jensen, 1994; Alias and Suleiman, 1993; Ongsritrakul and Hubbard, 1996; Chen and Duan, 2000; and Chen et al., 2000). The objective of this chapter is to account for the sources of changes in Hungary's exports to the EU. (The EU's export performance in Hungarian markets is also considered.) First, it provides a brief description of the various CMS models, then presents results. Finally, we examine the sensitivity of results under different benchmarks.

4.1 The Constant Market Share Model

The basis presumption underlying the CMS model is that the share of a country in a market should remain constant given the same level of competitiveness. Hence, any difference between the actual change in exports of the particular ('focus') country and the sum of the market competitors should be caused by a change in export composition or competitiveness (Chen et al., 2000). In the traditional CMS models, there are only two effects to explain the changes in export growth: the structural effect and the residual effect. The former describes the hypothetical change in expected exports, while the latter is the difference between the actual and the expected change. One can derive these effects more formally (Ahmadi-Esfahani, 1995). Market share can be defined as follows:

(1) $S=q/Q$,

where S is the particular country's share of the reference market, q is the particular country's exports and Q is the exports of the reference. Manipulating equation (1) yields: $q=SQ$. Differentiating with respect to time one can obtain:

(2) $\Delta q=S\Delta Q+Q\Delta S$

where Δ is the change in the variable over time. The first expression on the right hand side is the structural effect and second is the residual effect. Equation (2) is valid only for an infinitely short time period. If the CMS model is applied at discrete intervals, the equation may be written in several ways utilising start and end of period variables. For example, some authors (e.g. Alias and Suleiman, 1993; Ongsritrakul and Hubbard, 1996) used the following equation:

$$(3)\ \Delta q= \underbrace{S^0\Delta Q}_{\text{size of market}} + \underbrace{\Sigma(S_i^0-S^0)*Q_i^1}_{\text{market composition}} + \underbrace{(q^1-\Sigma S_i^0Q_i^1)}_{\text{competitiveness}},$$

where superscript 0 describes the beginning and superscript 1 represents the end of the discrete period; subscript i refers to a target country or product group.

The three structural components of the market share are calculated with this expression. First, the size of market effect refers to the change in quantity of exports of the reference. If this grows (falls), then even with a constant market share S^0, a given country's exports will increase (decrease) in quantity by $S^0\Delta Q$. Second, the market composition effect measures a particular country's differential export share in an individual product group or target country compared to its overall market share in exports to the reference (sum of target countries or product groups) in the base period. The focus country's exports will rise (decline) if they are concentrated in those target countries or product groups for which total exports, Q_i^1 have increased faster (slower) than for the reference as a whole. Third, the competitive effect identifies the difference between a particular country's exports in the subsequent period and the level of exports that would have been if the country had maintained its base period market share in each of the target countries or product groups. Thus, the competitive effect is the residual.

However, most recent applications (e.g. Ahmadi-Esfahani, 1995; Ahmadi-Esfahani and Jensen, 1994; Chen and Duan, 2000; and Chen et al., 2000) are offered in an alternative specification:

$$(4)\ \Delta q = \underbrace{S^0 \Delta Q}_{\text{structural effect}} + \underbrace{\Delta S Q^0}_{\text{residual}} + \underbrace{\Delta S \Delta Q}_{\text{second-order effect}}$$

Disaggregating the export quantities into flows of various commodities and flows to various market, equation (4) becomes:

$$(4a)\ \Delta q = \underbrace{\sum_i \sum_j S_{ij}^0 \Delta Q_{ij}}_{\text{structural effect}} + \underbrace{\sum_i \sum_j \Delta S_{ij} Q_{ij}^0}_{\text{residual}} + \underbrace{\sum_i \sum_j \Delta S_{ij} \Delta Q_{ij}}_{\text{second-order effect}}$$

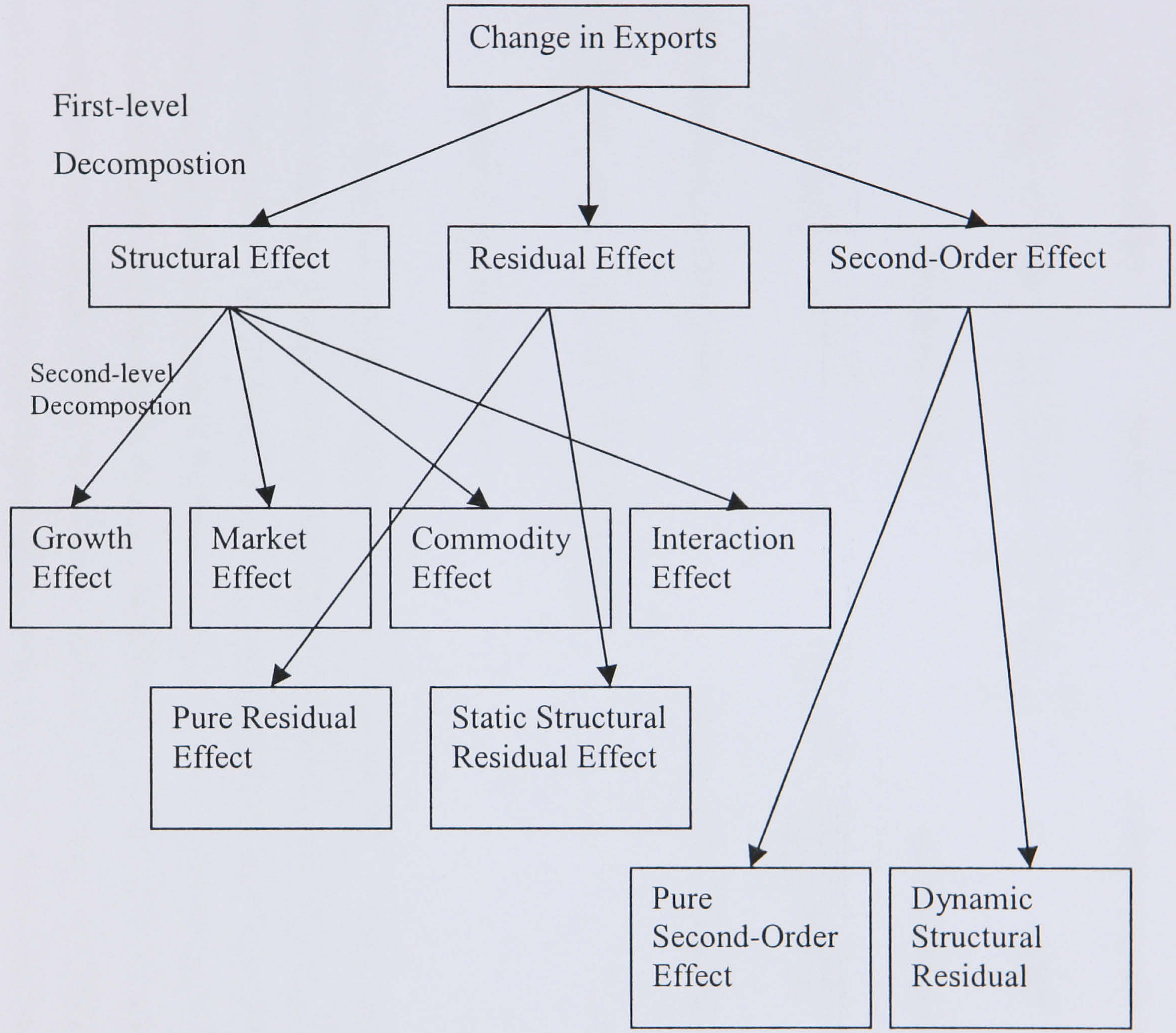
where Q_{ij} is the reference's exports of commodity i to market j.

The first expression on the right hand side of (4) is the same as in equation (3), but its name is different. However, this identity is true for equation (3) and (4), but not necessarily for equation (4a). The other two components have different implications for the sources of export growth. The residual effect has also been called the competitive effect (Chen and Duan, 2000), implying that the change in exports occurs due to a change in the exporting country's competitiveness. The second-order effect can be interpreted as a change in exports due to the interaction of the change in the exporting country's competitiveness and the change in the exports of the reference.

The limitations of the traditional CMS model are well known in the literature (e.g. Jepma, 1986, and Richardson, 1971a,b). The most important problems are that the CMS estimates are sensitive to the choice of base year, level of commodity aggregation, and definition of reference market. To solve some of these problems Jepma (1986) proposed an improved version of the traditional CMS model. Jepma's model has two advantages over the basic model. First, it introduces a number of new components that help to explain the changes in exports. Second, Jepma's model overcomes the order problem associated with the commodity and market effects in the traditional model. This order problem arises because the order specification of measuring these two effects applying different methods can yield strongly different results.

According to Jepma (1986) one can distinguish two levels of CMS model, as figure 4.1 displays. In the first level, the CMS model decomposes the changes in exports into three factors (i.e., equation (4)). At the second level, the structural effect is further decomposed into the growth effect, the market effect, the commodity effect, and the interaction effect; the residual effect contains the pure residual effect and static structural residual effect; and finally the second-order effect is split into the pure second-order effect and the dynamic structural residual.

Figure 4.1 The two-level decomposition of the change in exports



Source: Chen and Duan (2000) p.5.

According to Jepma (1986) the improved CMS model can be shown as:

$$(5)\ \Delta q = S^0 \Delta Q + \left(\sum_i \sum_j S_{ij}^0 \Delta Q_{ij} - \sum_i S_i^0 \Delta Q_i\right) + \left(\sum_i \sum_j S_{ij}^0 \Delta Q_{ij} - \sum_i S_j^0 \Delta Q_j\right)$$

growth effect market effect commodity effect

$$+\left[\left(\sum_i S_i^0 \Delta Q_i - S^0 \Delta Q\right) - \left(\sum_i \sum_j S_{ij}^0 \Delta Q_{ij} - \sum_j S_j^0 \Delta Q_j\right)\right] + \Delta S Q^0$$

interaction effect pure residual effect

$$+\left(\sum_i \sum_j \Delta S_{ij} Q_{ij}^0 - \Delta S Q^0\right) + \left(Q^1 / Q^0 - 1\right) \sum_i \sum_j \Delta S_{ij} Q_{ij}^0$$

static structural residual effect pure second-order effect

$$+\left[\sum_i \sum_j \Delta S_{ij} \Delta Q_{ij} - \left(Q^1 / Q^0 - 1\right) \sum_i \sum_j S_{ij} Q_{ij}^0\right]$$

dynamic structural residual

where q is the focus country's exports to the reference market; S describes its market share in the reference market; S_j is the market share in the destination j; S_i is the market share of commodity i in the reference market; S_{ij} is market share of commodity i in the destination j; Q is total imports of the reference market; Q_j is total imports in destination j; Q_i is total imports of commodity i; Q_{ij} is total imports of commodity i in destination j; Δ represents the change in the two periods; superscript 0 and 1 are beginning and terminal year; i represents export commodities and j describes export destinations.

The growth effect in equation (5) measures that part of the export growth of the focus country that is attributed to the general increase of the reference market. The market effect identifies the influence that the markets of destination can have on the focus country's exports. The commodity effect suggests the extent to which exports of the focus country are concentrated in commodities with higher or lower rates of change than the reference market averages. The structural interaction effect indicates the extent to which actual market distribution of the commodities affects the size of the commodity effect. The pure residual effect measures the growth in the focus country attributable to a general increase of competitiveness. The static structural residual effect indicates the impact of changes in the focus country's export structure on export performance. The pure second-order effect measures the influence of changes in the size of reference market demand on the focus country's exports given that the structure of the reference market's demand is unchanged. The dynamic structural residual explains the interaction of the focus country's market share with changes in structure of the reference market.

4.2 Empirical Models and Procedures

The traditional and improved CMS models, as represented in equations (3)-(5) are applied to the change in Hungarian agricultural exports to the EU market over the period 1992-1998. CMS analysis has been carried out by product groups and by member countries as well. Also, the CMS analysis is conducted from an EU point of view, i.e. the EU's agricultural export performance in Hungarian markets.

To avoid the bias of CMS estimations due to sensitivity to choice of the base year, the base period is the average of 1992-1994 and subsequent period is the average of 1996-1998. Three separate models are shown in the results, differing both in basic models and in the level of decomposition. The first model, as represented in equation (3), is one version of the basic CMS model. The second model, equation (4a), is the alternative form of the traditional model. The third model, equation (5), is the same as Jepma's improved model, except that there is no commodity and structural interaction effect. The reason for this is that in analysing a single market, there is obviously no commodity and structural interaction effect; in examining just one market there is no summation over other markets. Consequently, for a single market, the third model becomes:

$$(6)\ \Delta q = \underbrace{S_t^0 \Delta Q_j}_{\text{growth effect}} + \underbrace{\left(S_j^0 \Delta Q_j - S_t^0 Q_j\right)}_{\text{market effect}} + \underbrace{\Delta S_t Q_j^0}_{\text{pure residual effect}}$$

$$+\left(\Delta S_j Q_j^0 - \Delta S_t Q_j^0\right) \qquad + \qquad \left(Q_t^1 / Q_t^0 - 1\right)\Delta S_j Q_j^0$$

static structural residual effect — pure second-order effect

$$+\left[\Delta S_j Q_j - \left(Q_t^1 / Q_t^0 - 1\right)\Delta S_j Q_j^0\right]$$

dynamic structural residual

where subscript t represent the total agricultural trade of the EU market share of total Hungarian agricultural trade in the EU market, and subscript j denotes commodity or member state of the EU. The data used in the analyses are as described in chapter 3.

4.3 Results using CMS Models

This section reports on the results from applying CMS models to explain Hungarian agricultural exports to EU markets. First, we discuss the results at the first level of decomposition of the CMS model by both product groups and member countries. Then we present results using the improved CMS model.

4.3.1 Result at the First Level of CMS Model for Hungarian Exports

Table 4.1 shows results using the two versions of traditional CMS models. The growth of Hungarian agricultural exports to the EU was only 29 million US dollars during the period in question. According to the first CMS model (equation 3), this gain consists of three components, which are shown in the top half of Table 4.1. Market size effect is 193 million US dollars, which is 666 per cent of the total gain. Market composition effect and competitive effect are each around –82 million US dollars, representing -283 per cent of the total gain. These results show that the small growth in Hungarian agricultural exports (29 million US dollars) to the EU is due to a positive market size effect dominating the market composition and competitiveness effects. In other words, the main source of the increase in agricultural exports was the rise in total agricultural imports of the EU by 15 per cent.

The bottom half of Table 4.1 displays the results of applying equation 4a. The structural effect is significantly greater than actual growth in exports. The extent of the residual effect is also greater than the increase of exports, but negative. It indicates that Hungary's general competitiveness relative to other exporters has fallen since 1992-1994. The second-order effect is also negative, which suggests that the influence of the interaction of the change in Hungary's competitiveness and the change in the EU's imports has been unfavourable. Furthermore, our results highlight that the market size effect and structural effect are different, if the latter is calculated at the disaggregated level.

Table 4.1 Results of two models of CMS according to product groups

Equation 3	million USD	Per cent
Market size effect	192.7	665.9
Market composition effect	-82.0	-283.2
Competitive effect	-81.8	-282.7
Changes in export	28.9	100.0
Equation 4a		
Structural effect	110.8	383.4
Residual effect	-67.3	-232.9
Second-order effect	-14.6	-50.5
Change in exports	28.9	100.0

Source: Author's calculation based on OECD database at two-digit level

Table 4.2 shows the results in detail according to product groups. The market share has been enhanced in only 8 of the 22 product groups: meat; cereals; sugar, sugar preparations and honey; feedstuff for animals; beverages; tobacco; cork and wood; processed animal and vegetable oils and fats. Their share in Hungarian agricultural exports to the EU over the period was 56 per cent.

Regarding the first CMS model, Table 4.2 indicates that market composition effect within total exports is positive for live animals, meat, fruits and vegetables, oilseeds, cork and wood, crude animal and vegetable materials, animal oils and fats. But positive market composition effects are linked with growth of market share only in the case of meat, and cork and wood. Hungary has lost markets of many product groups in the EU. The negative overall market composition effect can be explained by the concentration of Hungarian exports in those products groups where demand of the EU has increased below average.

Table 4.2 CMS analysis disaggregated by product groups (million USD)

	Hungary's market share (per cent)		market composition effect	structural effect	residual effect	second order effect
	1992-94	1996-98				
00: Live animals other than animals of division 03	2.19	1.89	66.47	-9.56	-14.25	1.31
01: Meat and meat preparations	2.05	2.09	301.26	0.55	9.53	0.01
02: Dairy products and birds' eggs	0.17	0.12	-85.21	2.49	-8.22	-0.74
03: Fish, crustaceans, molluscs and preparations	0.06	0.04	-109.78	1.75	-1.94	-0.38
04: Cereals and cereal preparations	0.32	0.53	-51.46	5.35	29.32	3.46
05: Vegetables and fruits	0.74	0.65	36.08	38.45	-31.82	-4.66
06: Sugar, sugar preparations and honey	0.36	0.38	-17.48	3.92	0.94	0.20
07: Coffee, tea, cocoa, spices, and manufactures	0.27	0.15	-64.58	12.44	-14.23	-5.32
08: Feedstuff for animals	0.25	0.26	-46.32	1.14	1.69	0.07
09: Miscellaneous edible products and preparations	0.27	0.07	-29.38	3.59	-13.14	-2.70
11: Beverages	0.19	0.22	-69.66	5.36	3.67	0.86
12: Tobacco and tobacco manufactures	0.13	0.25	-41.86	1.71	7.99	1.58
21: Hides, skins and furskins, raw	0.46	0.37	-5.21	1.82	-2.40	-0.38
22: Oil seeds and oleaginous fruits	1.14	0.98	34.72	12.53	-9.37	-1.73
23: Crude rubber	0.01	0.00	-7.91	0.02	-0.03	-0.01
24: Cork and wood	0.88	0.90	31.12	7.86	2.90	0.21
26: Textiles fibres and their wastes	0.15	0.15	-27.13	0.46	0.15	0.01
29: Crude animal and vegetable materials, n.e.s.	0.97	0.81	33.94	15.05	-13.92	-2.39
41: Animal oils and fats	1.72	0.71	8.74	1.39	-7.41	-0.81
42: Fixed vegetable oils and fats	0.21	0.05	-28.10	4.22	-6.77	-3.20
43: Processed Animal and vegetable oils and fats	0.05	0.09	-8.99	0.16	0.43	0.12
59211/12: Wheat/Maize starch	0.19	0.01	-1.21	0.07	-0.40	-0.07
Total	0.65	0.58	-81.96	110.78	-67.27	-14.57

Source: Author's calculation based on SITC data at two-digit level.

The structural effects are positive for all product groups except live animals and they are relatively large for vegetable and fruits, coffee, tea, cocoa, oil seeds and crude animal and vegetable materials. However, the large positive structural effects are related to large negative residual effects. The residual and second order effects are positive, but small for sugar, feedstuff for animals, beverage, tobacco, cork and wood, textiles fibres and processed animal and vegetable oils. The residual effects are positive and relatively large for meat and cereals. This suggests that the competitiveness of these product groups has improved significantly during the analysed period.

CMS analysis has also been applied by the EU member countries. The top half of the Table 4.3 displays that, according to the first CMS model, the components of export growth are significantly different from the analysis by product groups. Market size effect is very similar, 193 million dollars, or 671 per cent of the total gain. However, there is considerable difference regarding the market composition effect. It is only -5 million dollars, 17 per cent of the total gain. Competitive effect is -159 million dollars, which is nearly twofold the effect in the case of product groups.

Table 4.3 Results by two models of CMS according to member states

Equation 3	Million USD	Per cent
Size market effect	192.7	671.4
Market composition effect	-5.0	-17.4
Competitive effect	-159.0	-554.0
Changes in export	28.7	100.0
Equation 4a		
Structural effect	187.7	654.0
Residual effect	-138.4	-482.2
Second-order effect	-20.6	-71.8
Change in exports	28.7	100.0

Source: Author's calculation based on OECD database.

The bottom half of Table 4.3 indicates that the composition of export growth is also different according to member states using the second CMS model. The structural effect is considerably greater than in the product groups' case. The negative residual effect and the second order effect are also higher.

Table 4.4 shows that market share has risen only in five of the 14 countries: Belgium, Ireland, UK, Portugal and Spain. The share of these countries has been only 13 per cent in Hungarian agricultural exports in the second part of the period investigated. Market composition effect has been positive only for five countries: Austria, Finland, Germany, Italy and Sweden. The market composition effect has been positive for the most important exports market for Hungary. However, the growing market share and positive market composition effects have not coincided. Hungary has lost markets in many EU countries and the negative market composition effect has exceeded the positive effects of increasing market share. The smaller market composition effect can be explained by less concentration of Hungarian exports in those member states where demand of the EU has increased below average.

Table 4.4 CMS analysis disaggregated by member states (million USD)

	Hungary's market share (per cent) 1992-94	1996-98	market composition effect	structural effect	residual effect	second order effect
Austria	4.75	3.67	221.27	70.19	-42.11	-15.89
Belgium	0.23	0.29	-76.94	8.88	8.73	2.22
Denmark	0.16	0.13	-33.85	2.07	-1.31	-0.31
Finland	0.73	0.50	2.42	6.91	-4.28	-2.20
France	0.33	0.27	-100.11	10.99	-17.27	-2.05
Germany	1.15	1.06	246.42	42.70	-42.67	-3.51
Greece	0.45	0.33	-8.64	3.02	-4.85	-0.85
Ireland	0.01	0.04	-22.08	0.06	0.75	0.21
Italy	0.97	0.80	95.95	17.87	-45.85	-3.00
Netherlands	0.34	0.32	-66.55	0.62	-3.31	-0.03
Portugal	0.01	0.02	-35.63	0.14	0.30	0.09
Spain	0.25	0.41	-68.12	9.51	21.80	6.22
Sweden	0.91	0.57	14.53	8.26	-15.48	-3.07
UK	0.11	0.14	-173.68	6.49	7.15	1.56
Total	0.65	0.58	-5.03	187.72	-138.40	-20.63

Source: Author's calculation based on OECD database.

The structural effects are positive for all member states and they are especially high for Austria, Germany and Italy. The share of these countries in total structural effects is about 70 per cent. In other words, the growth of exports to Hungary's main export markets can be explained mainly by the increase of imports in these countries. However, the residual and second order effects indicate that the competitiveness of Hungarian exports in these markets has declined considerably. Residual effects and second order effects are positive for Belgium, Ireland, Portugal, Sweden and UK, which suggests an improvement in Hungarian agricultural export competitiveness, but the proportion of these countries in Hungarian agricultural exports to the EU is below 20 per cent. In sum, the competitiveness of Hungarian agricultural exports appears to have declined in its major trading partners and has been enhanced only in a minority of its less important markets.

The conclusions ffrom the first CMS model are very similar; the main source of export growth has been a market size effect. The market composition and competitive effect have been negative, but the latter effect was dominant. The second CMS model suggests that the increase of exports has been driven mainly by the structural effect, while the residual effect and second order effect have been negative, especially the former. Moreover, our analysis accords with the observation that the CMS estimates are significantly influenced by market composition of the model (country or product), as has been strongly emphasised by Richardson (1971a).

4.3.2 Results at the Second Level CMS Model for Hungarian Exports

Table 4.5 presents the estimated CMS effects in accordance with the second level of decomposition established in the empirical model. The CMS estimates are again calculated by both product groups and member states. The second level CMS decomposition results indicate that the positive structural effects are mainly caused by the growth effects. In terms of percentage, the contributions of the growth effects to the rise in Hungarian exports to the EU are about 670 per cent, both by product groups and member states.

The market effect reflects the impact of Hungary's range of markets on its export performance. It is negative for product groups (-284 per cent) suggesting that Hungary's exports do not concentrate on fast growing product groups. The market effect is also negative for member states, but much smaller (-17.5 per cent) than in the case of product groups.

The pure residual effects are negative and their size is very similar for both product groups and member states. This implies that Hungary's general competitiveness has worsened and contributed negatively to the growth of its agricultural exports to the EU by 485-499 per cent. But static residual effects are positive, especially for commodity groups. This suggests that Hungary was able to increase the export competitiveness of specific commodities at specific destinations.

Table 4.5 CMS results at the second level (million USD)

CMS effects equation 5	product groups	per cent	member states	per cent
Growth	193.0	666.9	192.7	671.7
Market	-82.2	-284.1	-5.0	-17.5
Pure residual	-140.6	-485.8	-143.2	-499.0
Static structural residual	73.3	253.4	4.8	16.7
Pure second order	-9.8	-33.9	-20.2	-70.3
Dynamic structural residual	-4.8	-16.5	-0.5	-1.6
Total	28.9	100.0	28.7	100.0

Source: Author's calculation based on OECD database.

The two components of the second order effect are also negative, but their magnitude is relatively small. This indicates that the changes in Hungary's export structure do not adapt to the changes in the level of EU demand.

Table 4.6 shows that the estimated growth effects are positive for all product groups except live animals. The growth and market effects are positive for meat, vegetables and fruits, oilseeds, cork and wood, crude animal and vegetable materials, animal oils and fats. The growth and market effects are relatively large with opposite sign for dairy products, fish, cereals, coffee, tea, cocoa, beverages, tobacco, fixed vegetable oils and fats. This implies that the growth effects of these product groups are significant, but that they are rather slow growing markets.

The pure residual effects are negative for all product groups, indicating the general decline of competitiveness of Hungarian agricultural exports. However, the static structural residual effects are positive for more than half of all commodities. Also, in most cases, the positive static structural residual effects offset the negative impact of the pure residual effects, like meat, cereals, sugar, feedstuff for animals, beverages, tobacco, cork and wood, and processed vegetable oils and fats.

Table 4.6 CMS results at the second level disaggregated by product groups (million USD)

	Growth	Market	Pure Residual	Static Structural Residual	Pure Second Order	Dynamic Structural Residual
00: Live animals other than animals of division 03	-2.8	-6.7	-3.3	-11.0	-2.1	3.4
01: Meat and meat preparations	0.2	0.4	-14.8	24.3	1.4	-1.4
02: Dairy products and birds' eggs	9.5	-7.1	-11.2	3.0	-1.2	0.5
03: Fish, crustaceans, molluscs and preparations	19.9	-18.1	-10.7	8.8	-0.3	-0.1
04: Cereals and cereal preparations	10.8	-5.5	-9.7	39.0	4.3	-0.8
05: Vegetables and fruits	33.9	4.6	-24.6	-7.2	-4.6	0.0
06: Sugar, sugar preparations and honey	7.0	-3.1	-3.5	4.4	0.1	0.1
07: Coffee, tea, cocoa, spices, and manufactures	30.1	-17.6	-8.5	-5.7	-2.1	-3.2
08: Feedstuff for animals	3.0	-1.9	-7.6	9.3	0.2	-0.2
09: Miscellaneous edible products and preparations	8.6	-5.0	-4.4	-8.7	-1.9	-0.8
11: Beverages	18.6	-13.2	-8.4	12.1	0.5	0.3
12: Tobacco and tobacco manufactures	8.6	-6.9	-4.6	12.6	1.2	0.4
21: Hides, skins and furskins, raw	2.5	-0.7	-1.7	-0.7	-0.3	0.0
22: Oil seeds and oleaginous fruits	7.1	5.4	-4.1	-5.3	-1.4	-0.4
23: Crude rubber	2.0	-1.9	-0.6	0.6	0.0	0.0
24: Cork and wood	5.8	2.1	-8.5	11.4	0.4	-0.2
26: Textiles fibres and their wastes	2.0	-1.5	-3.6	3.7	0.0	0.0
29: Crude animal and vegetable materials, n.e.s.	10.1	5.0	-6.2	-7.7	-2.0	-0.4
41: Animal oils and fats	0.5	0.9	-0.5	-6.9	-1.1	0.3
42: Fixed vegetable oils and fats	13.3	-9.0	-3.0	-3.8	-1.0	-2.2
43: Processed Animal and vegetable oils and fats	2.1	-1.9	-0.8	1.2	0.1	0.1
59211/12: Wheat/Maize starch	0.3	-0.2	-0.2	-0.2	-0.1	0.0
Total	193.0	-82.2	-140.6	73.3	-9.8	-4.8

Source: Author's calculation is based on OECD database at two-digit level.

The magnitudes of the pure second order and dynamic structural residual effects are small, below 5 millions dollars. Product groups with positive pure second order and dynamic structural residual effects are: sugar, beverages, tobacco, and processed vegetable oils and fats. This suggests that most product groups have not been able to increase their share of the EU market when the EU demand is growing.

Table 4.7 shows that the growth effects are positive for all countries, and are relatively high (>20 millions dollars) in the cases of Belgium, France, Germany, Spain and the UK. However, for nine of fifteen member states the market effects are negative, but do not offset the positive growth effects. Both effects are positive for traditional Hungarian export markets, like Austria, Germany and Italy. Furthermore, they are positive in the cases of Finland and Sweden. This indicates that Hungarian agricultural exports to these countries have increased due to the growth effects coinciding with fast growing markets.

Table 4.7 CMS results at the second level disaggregated by member states (million USD)

Country	Growth	Market	Pure Residual	Static Structural Residual	Pure Second Order	Dynamic Structural Residual
Austria	9.58	60.61	-2.75	-39.37	-6.14	-9.75
Belgium	24.49	-15.61	-10.42	19.15	1.27	0.95
Denmark	8.57	-6.50	-3.91	2.59	-0.19	-0.12
Finland	6.09	0.82	-1.28	-3.00	-0.62	-1.58
France	21.63	-10.64	-19.69	2.43	-2.52	0.46
Germany	23.96	18.74	-31.52	-11.15	-6.22	2.71
Greece	4.31	-1.29	-2.66	-2.19	-0.71	-0.15
Ireland	4.79	-4.73	-1.90	2.66	0.11	0.10
Italy	11.98	5.89	-19.82	-26.03	-6.68	3.68
Netherlands	1.19	-0.57	-15.00	11.68	-0.48	0.45
Portugal	8.11	-7.97	-3.05	3.35	0.04	0.04
Spain	24.62	-15.12	-9.35	31.15	3.18	3.04
Sweden	5.85	2.41	-3.19	-12.29	-2.26	-0.82
UK	37.57	-31.08	-18.66	25.81	1.04	0.52
Total	192.75	-5.03	-143.19	4.79	-20.17	-0.46

Source: Author's calculation is based on OECD database.

The negative pure residual effects imply that the general competitiveness of Hungarian agricultural exports has deteriorated in all member states, especially in France, Germany and Italy. But the static structural residual effects are positive for eight countries; they are high in Belgium, Spain and the UK and in these countries the static structural residual effects are larger than the negative pure residual effects. Both effects are negative for Austria, Finland, Germany, Greece, Italy and Sweden. In other words, Hungary's export competitiveness, in general and specific terms, has declined in these countries.

4.3.3 Results at the First Level of CMS Model for EU Exports

Table 4.8 displays results from applying the two CMS models at the first level from an EU point of view. The EU's exports to Hungary have increased by only 18.2 million dollars during the analysed period. The EU's share in Hungarian markets has declined from 44 per cent to 37 per cent. All of the CMS effects are considerably larger than the actual growth in exports, except second order effect. Market size effect is about 110 million US dollars, which is 605 per cent of the total gain. Market composition effect is -45 million US dollars and competitive effect is – 47 million US dollars, 245 per cent and 261 per cent of the total gain, respectively.

Table 4.8 Results of CMS according to product groups (EU exports)

Equation 3	Million USD	Per cent
Market size effect	110.2	605.4
Market composition effect	-44.5	-244.7
Competitive effect	-47.4	-260.7
Changes in export	18.2	100.0
Equation 4a		
Structural effect	65.6	360.7
Residual effect	-47.8	-263.2
Second-order effect	0.4	2.5
Change in exports	18.2	100.0

Source: Author's calculation based on OECD database at two-digit level.

The bottom half of Table 4.8 shows that structural effects are the main contributor to the increase in EU exports to Hungary. The significant negative residual effect indicates that the EU's general competitiveness has fallen. The second order effect is positive, but small. In other words, second order effects do not play an important role in the growth of EU exports to Hungary. Our results imply again that the estimates using the two CMS decompositions are strongly different from each other.

Table 4.9 CMS analysis by product groups disaggregated (EU exports) (million USD)

	EU's market share (per cent)		market composition effect	structural effect	residual effect	second order effect
	1992-94	1996-98				
00: Live animals other than animals of division 03	55.8	48.4	1.7	1.93	-0.80	-0.26
01: Meat and meat preparations	77.5	65.6	19.8	-2.36	-7.38	0.36
02: Dairy products and birds' eggs	70.3	39.7	9.4	-9.47	-15.11	4.12
03: Fish, crustaceans, molluscs and preparations	35.2	27.5	-2.1	1.62	-1.49	-0.36
04: Cereals and cereal preparations	57.0	49.7	6.5	-1.58	-3.81	0.20
05: Vegetables and fruits	51.8	44.5	10.7	13.40	-8.16	-1.89
06: Sugar, sugar preparations and honey	54.6	53.2	1.9	-3.93	-0.36	0.10
07: Coffee, tea, cocoa, spices, and manufactures	38.0	29.6	-9.5	19.53	-9.05	-4.33
08: Feedstuff for animals	23.6	23.9	-48.0	18.53	0.55	0.28
09: Miscellaneous edible products and preparations	80.5	73.0	19.4	-19.41	-5.77	1.80
11: Beverages	76.5	86.3	8.9	-3.12	3.07	-0.40
12: Tobacco and tobacco manufactures	22.9	26.4	-15.7	5.24	1.78	0.79
21: Hides, skins and furskins, raw	45.6	60.0	0.5	0.98	3.71	0.31
22: Oil seeds and oleaginous fruits	33.0	29.1	-3.1	3.07	-0.75	-0.37
23: Crude rubber	3.6	1.0	-17.6	0.44	-0.81	-0.31
24: Cork and wood	18.6	17.0	-29.4	2.21	-1.62	-0.19
26: Textiles fibres and their wastes	12.9	14.0	-29.5	1.80	0.89	0.15
29: Crude animal and vegetable materials, n.e.s.	82.1	76.3	26.8	8.07	-3.53	-0.57
41: Animal oils and fats	88.5	100.0	0.9	-0.81	0.33	-0.11
42: Fixed vegetable oils and fats	33.6	33.9	-6.8	13.77	0.09	0.15
43: Processed Animal and vegetable oils and fats	83.1	88.6	10.4	15.44	0.44	1.03
59211/12: Wheat/Maize starch	96.6	72.9	0.4	0.29	-0.10	-0.07
Total	44.0	37.3	-44.5	65.64	-47.89	0.45

Source: Author's calculation based on SITC data at two-digit level.

Table 4.9 indicates that the proportion of EU exports has been enhanced for beverages, tobacco, hides, textiles fibres, animal oils, processed animal and vegetable oils and fats. Their share of EU's exports was only 19 per cent in the second half of the analysed period. The market composition effects were negative for fish, coffee, tea, cocoa, feedstuff for animals, tobacco, oilseeds, crude rubber, cork and wood, textiles fibres, and fixed vegetable oils and fats. The growth of market share and positive market composition effect has coincided, except for textiles fibres. The EU's share in

Hungarian markets has increased for beverages, tobacco and processed animal and vegetable oils and fats. The proportion of these product groups in the EU's exports to Hungary was only 13 per cent. In other words, Hungarian exports to the EU and the EU's exports to Hungary have risen for different product groups. The market composition effect has been positive in both Hungary and the EU for live animals, meat, fruit and vegetables, crude animals and vegetable materials, and animal oils and fats. Their share was about 32 per cent of the EU's imports from Hungary.

The structural effects are negative for meat, dairy products, cereals, sugar, miscellaneous edible products, beverages and animal oils and fats. Some products present relatively high and positive structural effects (>15 millions dollars): coffee, tea, cocoa, feedstuff for animals and processed animal and vegetable oils and fats. The residual effects are small and negative for eight product groups and show the largest negative value for dairy products. In general, the second order effects are small, their values are below five millions dollars. The CMS effects are positive for one-third of all product groups: feedstuff for animals, tobacco, hides, textiles fibres, fixed vegetable oils and fats and processed animal and vegetable oils and fats. This implies that the EU was able to increase its market share in Hungary in semi-processed and processed commodities.

4.3.4 Results at the Second Level CMS Model for EU Exports

Table 4.10 displays the CMS effects according to the second level of decomposition (equation 5). The results suggest that the positive structural effects are determined mainly by the large growth effects. Their contribution to the increase of the EU's exports to Hungarian markets is 605 per cent. The market effect indicates that the exports of the EU are not focused on fast growing product groups. The pure residual effect suggests that the general competitiveness of the EU has decreased significantly by 413 per cent. But the static structural residual effects imply that the EU has increased its competitiveness in specific commodities. The extent of structural and residual effects is larger than the total changes in exports. However, the second order effects are smaller than the export growth. The pure second order effects are negative, suggesting that the EU's market share has declined when total Hungarian imports have increased. The negative dynamic structural residual effects indicate that the EU has had a more rapidly growing export share in markets where Hungarian import demand has enhanced relatively slowly.

Table 4.10 CMS results at the second level (EU exports) (million USD)

CMS effects equation 5	product groups	per cent
Growth	110.16	605.4
Market	-44.52	-244.7
Pure residual	-75.07	-412.5
Static structural residual	27.18	149.4
Pure second order	-10.78	-59.3
Dynamic structural residual	11.23	61.7
Total	18.20	100.0

Source: Author's calculation based on OECD database at two-digit level.

Table 4.11 shows that the growth and market effects are negative for meat, dairy products, cereals, sugar, miscellaneous edible products, beverages and animal oils and fats. Both effects are positive for live animals, vegetables and fruits, hides, crude animal and vegetable materials, processed animal and vegetable oils and fats and starch. The growth effects are positive, but with relatively high negative market effects, for coffee, tea, cocoa, feedstuff for animals and fixed vegetable oils and fats. This suggests that the growth effects for these commodities are considerable, although they are slow growing markets.

Table 4.11 CMS results at the second level disaggregated by product groups (million USD)

	Growth	Market	Pure Residual	Static Structural Residual	Pure Second Order	Dynamic Structural Residual
00: Live animals other than animals of division 03	1.52	0.41	-0.73	-0.07	-0.18	-0.07
01: Meat and meat preparations	-1.34	-1.02	-4.21	-3.17	-1.66	2.02
02: Dairy products and birds' eggs	-5.93	-3.54	-3.34	-11.77	-3.40	7.52
03: Fish, crustaceans, molluscs and preparations	2.02	-0.40	-1.30	-0.19	-0.34	-0.02
04: Cereals and cereal preparations	-1.22	-0.36	-3.56	-0.25	-0.86	1.06
05: Vegetables and fruits	11.39	2.01	-7.53	-0.63	-1.84	-0.06
06: Sugar, sugar preparations and honey	-3.17	-0.76	-1.70	1.33	-0.08	0.19
07: Coffee, tea, cocoa, spices, and manufactures	22.61	-3.08	-7.25	-1.80	-2.04	-2.29
08: Feedstuff for animals	34.58	-16.05	-10.56	11.11	0.12	0.15
09: Miscellaneous edible products and preparations	-10.62	-8.79	-5.22	-0.55	-1.30	3.10
11: Beverages	-1.79	-1.32	-2.13	5.19	0.69	-1.09
12: Tobacco and tobacco manufactures	10.05	-4.81	-3.48	5.25	0.40	0.39
21: Hides, skins and furskins, raw	0.95	0.03	-1.74	5.45	0.83	-0.53
22: Oil seeds and oleaginous fruits	4.09	-1.02	-1.28	0.53	-0.17	-0.20
23: Crude rubber	5.33	-4.89	-2.12	1.31	-0.18	-0.13
24: Cork and wood	5.24	-3.03	-7.00	5.38	-0.36	0.18
26: Textiles fibres and their wastes	6.16	-4.36	-5.45	6.34	0.20	-0.05
29: Crude animal and vegetable materials, n.e.s.	4.33	3.74	-4.09	0.55	-0.80	0.22
41: Animal oils and fats	-0.40	-0.41	-0.19	0.52	0.07	-0.18
42: Fixed vegetable oils and fats	18.06	-4.29	-1.63	1.71	0.02	0.13
43: Processed Animal and vegetable oils and fats	8.18	7.26	-0.54	0.98	0.10	0.93
59211/12: Wheat/Maize starch	0.13	0.16	-0.03	-0.07	-0.02	-0.05
Total	110.16	-44.52	-75.07	27.18	-10.78	11.23

Source: Author's calculation based on OECD database at two-digit level.

The pure residual effects are negative for all product groups. This indicates that the general competitiveness of the EU in Hungarian markets has fallen. But more than 60 per cent of all commodities have positive structural residual effects. Moreover, the positive structural residual effects are lower than the negative pure residual effects in five cases: sugar, oil seeds, crude rubber, cork and wood, crude animal and vegetable materials.

The value of the pure second order and dynamic structural residual effects are small, except for dairy products. Both effects are positive for feedstuff for animals, tobacco, fixed vegetable oils and fats, processed animal and vegetable oils and fats. This implies that these product groups have been able to increase their share in the Hungarian market, when Hungary's import demand is rising.

4.4 Sensitivity Analysis

The above results indicate that changes in Hungarian agricultural trade performance with the EU, and the EU trade performance in Hungarian markets, are with associated with growth effects. In order to make a more conclusive judgement, an analysis of the sensitivity of the CMS estimates is necessary. Therefore, this section examines the sensitivity of the CMS estimates to changes in: level of commodity aggregation, choice of base year and definition of reference market. With respect to these three areas, the following investigations were carried out. First, CMS estimates were obtained at the 1, 2 and 3-digit Standard International Trade Classification (SITC) level. Second, at the 2-digit level the end year was changed. Finally, the definition of the reference market was altered. In addition to the EU market, CMS analysis was performed for the total world market.

4.4.1 Variations Due to the Commodity Aggregation

Table 4.12 displays the impact of changes in commodity aggregation on the CMS results for Hungarian agricultural exports to the EU. The signs of all of the CMS estimates have remained the same at the different levels of aggregation. The coefficients of variation are relatively high for market effects, static structural residual effects and dynamic structural residual effects. Apart from these variations, differences in the magnitude of each CMS component over the various levels of commodity aggregation are not sufficient enough to invalidate the results reported in the previous sections.

Table 4.12 Variations of CMS estimates for Hungary due to changes in commodity aggregations (million USD)

CMS effects	1-digit	2-digit	3-digit	average	coefficient of variation (%)
structural	179.4	110.8	161.1	150.4	23.6
growth	192.7	193.0	192.9	192.9	0.1
market	-13.4	-82.2	-31.9	-42.5	-83.9
residual	-130.7	-67.3	-111.7	-103.2	-31.5
pure residual	-143.0	-140.6	-143.6	-142.4	-1.1
static structural residual	12.2	73.3	31.9	39.2	79.7
second order	-19.7	-14.6	-21.0	-18.4	-18.4
pure second order	-19.0	-9.8	-16.3	-15.1	-31.5
dynamic structural residual	-0.7	-4.8	-4.7	-3.4	-69.5
change in exports	28.9	28.9	28.4	28.8	1.1

Source: Author's calculation based on OECD database.

Table 4.13 shows the effect of commodity aggregation on the CMS estimates for the EU's export performance in Hungarian markets. One can observe that market effects and static structural residual effects have opposite signs at the various levels of aggregation. Also, coefficients of variation are the highest for these CMS components. Moreover, the results suggest that residual, pure second order and dynamic structural residual effects are influenced significantly by the changes in the aggregation levels. Consequently, the CMS estimates are highly sensitive to commodity aggregation and greater care is needed in interpreting the results.

Table 4.13 Variations of CMS estimates for the EU due to changes in commodity aggregations (million USD)

CMS effects	1-digit	2-digit	3-digit	average	coefficient of variation (%)
structural	942.1	896.5	837.9	892.2	5.9
growth	892.8	896.8	892.8	894.1	0.3
market	49.3	-0.3	-54.9	-2.0	-2669.8
residual	-329.4	-173.8	-136.1	-213.1	-48.1
pure residual	-307.0	-310.9	-307.0	-308.3	-0.7
static structural residual	-22.4	137.1	170.9	95.2	108.4
second order	-145.1	-255.1	-234.2	-211.5	-27.6
pure second order	-124.8	-66.1	-51.6	-80.9	-48.0
dynamic structural residual	-20.3	-189.0	-182.7	-130.6	-73.2
change in exports	467.6	467.6	467.6	467.6	0.0

Source: Author's calculation based on OECD database.

4.4.2 Variations Due to Changes in End Year

The CMS estimates are significantly affected by changes in the end year. These variations for Hungarian agricultural exports to the EU over each time period are reported in Table 4.14. The value of the CMS components fluctuate strongly from year to year. Opposite signs are observed in each period for market effects, growth effects, second order effects and pure second order effects. The high value of coefficients of variation indicate that the structural effects, growth effects and pure second order effects are changed considerably period by period. In short, the CMS estimates are highly sensitive to the choice of end year.

It is interesting to note that the changes in exports are negative for all periods. The reason for this is that Hungarian agricultural exports in 1992 are higher than in any subsequent year. The static structural residual effects are positive for each of all the periods. The signs of the structural effects, growth effects, second order and pure second order effects have changed. However, as presented above, Hungarian exports increased between the average of 1992-1994 and the average of 1996-1998. In other words, sensitivity analysis reinforces our empirical procedure using three years' averages as the bases of comparison rather than specific years.

Table 4.14 Variations of CMS estimates for Hungary due to changes in end year (million USD)

End year CMS effects	1993	1994	1995	1996	1997	1998	average	coefficient of variation (%)
structural	-221.0	-91.5	95.0	66.1	-16.8	0.0	-28.0	-410.4
growth	-178.0	-28.4	191.0	170.8	99.2	140.6	65.9	216.6
market	-43.0	-63.1	-96.0	-104.7	-116.0	-140.6	-93.9	-37.9
residual	-97.4	-56.9	-158.4	-99.3	-130.1	-131.4	-112.2	-31.5
pure residual	-150.0	-136.6	-254.4	-204.7	-258.5	-266.6	-211.8	-27.1
static structural residual	52.5	79.7	96.0	105.5	128.4	135.1	99.5	31.0
second order	8.5	-14.0	-32.9	-24.4	-29.7	-19.9	-18.7	-79.8
pure second order	11.7	1.1	-20.4	-11.5	-8.7	-12.5	-6.7	-169.6
dynamic structural residual	-3.2	-15.1	-12.4	-12.9	-21.0	-7.4	-12.0	-51.3
change in exports	-309.9	-162.4	-96.2	-57.5	-176.6	-151.3	-159.0	-54.4

Source: Author's calculation based on OECD database at two-digit level.

Table 4.15 displays the impact of changes in period on the EU's export performance in Hungarian markets. First, the value of exports of the EU has varied significantly year by year, showing both growth and falls compared to 1992. Second, all of the CMS components have fluctuated sharply over the subsequent periods. Third, the static residual effects are positive, and the residual effects, pure residual effects and dynamic structural residual effects are negative for all analysed periods. Fourth, in general, coefficients of variation are high (>100 per cent) except residual and pure residual effects. In summary, the CMS results are influenced strongly by the period choice.

Table 4.15 Variations of CMS estimates for the EU due to changes in end year (million USD)

End year CMS effects	1993	1994	1995	1996	1997	1998	average	coefficient of variation (%)
structural	-224.2	119.7	573.9	2742.7	590.0	478.2	713.4	146.2
growth	-198.6	179.6	626.6	1920.4	661.8	533.2	620.5	115.4
market	-25.6	-59.9	-52.7	822.3	-71.8	-55.0	92.9	385.1
residual	-547.6	-564.4	-333.8	-616.9	-329.4	-331.4	-453.9	-30.0
pure residual	-576.7	-622.0	-405.2	-1137.7	-414.7	-401.9	-593.0	-47.8
static structural residual	29.0	57.7	71.4	520.8	85.3	70.5	139.1	135.1
second order	35.7	-41.1	-112.7	-2142.2	-115.0	-95.2	-411.8	-206.4
pure second order	39.4	-36.7	-75.7	-428.8	-78.9	-64.0	-107.4	-152.1
dynamic structural residual	-3.7	-4.4	-37.0	-1713.5	-36.2	-31.2	-304.3	-226.9
change in exports	-736.2	-485.75	127.38	-16.5	145.6	51.631	-152.3	-242.0

Source: Author's calculation based on OECD database at two-digit level.

4.4.3 Variations Due to Changes in Reference Market

The results of varying the definition of the reference market (total world market and the EU) are shown in Table 4.16. The signs of all CMS components are the same for the EU and world market as well. The main source of growth in Hungarian exports both to the EU and world market, are structural, including growth effects. The general competitiveness of Hungarian agricultural exports has declined considerably in both markets. But this negative trend is partly compensated by the increase of specific competitiveness. The rise of Hungarian exports in both markets is also unfavourably influenced by the negative pure residual effects and second order effects. Overall, the changing definition of reference market indicates relatively low sensitivity in the CMS estimates.

Table 4.16 Variations of CMS estimates for Hungary due to changes in reference market (million USD)

CMS effects	World	per cent	EU	per cent
structural	896.5	191.7	110.8	382.8
growth	896.8	191.8	193.0	667.9
market	-0.3	-0.1	-82.2	-284.1
residual	-173.8	-37.2	-67.3	-232.4
pure residual	-310.9	-66.5	-140.6	-485.8
static structural residual	137.1	29.3	73.3	253.4
second order	-255.1	-54.6	-14.6	-50.3
pure second order	-66.1	-14.1	-9.8	-33.9
dynamic structural residual	-189.0	-40.4	-4.8	-16.5
change in exports	467.6	100.0	28.9	100.0

Source: Author's calculation based on OECD database at two-digit level.

4.5 Summary

The objective of this chapter was to evaluate the performance of Hungarian agricultural exports to the EU, and the development in exports of the EU to Hungary, over the 1992-1998 period, using three different versions of the CMS model.

All three CMS models suggest that the main source of the growth in agricultural trade between Hungary and the EU has been the increase of total agricultural imports in the reference market. But, agricultural trade has concentrated on those product groups where import demand has been enhanced below average.

The improved CMS models indicate that the general competitiveness of Hungarian agricultural exports has decreased in both the EU and the world market. However, specific competitiveness has grown for meat, cereals, sugar, feedstuff for animals, beverages, tobacco, cork and wood, and processed vegetable oils and fats. The CMS estimates by EU member states show that Hungary's competitiveness, in general and specific terms, has deteriorated in its most important trading partners, Austria, Germany and Italy.

The CMS analysis shows similar results for the EU's export performance. The CMS estimates indicate that the general competitiveness of the EU in Hungarian markets has fallen. But the EU was able to increase its competitiveness for some product groups: sugar, oil seeds, crude rubber, cork and wood, and crude animal and vegetable materials.

The results of the sensitivity tests indicate the CMS estimates are not severely influenced by commodity aggregation and the changing in definition of reference markets. However, they are more sensitive to changes in period choice. This reveals that using three years' average data in the analysis compared to single years yields more reliable results. Overall, these variations are not sufficient to alter the conclusion of a fall in Hungarian and the EU's competitiveness.

In order for Hungary to improve its overall export performance in the EU market in the future, it needs to concentrate on changing its export structure. Hungary should increase its share in those markets, where import demand in the EU is expected to increase above average, both in terms of product groups and countries.

CHAPTER 5 REVEALED COMPARATIVE ADVANTAGE IN HUNGARIAN AGRICULTURE

Following on from the CMS analysis in chapter 4, we focus in this chapter on revealed comparative advantage (RCA), a common approach to analysing trade data. The chapter is organised as follows. The first section outlines alternative approaches to measuring RCA and methodological issues. The empirical models and procedures are described in the second section. The results are presented and discussed separately in three contexts from section 3 to section 5. Changes in Hungary's RCA are also reported within the same sections. Policy interventions are discussed in section 6. Finally, a summary is presented in section 7.

5.1 Measuring Revealed Comparative Advantage

The concept of comparative advantage is central to traditional international trade theory. However, the law of comparative advantage is difficult to quantify and test directly, because relative prices under autarky are not observable. Moreover, the principle of comparative advantage does not imply a simple deterministic relationship between it and the volume of trade, as is often conveniently forgotten in empirical works (Greenaway and Milner, 1989).

Despite these difficulties and given the important role of comparative advantage to both theoretical and policy analysis, there are large efforts to apply it to real world circumstances. These involve basically indirect methods which use information based on post-trade situations and assumptions about relationships between observable and unobservable variables. The concept of revealed comparative advantage (RCA) is very popular in empirical trade analysis as a way to identifying of comparative advantage in both cross-country and cross-industry investigations.

5.1.1 Measures of Revealed Comparative Advantage

Many researchers have attempted to define an appropriate index of revealed comparative advantage (e.g. Balassa, 1965; Bowen, 1983; Donges and Riedel, 1977;

Kunimoto, 1977; Vollrath, 1987; 1989). Detailed investigations of various RCA measures can be found in Vollrath (1991), hence we focus only on those RCA indices which are applied in this work.

The original RCA index was formulated by Balassa (1965) as:

(1) $B = (x_{ij} / x_{it}) / (x_{nj} / x_{nt})$

where x represents exports, i is a country, j is a commodity, 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 relative to its total exports and to the corresponding export performance of a set of countries, e.g., the EU. If B>1, then a comparative advantage is revealed.

The basic assumption underlying B is that the commodity pattern of exports reflects relative costs as well as differences in non-price factors and that comparative advantage can be expected to determine the export structure. The higher the relative net exports within a particular product group, the greater the revealed comparative advantage. However, Balassa restricted his analysis to manufactured goods on the grounds that distortions in primary commodity trade mean that it would not reflect comparative advantage. We return to this problem later.

Vollrath (1991) offered three alternative specifications of revealed comparative advantage, following analyses of international competitiveness in agriculture (Vollrath, 1987 and 1989; and Vollrath and Vo, 1990). The first of these measures is the *relative trade advantage* (RTA), which accounts for imports as well as exports. It is calculated as the difference between *relative export advantage* (RXA), which equates to the Balassa index[5], and its counterpart, *relative import advantage* (RMA):

(2) RTA = RXA-RMA

where,

[5] Vollrath's RXA differs slightly from the Balassa index in that (i) it eliminates country and commodity double-counting attributed to the latter, and (ii) it accounts for *all* traded goods and *all* countries, rather than sub-sets, and is therefore global in nature.

$RXA = B$

and

$RMA = (m_{ij} / m_{it}) / (m_{nj} / m_{nt})$

where m represents imports. Thus,

$RTA = [(x_{ij} / x_{it}) / (x_{nj} / x_{nt})] - [(m_{ij} / m_{it}) / (m_{nj} / m_{nt})]$

Vollrath's second measure is simply the logarithm of the relative export advantage

(3) $\ln RXA = \ln B$;

and his third measure is *revealed competitiveness* (RC), defined as:

(4) $RC = \ln RXA - \ln RMA$.

The advantage of expressing these latter two indices in logarithmic form is that they become symmetric through the origin. Positive values of RTA, lnRXA and RC reveal a comparative/competitive advantage.

5.1.2 Methodological Issues in Measuring of Revealed Comparative Advantage

The classic Balassa index (B) is criticised for several reasons. A problem with this and similar indices is that observed trade patterns are likely to be distorted by government policies and interventions and may therefore misrepresent underlying comparative advantages. This is especially true of the agricultural sector, where government interference is commonplace, a point noted by Balassa (1965). Of the four indices defined above, B and lnRXA embody only export data, whereas RTA and RC account for imports as well. For this reason, Vollrath suggests that the former two may be preferable because they are less susceptible to policy-induced distortions, which tend to be more pronounced on the import side. However, export subsidies have been widely used in agriculture, especially by the EU and Hungary, and there would appear less of an argument, in this respect, in favour of B and lnRXA. Policy-induced distortions to trade are discussed further in section 7.

Another problem with the Balassa measure is that its value is asymmetric: it varies from one to infinity for products in which a country has 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 B's distribution 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, thus not producing reliable t-statistics. In addition, the use of the RCA in regression analysis gives much more weight to values above one, when compared with observations below one ".

A methodological problem also 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 can also be extended to the other RCA indices described above. It is clear that RMA also suffers from the skewed distribution problem. The RTA and RC indices also face similar problems, although they are symmetric about the origin. Dalum et al. (1998) propose as a revealed symmetric comparative advantage (RSCA) index that alleviates the skewness problem:

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

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 method is that changes below unity have the same weight as changes above unity. But the disadvantage of this approach is that reduced asymmetry does not necessarily imply normality in the error terms and the forced symmetry may hide some of the B dynamics (De Benedictis and Tamberi, 2001).

Proudman and Redding (2000) shed light on the importance of the fact that the arithmetic mean of the B index across sectors is not necessarily equal to one. They argue that the numerator in equation (1) is unweighted by the share of total exports accounted for by a particular product groups, while the denominator is a weighted sum of export proportions 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 indicates high values for the numerator and low values for the denominator. This yields mean values of B above one in a given country. Moreover, average values of B may change over time, and hence a country may misleadingly display changes in its average extent of specialisation as measured by B the index. The authors propose an alternative measure of revealed comparative advantage in which a country's export proportion in a given product groups is divided by its mean export share in all commodity groups:

$$(6)\ \overline{B}_{ij} = \frac{B_{ij}}{\frac{1}{n}\sum_j B_{ij}}.$$

The mean value of the normalised B in (6) is constant and equal to one. The interpretation of this index is that at each point of time, 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 suggested by Proudman and Redding is not satisfactory. They argue that the normalised B index loses its consistency with respect to the original B, because it may display the opposite status of the B in cross-sectoral analysis in cases where the B value falls into the range between one and its mean.

Hillman (1980) 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 intervention on exports. He showed diagrammatically 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 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 the 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 proved that comparative advantage according to pre-trade relative prices for country i in commodity j requires the following necessary and sufficient condition to hold:

$$(7)\ 1-\frac{X_{ij}}{W_i} > \frac{X_{ij}}{X_j}\left(1-\frac{X_j}{W}\right),$$

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 (7) is necessary and sufficient to guarantee that changes in the B index are consistent with changes in countries relative factor-endowments. This condition guarantees that a 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:

$$(8)\ HI=\left(1-\frac{X_{ij}}{W_i}\right)/\frac{X_{ij}}{X_j}\left(1-\frac{X_j}{W}\right).$$

If HI is larger than unity, the B index used in cross country comparisons 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 been carried out applying Hillman's index. The Marchese and Nadal de Simone (1989) results show that Hillman's condition is violated in 9.5 per cent of exports of 118 developing countries in 1985. In the data set used in the study by Hinloopen and Van

Marrewijk (2001), Hillman's condition was not valid for 7 per cent of export value and 0.5 per cent of the number of observations. These results suggest that Hillman's condition is less restrictive than might have been expected.

Bowen (1983) highlighted the importance of an implicit assumption in using the B index, namely that every country exports every commodity. He proved that if this condition does not hold then this will invalidate the theoretical basis for the common interpretation of the B index, that values of it above (below) unity indicate relative trade advantage (disadvantage). Bowen therefore proposed two indices that use production and consumption data.

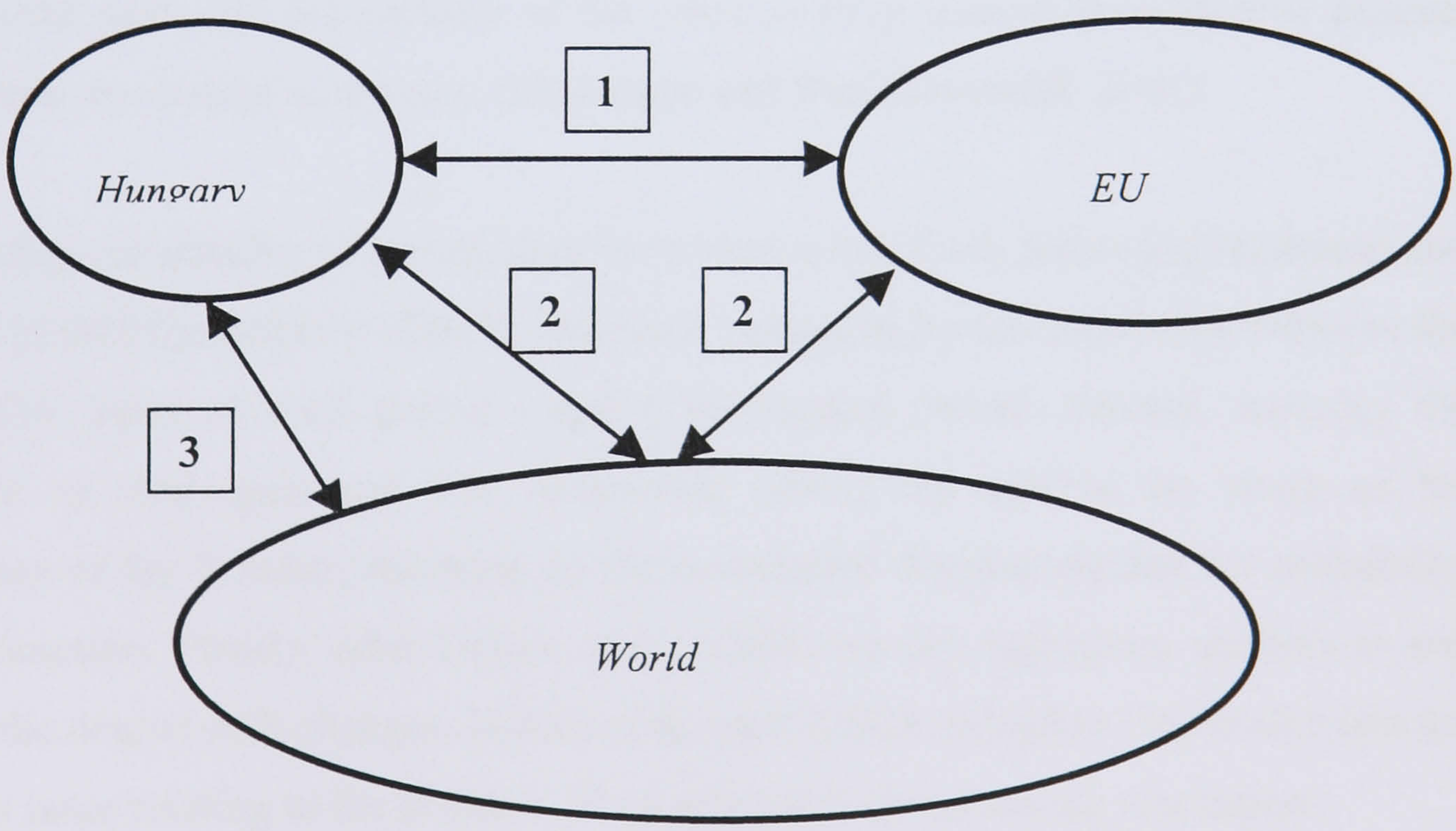
As mentioned above, there is a range of RCA indices that has been proposed and employed to measure comparative advantage. Thus we may expect that there will be some inconsistency in the results obtained by each index. This sensitivity problem is empirically confirmed by Ballance et al. (1987). Their results, using simple statistical tests, suggest that the inconsistency is greatest when the indices are interpreted as a cardinal measure rather than as ordinal or dichotomous measures.

5.2 Empirical Models and Procedures

We use an approach following Vollrath (1991) that has become very popular in recent analysis of East-West European agricultural trade. For example, Eiteljörge and Hartmann (1999) use agri-food trade data to calculate various RCA indices – RXA, RMA and RTA (see equation 2) - for a number of Central and East European countries, including Hungary. However, their analysis is restricted to aggregate data (26 product groups) and covers only three years (1995-97). Bojnec (2001) also investigates Central and East European agricultural trade using RCA indices. His study suggests that Hungarian agriculture is competitive in the world market in general, but with a declining pattern of comparative advantage. Whilst his analysis covers six years (1992-97), it is restricted to total agricultural trade without analysing disaggregated data by product group. The analysis presented in this chapter is more comprehensive in coverage, based on our 255 product groups and 7 years (1992-98) of data. Additionally, we focus not only on the simple calculation of RCA indices to identify revealed comparative advantage of Hungarian agriculture, but also investigate the stability in the pattern of the RCAs.

Some specifications aim to 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 competitiveness of Hungary, we have chosen to compute RCAs within different contexts (see figure 5.1). First, we have used bilateral trade with the EU to identify comparative advantage (arrow 1). Its interpretation is one of bilateral competitiveness. Second, we have chosen to calculate RCAs at the regional level, still with the EU as the comparator, but using total trade flows (arrows 2) to identify regional competitiveness. Finally, RCAs are also calculated in a world context, as a measure of the global competitiveness of Hungarian agriculture (arrow 3).

Figure 5.1 Calculating revealed comparative advantage



Following Marchese and Nadal de Simone (1989), we have tested the validity of the Hillman condition for our data set. Our results show that our calculations of the B index are fully consistent with Hillman's condition.

We have used four RCA indices to identify revealed comparative advantages of Hungary in specific product groups – equations (1) to (4). Therefore our estimations may be sensitive to the index used. As mentioned above, Ballance *et al.* (1987) have suggested some simple statistical tests for examining the extent to which various measures of revealed comparative advantage are consistent. The usual interpretation of an RCA index is that it identifies the extent to which a country has a comparative (dis)advantage in a commodity with respect to another country or group of countries. Ballance *et al.* offered two other interpretations. First, that the index provides a ranking of commodities by degree of comparative advantage. Second, that the index identifies a binary type demarcation of commodities based on comparative advantage and comparative disadvantage. Referring to these three interpretations as cardinal, ordinal and dichotomous measures of comparative advantage, they suggest a test of consistency for each. Following their proposal, all such sensitivity tests are carried out.

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

The first type of stability is investigated in several ways. First, following Hoekman and Djankov (1996) the stability of RCA indices is measured by the correlation between the given RCA index in time period t and a subsequent period. Second, applying the procedure of Hinloopen and Van Marrewijk (2001) we analyse the shape of the distribution of the B index, focusing on the cumulative distribution and the probability density function. Finally, after Dalum et al. (1998) we use regression analysis to test whether the degree of B changes. Dalum et al. used RSCA (equation (5)) to alleviate the skewness issue relating to the B index. They estimated the following regression:

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

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

(10a) $\sigma_i^{2t2} / \sigma_i^{2t1} = \beta_i^2 / R_i^2$.

Hence,

(10b) $\sigma_i^{t2} / \sigma_i^{t1} = |\beta_i| / |R_i|$,

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

The second type of stability is analysed in two ways. First, we use a crude approximation developed by Hoekman and Djankov (1996). This measures the relative importance of those exports which revealed a comparative advantage in time period t but a comparative disadvantage (RCD) in t+1, and vice versa, that is, an RCD in t and an RCA in t+1. Second, following a recent empirical method pioneered by Proudman and Redding (2000) and applied by Hinloopen and Van Marrewijk (2001), we employ transition probability matrices to identify the persistence and mobility of revealed comparative advantage 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).

5.3 Bilateral Revealed Comparative Advantages of Hungarian Agriculture

We focus initially on Hungary's bilateral agricultural trade with the fifteen member states of the EU during the period 1992-98. In calculating RCAs, all trade flows refer only to those between Hungary and the EU. The data, as described in chapter 3, are supplied by the OECD at the four-digit level of the Standard International Trade Classification (SITC). There are 253 four-digit product categories, to which we add two five-digit product categories (wheat starch and maize starch). The full sample therefore covers 255 product categories and covers bilateral trade flows between Hungary and the EU in each of the seven years. RCAs are calculated at both the two-digit and four-digit level of the SITC.

Table 5.1 displays summary statistics (mean and coefficient of variation) for the four RCA indices, described in section 5.2.1, for Hungarian agricultural trade with the EU over the period 1992-98. (The RCA indices are presented in full in Appendix.1) The indices present a similar pattern, with all four showing a revealed comparative advantage for five of the 22 product groups: live animals, meat, vegetables and fruit, oilseeds, and animal oils and fats.

The low coefficients of variation for these product groups indicate that the indices were fairly stable over the seven year period (as confirmed by inspection of the annual indices reported in Appendix 1). Other product groups revealing a comparative advantage are cork and wood, and crude animal and vegetable materials (B, lnRXA and

RC), and cereals, crude rubber, textiles fibres, animal oils and fats, fixed vegetable oils and fats, processed animal and vegetable oils and fats (RTA). The coefficients of variation for these groups are higher, suggesting greater variability from year to year.

Table 5.1 Revealed comparative advantages of Hungary with respect to EU, by product group and RCA index, 1992-98

	Mean, 1992-98				Coefficient of variation (%), 1992-98			
Index	B	RTA	lnRXA	RC	B	RTA	lnRXA	RC
Revealed comparative advantage if:	>1	>0	>0	>0				
00: Live animals other than animals of division 03	**4.45**	**3.92**	**1.48**	**2.12**	16.8	18.1	11.6	6.9
01: Meat and meat preparations	**4.75**	**4.14**	**1.56**	**2.16**	5.4	12.6	3.5	25.4
02: Dairy products and birds' eggs	0.20	-0.32	-1.72	-0.95	45.0	-63.9	-26.9	-45.7
03: Fish, crustaceans, molluscs	0.12	-0.14	-2.19	-0.81	30.1	-46.4	-15.0	-35.7
04: Cereals and cereal preparations	0.81	**0.10**	-0.31	**0.12**	49.8	602.8	-148.2	642.1
05: Vegetables and fruits	**2.21**	**1.52**	**0.78**	**1.18**	15.4	24.3	18.0	24.5
06: Sugar, sugar preparations and honey	0.85	-0.06	-0.17	**0.15**	18.2	-1271.7	-106.9	480.2
07: Coffee, tea, cocoa, spices	0.88	-1.00	-0.16	-0.76	31.5	-53.7	-174.7	-43.1
08: Feedstuff for animals	0.96	-2.57	-0.06	-1.31	24.6	-22.6	-369.3	-20.1
09: Miscellaneous edible products & preparations	0.29	-1.72	-1.51	-2.09	81.2	-50.6	-51.3	-19.6
11: Beverages	0.43	-0.05	-0.85	-0.04	13.9	-466.2	-16.0	-1557.9
12: Tobacco and tobacco manufactures	0.11	-1.48	-2.54	-2.98	68.7	-23.5	-38.8	-29.6
21: Hides, skins and furskins, raw	0.92	-1.28	-0.10	-0.81	19.5	-60.4	-195.1	-56.2
22: Oil seeds and oleaginous fruits	**11.61**	**0.22**	**2.38**	**2.78**	37.0	131.1	17.1	12.5
23: Crude rubber	0.04	**10.05**	-3.41	-3.81	48.4	40.3	-14.8	-13.0
24: Cork and wood	**3.33**	-1.82	**1.19**	**0.61**	16.0	-28.3	12.4	63.2
26: Textiles fibres and their wastes	0.69	**1.55**	-0.45	-1.00	40.4	50.1	-96.6	-63.4
29: Crude animal and vegetable materials, n.e.s.	**2.12**	-0.73	**0.75**	**0.43**	12.9	-90.8	16.0	60.3
41: Animal oils and fats	**3.73**	**1.45**	**1.16**	**1.68**	59.3	20.5	53.6	13.2
42: Fixed vegetable oils and fats	0.31	**2.36**	-1.65	-1.85	108.8	112.4	-63.4	-77.4
43: Processed animal and vegetable oils and fats	0.19	**1.64**	-1.77	-2.44	44.0	172.0	-24.8	-17.7
59212: Wheat/Maize starch	0.20	-0.18	-2.64	-1.80	129.5	-267.5	-127.2	-172.1

Source: Author's calculation based on SITC code data at two-digit level.
Note: Revealed comparative advantages are shown in **bold**.

5.3.1 Consistency Tests for Bilateral Revealed Comparative Advantage

Notwithstanding that the general patterns of revealed comparative advantage reported for the four indices are similar, specific results are likely to be sensitive to the index used. As a cardinal measure of comparative advantage, the consistency test over different indices is based on the simple correlation coefficient. As Table 5.2 shows, two pairings display a very high level of correlation: B and RTA ($\geq$0.93) except for 1994, and lnRXA and RC ($\geq$0.79) in each of the seven years. Correlation coefficients between all other pairs of RCA indices over the period are low (<0.65). Thus, except for B and RTA and lnRXA and RC, the indices, interpreted as cardinal measures, do not produce consistent results. However, it should be noted that a linear correlation coefficient will tend to show a low value nonlinear transformations of the same variable, e.g. B and lnRXA.

Table 5.2 Correlation coefficients among RCA indices, 1992-98

Year	1992	1993	1994	1995	1996	1997	1998
B:							
RTA	0.96	0.98	0.44	0.93	0.98	0.95	0.99
lnRXA	0.59	0.60	0.61	0.65	0.60	0.56	0.43
RC	0.49	0.54	0.52	0.53	0.48	0.45	0.37
RTA:							
lnRXA	0.58	0.59	0.23	0.57	0.59	0.55	0.42
RC	0.56	0.60	0.36	0.57	0.52	0.54	0.41
lnRXA							
RC	0.79	0.85	0.86	0.84	0.88	0.87	0.86

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

The consistency test for RCA indices as ordinal measures is based on the rank correlation coefficient for each pairing. Results for our four RCAs show that the indices are reasonably consistent, except for the pairings of B and RTA (Table 5.3). The pairings of B and lnRXA is perfectly consistent by definition.

Table 5.3 Rank correlation coefficients among RCA indices, 1992-98

Year	1992	1993	1994	1995	1996	1997	1998
B:							
RTA	0.58	0.45	0.47	0.47	0.45	0.45	0.45
lnRXA	1.00	1.00	1.00	1.00	1.00	1.00	1.00
RC	0.80	0.86	0.85	0.83	0.87	0.86	0.84
RTA:							
lnRXA	0.80	0.72	0.74	0.70	0.73	0.75	0.71
RC	0.91	0.89	0.91	0.89	0.87	0.86	0.89
lnRXA							
RC	0.80	0.86	0.85	0.83	0.87	0.86	0.84

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

The test for the RCA indices as a dichotomous measure is simply the share of product groups in which both of the paired indices suggest comparative advantage or comparative disadvantage. This test indicates that all four of our RCA indices are highly consistent, with shares of ≥0.86 (Table 5.4). Moreover, B and lnRXA, and lnRXA and RC are perfectly consistent, with a share of 100 per cent.

Table 5.4 Dichotomous test: shares (%) of matching indices, 1992-98

Year	1992	1993	1994	1995	1996	1997	1998
B:							
RTA	87	88	87	87	89	87	86
lnRXA	100	100	100	100	100	100	100
RC	86	88	87	87	89	87	86
RTA:							
lnRXA	87	88	87	87	89	87	86
RC	100	100	100	100	100	100	100
lnRXA:							
RC	86	88	87	87	89	87	86

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

These simple tests for consistency shed light on the sensitivity of any conclusions based on the various RCA indices. The tests on RCA indices as cardinal and ordinal measures confirm that the indices are inconsistent or only moderately consistent, in accord with the findings of Ballance *et al.* However, the use of RCA indices as a binary-type measure of comparative advantage or comparative disadvantage is supported by the dichotomous test. Accordingly, our RCA measures are useful proxies in determining whether or not Hungary has a comparative advantage in a particular commodity or product group.

5. 3. 2 Stability of Bilateral Revealed Comparative Advantage

Using 1992 as the base year, the simple correlation coefficients for our four RCA indices for Hungary over 1993-98 tend to be high, with a few exceptions (Table 5.5), suggesting that the structure of comparative advantage did not alter significantly during the 1990s. The exceptions are 1994 under RTA and, perhaps more significantly, a marked decline over 1996 to 1998 under B and RTA, which indicates an alteration in the pattern of revealed comparative advantage in the later years of the period, although this is not evident in lnRXA and RC.

Table 5.5 Correlation coefficients of RCA indices between 1992 and 1993-98

Index	Base year	1993	1994	1995	1996	1997	1998
B	1992	0.82	0.74	0.76	0.84	0.65	0.32
RTA	1992	0.82	0.19	0.79	0.83	0.63	0.33
lnRXA	1992	0.86	0.78	0.76	0.75	0.70	0.63
RC	1992	0.87	0.85	0.74	0.73	0.70	0.70

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

Table 5.6 provides three types of information on the distribution of the B index for the period 1992 and 1998. First, percentile points "P-z" are reported, where z ranges from 5 to 95. This shows detailed information on the cumulative distribution of the B index. For example, in 1992 the P-25 point is 0.27, which means that 25 per cent of the observations in 1992 had a B index below 0.27. Second, some summary statistics on the distribution are presented, in particular the mean, the maximum and the standard deviation. In 1992 these were 2.62, 29.03 and 4.59, respectively. Third, the B index points B-z are reported, where z varies from 1 to 8. For example, the B-4 point in 1992 was 0.82, indicating that 82 per cent of the observations in 1992 had a B index below 4, consequently 18 per cent of the observations had a B index above 4.

Table 5.6 suggests that the distribution of the B index has not changed dramatically over time, but the value of each cell has declined. While 50 per cent of the observations in 1992 had a B index below 0.95, this value was only 0.34 in 1998. That is, the distribution has shifted to the left. The mean has decreased significantly after 1993, and the maximum and the standard deviation have fluctuated with a downward trend. The B<1 row suggests that the share of observations with a B index below 1 (i.e. they have revealed comparative disadvantage) has increased from 44 per cent to 56 per cent during the period.

Table 5.6 Empirical distribution of the B index

	1992	1993	1994	1995	1996	1997	1998
P-5	0.00	0.00	0.00	0.00	0.01	0.00	0.00
P-10	0.01	0.01	0.01	0.02	0.01	0.01	0.00
P-25	0.27	0.14	0.21	0.14	0.07	0.08	0.08
P-50	0.95	0.92	0.84	0.68	0.70	0.43	0.34
P-75	2.60	2.90	2.46	2.15	1.94	1.16	1.03
P-90	5.52	6.07	4.00	4.07	4.68	3.04	2.74
P-95	9.20	11.00	11.06	8.34	8.22	4.84	4.24
mean	2.62	2.80	2.07	1.85	1.97	1.14	1.05
maximum	29.03	32.63	12.65	12.66	17.69	9.14	7.99
standard deviation	4.59	5.16	3.03	2.71	3.28	1.76	1.55
B<1	0.44	0.51	0.49	0.51	0.44	0.49	0.56
B<2	0.64	0.65	0.64	0.73	0.75	0.82	0.82
B<4	0.82	0.78	0.87	0.85	0.84	0.91	0.93
B<8	0.93	0.91	0.93	0.93	0.95	0.98	1.00

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

Table 5.7 reports that β values are significantly different from zero and positive, indicating that the hypothesis of reverse patterns can be rejected. In other words, this reinforces our previous results that trade patterns have not changed fundamentally over the period.

Table 5.7 Stability of the B index between 1998 and 1992

year	α	β	R	β/R	J-B*
1992	-0.303	0.709	0.791	0.896	27.589
1993	-0.276	0.705	0.816	0.864	55.468
1994	-0.244	0.779	0.866	0.899	24.231
1995	-0.213	0.898	0.918	0.935	3.618
1996	-0.187	0.786	0.893	0.880	46.384
1997	-0.049	0.908	0.910	0.998	77.240

Source: Based on SITC code data at three-digit level.
Note: * Jarque-Bera test: $\chi^2_{2,5\%} = 5.99$

The values in the fourth column (β/R) of Table 5.7 suggest that that the patterns of revealed comparative advantage have converged. But the β/R ratios are near to one, thus suggesting that the dispersion in the distribution of the B index has not changed basically. Contrary to the original intention of the normalisation approach proposed by Dalum et al. (1998) and Laursen (1998), the Jarque-Bera test reports that the hypothesis of normality of the error terms can be rejected for 5 out of 6 regressions.

Those product groups in which Hungary had an RCA in 1992 but an RCD in 1998, or vice versa, account for ≤ 12 per cent of total exports (Table 5.8).[6] And in all cases bar one, the share of these product groups, for which there was a 'switch' in comparative (dis)advantage, declined over the period. This also suggests that the structure of Hungary's revealed comparative advantage did not change radically during the 1990s.

[6] The results based on B and lnRXA, RTA and RC are identical because of the perfect match under the dichotomous consistency test – see Table 5.4.

Table 5.8 Changes in structure of Hungarian agricultural exports, 1992 and 1998

Index	Share in total exports of product groups where:			
	RCA_{92} and RDA_{98}		RDA_{92} and RCA_{98}	
	1992	1998	1992	1998
B	8.4	1.4	2.6	2.7
RTA	5.1	1.8	7.0	1.3
lnRXA	8.4	1.4	2.6	2.7
RC	5.1	1.8	7.0	1.3

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

Further information on the dynamics of the B index can be obtained by the analysis of the Markovian transition matrices. Our estimated transition matrix is based on a seven year base, and shows the probability of passing from one state to another between the starting year (1992) and the ending year (1998).

Table 5.9 Transition probabilities of the B index

B	1998			
1992	a	b	c	d
a	0.92	0.04	0.04	0.00
b	0.75	0.25	0.00	0.00
c	0.50	0.30	0.10	0.10
d	0.10	0.20	0.40	0.30
initial distribution	0.49	0.15	0.18	0.18
final distribution	0.67	0.15	0.11	0.07
limit distribution	0.89	0.06	0.04	0.01

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

The diagonal elements in Table 5.9 indicate that the B indices with low values (≤1) are fairly persistent from 1992 to 1998. In other words, if a product had a comparative *dis*advantage, this status has remained more or less the same at the end of the period. However, intermediate and high value indices (classes b, c and d) report a considerable change during the analysed period. There is a zero per cent chance of moving from class a to class d and from b to classes c and d. The chances for a 'switch' from comparative advantage to comparative disadvantage are high for intermediate classes b and c (75 and 50 per cent) but relatively small for observations in class d (10 per cent). The limit distribution shows a continuation of the worsening trend in comparative advantage between the initial and end years.

5. 4 Regional Revealed Comparative Advantages of Hungarian Agriculture

We now apply the four RCA indices to Hungary's trade in agri-food products over the period 1992-98, with the EU still as the comparator, but using total trade with the rest of world rather than bilateral trade. Otherwise, the data are as before.

Summary statistics (mean and coefficient of variation) for the four indices are displayed in Table 5.10. The indices present a similar pattern, with all four showing a revealed comparative advantage for 11 of the 22 product groups: live animals; meat; cereals; vegetables and fruit; sugar; beverages; oilseeds; cork and wood; and animal and vegetable materials, oils and fats. The relatively low coefficients of variation for these product groups indicate that the indices were fairly stable over the seven year period.

Table 5.10 Revealed comparative advantages of Hungary with respect to the EU, by product group and index, 1992-98

	Mean, 1992-98				Coefficient of variation (%) 1992-98			
	B	RTA	lnRXA	RC	B	RTA	lnRXA	RC
Revealed comparative advantage if:	>1	>0	>0	>0				
00: Live animals other than animals of division 03	**3.85**	**3.56**	**1.33**	**2.59**	20	23	17	15
01: Meat and meat preparations	**4.18**	**3.87**	**1.42**	**2.65**	18	20	13	19
02: Dairy products and birds' eggs	0.45	**0.18**	-0.81	**0.59**	16	63	-20	71
03: Fish, crustaceans, molluscs	0.12	-0.02	-2.20	-0.18	34	-188	-17	-163
04: Cereals and cereal preparations	**2.50**	**2.14**	**0.79**	**1.85**	54	66	69	39
05: Vegetables and fruits	**2.70**	**2.35**	**0.96**	**2.00**	26	28	31	10
06: Sugar, sugar preparations and honey	**1.19**	**0.74**	**0.13**	**1.08**	32	79	237	69
07: Coffee, tea, cocoa, spices	**1.03**	**0.05**	-0.01	**0.02**	26	286	-4553	725
08: Feedstuff for animals	**1.06**	-0.83	**0.02**	-0.61	30	-35	1500	-44
09: Miscellaneous edible products & preparations	0.78	-0.25	-0.28	-0.24	23	-120	-91	-114
11: Beverages	**1.23**	**0.98**	**0.15**	**1.58**	35	42	261	23
12: Tobacco and tobacco manufactures	0.74	-0.12	-0.51	-0.33	75	-414	-132	-190
21: Hides, skins and furskins, raw	0.76	-0.38	-0.33	-0.42	31	-60	-106	-56
22: Oil seeds and oleaginous fruits	**9.70**	**9.33**	**2.16**	**3.19**	44	46	25	20
23: Crude rubber	0.92	**0.10**	-1.06	-0.83	132	1269	-153	-191
24: Cork and wood	**2.23**	**1.25**	**0.78**	**0.82**	23	32	31	16
26: Textiles fibres and their wastes	0.78	-0.16	-0.27	-0.20	22	-109	-84	-105
29: Crude animal and vegetable materials, n.e.s.	**1.68**	**0.94**	**0.48**	**0.80**	26	36	59	17
41: Animal oils and fats	**3.07**	**2.72**	**0.95**	**2.09**	57	59	70	15
42: Fixed vegetable oils and fats	**2.73**	**1.99**	**0.97**	**1.40**	29	53	28	56
43: Processed animal and vegetable oils and fats	0.12	-1.02	-2.16	-2.21	25	-43	-12	-17
59212: Wheat/Maize starch	0.38	**0.13**	-1.18	**0.28**	58	192	-71	300

Source: Author's calculation based on SITC code data at four-digit level.
Note: Revealed comparative advantages are shown in **bold**.

5.4.1 Consistency Tests for Regional Comparative Advantage

As a cardinal measure of comparative advantage, the consistency test based on the simple correlation coefficient between paired indices, shows that of the six pairings, four show only moderate levels of correlation (Table 5.11), suggesting that the indices, as cardinal measures, are not consistent. However, two pairings show a high level of correlation: B and RTA, for which the coefficient is ≥ 0.95; and lnRXA and RC ($\geq$ 0.75).

Table 5.11 Cardinal test: correlation coefficients of paired indices, 1992-98

Year	1992	1993	1994	1995	1996	1997	1998
B:							
RTA	0.97	0.99	0.98	0.96	0.99	0.95	0.95
lnRXA	0.67	0.65	0.64	0.66	0.62	0.64	0.63
RC	0.48	0.53	0.51	0.54	0.45	0.46	0.50
RTA:							
lnRXA	0.65	0.64	0.63	0.61	0.61	0.63	0.60
RC	0.53	0.56	0.56	0.59	0.49	0.57	0.57
lnRXA:							
RC	0.75	0.80	0.81	0.81	0.81	0.81	0.84

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

The consistency test for RCA indices as ordinal measures, based on the rank correlation coefficient for each pairing, shows that the indices are reasonably consistent in *ranking* product groups by revealed comparative advantage (Table 5.12).

Table 5.12 Ordinal test: rank correlation coefficients of paired indices, 1992-98

Year	1992	1993	1994	1995	1996	1997	1998
B:							
RTA	0.74	0.71	0.73	0.69	0.71	0.68	0.67
lnRXA	1.00	1.00	1.00	1.00	1.00	1.00	1.00
RC	0.72	0.79	0.81	0.78	0.77	0.80	0.79
RTA:							
lnRXA	0.77	0.79	0.82	0.78	0.79	0.79	0.80
RC	0.88	0.92	0.91	0.91	0.92	0.91	0.91
lnRXA:							
RC	0.72	0.79	0.81	0.78	0.77	0.80	0.79

Source: Based on SITC code data at four-digit level

The test for the indices as a dichotomous measure, as simply the share of product groups in which both of the paired indices suggest comparative advantage or comparative disadvantage, indicates that all four of our indices are again reasonably consistent (Table 5.13).

Table 5.13 Dichotomous test: shares (per cent) of matching indices, 1992-98

Year	1992	1993	1994	1995	1996	1997	1998
B:							
RTA	67	71	71	71	72	69	70
lnRXA	100	100	100	100	100	100	100
RC	80	81	83	83	80	80	80
RTA:							
lnRXA	67	71	71	71	72	69	70
RC	82	85	81	85	85	85	87
lnRXA:							
RC	80	81	83	83	80	80	80

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

These simple tests for consistency reinforce the sensitivity of any conclusions based on the RCA indices. Similar to our previous calculations focusing on bilateral RCA indices, they confirm that the indices are less consistent as cardinal measures. The test results again suggest that the RCA indices are more satisfactory as ordinal or binary measures of comparative advantage.

5.4.2 Stability of Regional Revealed Comparative Advantage

The first indicator of stability of the RCA indices is obtained by measuring the correlation between the index in time period t and subsequent time periods. Using 1992 as the base year, the simple correlation coefficients for our four indices for Hungary over 1993-98 are all reasonably high, confirming that the structure of comparative advantage did not alter significantly during the 1990s (Table 5.14).

Table 5.14 Correlation coefficients of indices for 1992 and 1993-98

Index	Base year	1993	1994	1995	1996	1997	1998	n
B	1992	0.74	0.65	0.71	0.71	0.73	0.77	252
RTA	1992	0.74	0.66	0.73	0.70	0.72	0.76	252
lnRXA	1992	0.86	0.79	0.81	0.76	0.73	0.73	171
RC	1992	0.82	0.77	0.80	0.75	0.76	0.77	162

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

Table 5.15 reports that the distribution of the B index has not changed fundamentally during the analysed period. However, a striking feature is that the values in many rows have a strongly declining trend.

Table 5.15 Empirical distribution of the B index

	1992	1993	1994	1995	1996	1997	1998
P-5	0.04	0.02	0.02	0.02	0.02	0.01	0.01
P-10	0.08	0.09	0.13	0.10	0.08	0.04	0.08
P-25	0.35	0.36	0.36	0.27	0.41	0.28	0.33
P-50	1.11	0.95	1.14	0.98	1.06	0.85	0.63
P-75	4.26	3.36	3.07	3.59	3.48	3.09	2.36
P-90	7.89	8.42	6.89	8.89	8.09	4.88	4.37
P-95	21.55	14.26	12.37	10.72	13.50	9.10	6.28
mean	4.01	3.62	2.97	3.06	3.35	2.36	2.03
maximum	61.26	62.58	36.21	31.80	49.44	28.91	24.84
standard deviation	9.26	8.85	5.56	5.12	7.10	4.30	3.75
B<1	0.47	0.53	0.47	0.51	0.42	0.56	0.58
B<2	0.64	0.69	0.67	0.67	0.62	0.65	0.69
B<4	0.71	0.76	0.78	0.76	0.76	0.82	0.87
B<8	0.91	0.89	0.93	0.85	0.89	0.95	0.96

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

Descriptive statistics display a similar picture; the mean, maximum and standard deviation have also decreased over the time. The share of product groups with a B index below one has grown from 47 per cent to 58 per cent between the period 1992 and

1998. This indicates that Hungary has lost its comparative advantage for some product groups. The downward trend in the values of the B indices suggests that Hungary's comparative advantage has weakened in general terms.

It appears from Table 5.16 that the β values are significantly different from the zero and positive, confirming our previous finding that trade patterns have not changed radically during the analysed period. The β/R ratios indicate that the pattern of revealed comparative advantage has converged. They also show that the dispersion in the distribution of the B index has remained fairly stable. But, it is noteworthy that the Jarque-Bera tests suggest that the hypothesis of normality of the error terms cannot be accepted for 3 out of 6 regressions.

Table 5.16 Stability of the B index between 1998 and 1992

	α	β	R	β/R	J-B*
1992	-0.134	0.813	0.847	0.960	24.825
1993	-0.100	0.738	0.759	0.972	3.977
1994	-0.110	0.820	0.827	0.992	3.740
1995	-0.110	0.865	0.909	0.952	19.754
1996	-0.131	0.876	0.917	0.955	1.133
1997	-0.044	0.908	0.962	0.944	10.347

Source: Based on SITC code data at three-digit level.
Note: * Jarque-Bera test: $\chi^2_{2,5\%} = 5.99$.

Those product groups in which Hungary had an RCA in 1992 but an RCD in 1998, or vice versa, accounted for < 20 per cent of total agri-food exports (Table 5.17).[7] And in most cases, the share of these product groups, for which there was a 'switch' in comparative (dis)advantage, declined over the period. This again suggests that the structure of Hungary's revealed comparative advantage did not change radically during the 1990s.

Table 5.17 Changes in structure of Hungarian agri-food exports, 1992 and 1998

Index	Percentage share in exports of product groups where:			
	RCA_{92} and RCD_{98}		RCD_{92} and RCA_{98}	
	1992	1998	1992	1998
B	5.2	0.1	14.4	14.8
RTA	0.9	0.7	6.4	2.1
lnRXA	5.2	0.1	14.4	14.8
RC	0.9	0.7	6.3	2.2

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

Table 5.18 shows that the observations on the B index with values <1 were considerable stable between 1992 and 1998, whilst product groups with various degrees of comparative advantage reveal significant changes in their pattern. There is a zero per cent probability of moving from class a, b or c to class d and from class c to class a. The chances for a change in comparative advantage status are relatively high for observations with a weak comparative advantage (class b; 67 per cent) and very small for observations with medium and strong comparative advantage (classes c and d; zero and 6 per cent). The comparison of the distribution of the B index in the initial and final years suggests an unfavourable trend in Hungarian comparative advantage against the EU. The limit distribution indicates the extent of further deterioration of Hungary's comparative advantage if the trend continues.

Table 5.18 Transition probabilities of B index

RCA	a	b	c	d
a	0.96	0.00	0.04	0.00
b	0.67	0.22	0.11	0.00
c	0.00	0.75	0.25	0.00
d	0.06	0.06	0.44	0.44
initial distribution	0.47	0.16	0.07	0.29
final distribution	0.58	0.11	0.18	0.13
limit distribution	0.89	0.05	0.05	0.00

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

[7] The results based on B and lnRXA are identical because of the perfect match under the dichotomous consistency test – see Table 5.13.

5 .5 Global Revealed Comparative Advantage of Hungarian Agriculture

Finally, we focus on Hungary's global comparative advantage over the period of 1992-1998. The data here are different, being global in nature, and they are supplied by the UNCTAD at the three-digit level of SITC. The sample contains 55 product groups at the three-digit level and 21 commodity groups at the two-digit level. RCAs are calculated at both three-digit and two-digit level.

Table 5.19 shows summary statistics for the four RCA indices. The indices show a similar pattern, with all four displaying a revealed comparative advantage for 12 of the 21 product groups: live animals; meat; cereals; vegetables and fruit; sugar; miscellaneous edible products; beverages; oilseeds; cork and wood; and animal and vegetable materials, oils and fats. The relatively low coefficients of variation for these product groups, except miscellaneous edible products, indicate that the indices were fairly stable over the seven year period. Other product groups present revealed comparative disadvantage according to the four RCA indices, except dairy products using the RTA index.

Table 5.19 Global revealed comparative advantages of Hungary by product group and index, 1992-98

	Mean, 1992-98				Coefficient of variation (%) 1992-98			
	B	RTA	lnRXA	RC	B	RTA	lnRXA	RC
Revealed comparative advantage if:	>1	>0	>0	>0				
00: Live animals other than animals of division 03	**5.14**	4.77	**1.61**	**2.63**	21.6	24.0	15.5	15.5
01: Meat and meat preparations	**5.74**	**5.32**	**1.66**	**2.62**	32.2	35.0	31.3	26.2
02: Dairy products and birds' eggs	0.90	**0.45**	-0.11	0.75	16.0	43.1	-139.3	53.0
03: Fish, crustaceans, molluscs	0.06	-0.06	-2.84	-0.74	33.2	-32.2	-12.2	-42.2
04: Cereals and cereal preparations	**2.21**	**1.98**	**0.67**	**2.28**	54.6	61.5	80.7	31.9
05: Vegetables and fruits	**2.36**	**1.93**	**0.83**	**1.68**	23.2	26.0	32.0	9.3
06: Sugar, sugar preparations and honey	**1.12**	**0.72**	**0.07**	**1.17**	34.0	75.5	434.8	62.5
07: Coffee, tea, cocoa, spices	0.84	-0.48	-0.22	-0.48	28.3	-35.9	-156.3	-47.7
08: Feedstuff for animals	0.94	-1.59	-0.09	-1.02	26.9	-14.6	-286.3	-23.2
09: Miscellaneous edible products & preparations	**1.33**	**0.02**	**0.25**	**0.07**	24.3	1561.0	103.6	394.4
11: Beverages	**2.29**	**1.98**	**0.77**	**1.99**	35.2	39.1	50.6	17.0
12: Tobacco and tobacco manufactures	0.55	-0.27	-0.81	-0.60	72.9	-131.9	-87.7	-116.0
21: Hides, skins and furskins, raw	0.74	-0.41	-0.35	-0.41	32.9	-112.7	-104.2	-132.5
22: Oil seeds and oleaginous fruits	**2.62**	**2.15**	**0.89**	**1.69**	36.9	45.5	49.7	32.6
23: Crude rubber	0.04	-0.40	-4.22	-3.37	132.0	-25.2	-35.4	-43.7
24: Cork and wood	**1.30**	**0.47**	**0.24**	**0.45**	19.9	35.7	82.8	24.3
26: Textiles fibres and their wastes	0.27	-0.61	-1.34	-1.22	23.6	-13.3	-18.7	-18.6
29: Crude animal and vegetable materials, n.e.s.	**2.40**	**1.36**	**0.84**	**0.82**	26.7	36.8	33.2	17.1
41: Animal oils and fats	**3.01**	**2.57**	**0.93**	**1.88**	56.7	58.9	70.5	15.3
42: Fixed vegetable oils and fats	**2.14**	**1.53**	**0.72**	**1.34**	32.7	60.3	42.8	62.0
43: Processed animal and vegetable oils and fats	0.11	-1.27	-2.22	-2.45	22.2	-46.2	-10.6	-17.0

Source: Author's calculation based on UNCTAD SITC code data at two-digit level.
Note: Revealed comparative advantages are shown in **bold**.

5.5.1 Consistency Tests for Global Revealed Comparative Advantage

Table 5.20 displays the cardinal test over different indices based on the simple correlation coefficients between paired indices. The correlation is perfect between B and RTA, and at a high level for lnRXA and RC ($\geq$ 0.79). However, correlation coefficients for other four pairings are poor ($\leq$ 0.48) indicating that the these indices, as cardinal measures, are not consistent.

Table 5.20 Cardinal test: correlation coefficients of paired indices, 1992-98

Year	1992	1993	1994	1995	1996	1997	1998
B:							
RTA	1.00	1.00	1.00	1.00	1.00	1.00	1.00
lnRXA	0.48	0.46	0.45	0.44	0.43	0.42	0.40
RC	0.29	0.26	0.21	0.22	0.25	0.23	0.19
RTA:							
lnRXA	0.49	0.46	0.47	0.45	0.43	0.43	0.41
RC	0.32	0.28	0.25	0.25	0.27	0.25	0.22
lnRXA:							
RC	0.79	0.79	0.81	0.82	0.82	0.83	0.83

Source: Author's calculation based on UNCTAD SITC code data at three-digit level.

The consistency test for the RCA indices as ordinal measures is, as before, based on the rank correlation coefficient for each pairing. Results show that the indices are much better in *ranking* product groups by revealed comparative advantage (Table 5.21).

Table 5.21 Ordinal test: rank correlation coefficients of paired indices, 1992-98

Year	1992	1993	1994	1995	1996	1997	1998
B:							
RTA	0.90	0.85	0.88	0.91	0.90	0.90	0.86
lnRXA	1.00	1.00	1.00	1.00	1.00	1.00	1.00
RC	0.78	0.79	0.82	0.85	0.81	0.87	0.76
RTA:							
lnRXA	0.90	0.85	0.88	0.91	0.90	0.90	0.86
RC	0.88	0.92	0.93	0.94	0.91	0.94	0.86
lnRXA:							
RC	0.78	0.79	0.82	0.85	0.81	0.87	0.76

Source: Author's calculation based on UNCTAD SITC code data at three-digit level.

The test for the indices as a dichotomous measure, again simply the share of product groups in which both of the paired indices suggest comparative advantage or comparative disadvantage, indicates that all four of our indices are again reasonably consistent (Table 5.22).

Table 5.22 Dichotomous test: shares (%) of matching indices, 1992-98

Year	1992	1993	1994	1995	1996	1997	1998
B:							
RTA	78	75	76	78	82	85	71
lnRXA	100	100	100	100	100	100	100
RC	78	75	76	78	82	85	71
RTA:							
lnRXA	78	75	76	78	82	85	71
RC	100	100	100	100	100	100	100
lnRXA:							
RC	78	75	76	78	82	85	71

Source: Author's calculation based on UNCTAD SITC code data at three-digit level.

In conclusion, the consistency tests have strengthened our previous findings that the indices are not consistent as cardinal measures of comparative advantage. However, the evidence also suggests that our RCA indices are reasonable proxies as an ordinal or binary measure.

5.5.2 Stability of Global Revealed Comparative Advantage

Again, the first indicator of stability in the RCA indices is the correlation between the index in time period t and subsequent time periods. Using 1992 as the base year, the simple correlation coefficients for our four indices for Hungary over 1993-98 are all high ($\geq$ 0.80), especially for B and RTA ($\geq$ 0.98), confirming that the structure of comparative advantage has remained fairly stable (Table 5.23).

Table 5.23 Correlation coefficients of indices for 1992 and 1993-98

Index	Base year	1993	1994	1995	1996	1997	1998
B	1992	1.00	0.99	0.99	0.98	0.99	0.99
RTA	1992	0.99	0.99	0.98	0.99	0.99	0.99
lnRXA	1992	0.93	0.86	0.93	0.92	0.92	0.87
RC	1992	0.88	0.80	0.91	0.88	0.88	0.89

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

The distribution of the B index has not altered considerably over the time period (Table 5.24). However, the values in any a particular row have declined over the time. Descriptive statistics report the same pattern; mean, maximum and standard deviation have also fallen during the analysed period.

Table 5.24 Empirical distribution of the B index

	1992	1993	1994	1995	1996	1997	1998
P-5	0.01	0.01	0.01	0.01	0.00	0.00	0.00
P-10	0.04	0.09	0.05	0.03	0.02	0.01	0.01
P-25	0.31	0.37	0.22	0.25	0.29	0.15	0.15
P-50	1.30	0.85	1.06	0.94	1.09	1.03	0.85
P-75	3.33	3.39	2.67	2.98	2.98	2.27	2.42
P-90	7.45	6.06	5.77	8.06	6.48	4.68	3.36
P-95	11.9	12.14	13.37	10.86	11.55	10.14	7.15
mean	4.86	4.96	4.52	4.66	4.69	3.47	2.84
maximum	116.37	142.99	131.17	131.48	131.94	91.90	78.89
standard deviation	16.00	19.35	17.70	17.70	17.80	12.39	10.60
B<1	0.44	0.51	0.49	0.51	0.44	0.49	0.56
B<2	0.62	0.69	0.62	0.64	0.64	0.73	0.75
B<4	0.78	0.82	0.87	0.85	0.84	0.84	0.91
B<8	0.89	0.91	0.91	0.89	0.91	0.93	0.96

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

The evidence indicates that the global comparative advantage in Hungarian agriculture has worsened in some commodity groups. The proportion of product groups with a B index below one has risen from 44 per cent to 56 per cent between 1992 and 1998, i.e. some product groups have lost their comparative advantage. Furthermore, comparing initial year values with the final values of the last three rows (B<2 – B<8), we may conclude that the level of comparative advantage has also weakened for commodity groups having weak, medium or strong comparative advantage.

The relatively high β values in Table 5.25 reveal trade patterns have not altered considerably from one year to next one. The β/R ratios in the fourth column display that the pattern of revealed comparative advantage has converged. Furthermore, they also suggest that the dispersion in the distribution of B index has been stable. However, the Jarque-Bera tests report non-normality in the error terms for 5 out of the 6 regressions.

Table 5.25 Stability of the B index between 1998 and 1992

	α	β	R	b/R	J-B*
1992	-0.139	0.787	0.863	0.912	13.406
1993	-0.103	0.761	0.802	0.954	3.857
1994	-0.097	0.796	0.834	0.954	11.510
1995	-0.111	0.836	0.909	0.920	13.402
1996	-0.128	0.830	0.882	0.941	6.353
1997	-0.056	0.865	0.931	0.93	114.910

Source: Based on UNCTAD SITC code data at three-digit level.
Note: * Jarque-Bera test: $\chi^2_{2,5\%} = 5.99$.

Those product groups in which Hungary had an RCA in 1992 but an RCD in 1998, or vice versa, accounted for < 22 per cent of total agri-food exports (Table 5.26).[8] Again, this suggests that the structure of Hungary's revealed comparative advantage did not alter dramatically during the 1990s.

Table 5.26 Changes in structure of Hungarian agri-food exports, 1992 and 1998

Index	Percentage share in exports of product groups where:			
	RCA_{92} and RCD_{98}		RCD_{92} and RCA_{98}	
	1992	1998	1992	1998
B	21.6	21.4	0.0	0.3
RTA	3.0	3.0	1.0	1.9
lnRXA	21.6	21.4	0.0	0.3
RC	3.0	3.0	1.0	1.9

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

The transition matrix suggest that the observations on the B index are persistent from 1992 to 1998 for observations with a comparative disadvantage (Table 5.27). Indices in classes b, c and d display a considerable variation in their pattern. There is a zero per cent chance of moving from class a, b or c to class d. The chances for a loss of comparative advantage status for observations with a weak comparative advantage (class b) are high (80 per cent), whilst they are relatively small for observations with medium (class c) and strong (class d) comparative advantage (11 and 17 per cent). The limit distribution suggests a worse case scenario should these trends continue.

Table 5.27 Transition probabilities of B index

B	a	b	c	d
a	0.92	0.04	0.04	0.00
b	0.80	0.10	0.10	0.00
c	0.11	0.56	0.33	0.00
d	0.17	0.08	0.33	0.42
initial distribution	0.44	0.18	0.16	0.22
final distribution	0.58	0.16	0.16	0.09
limit distribution	0.85	0.08	0.07	0.00

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

[8] The results based on B and lnRXA and RTA and RC are the same because of the perfect match under the dichotomous consistency test – see Table 5.22.

5.6 Policy interventions

Mention was made earlier of the problem of using observed trade patterns to identify comparative advantage when, in reality, these trade flows are often distorted by government policies and interventions. This is particularly the case in agriculture, where government support of the industry and explicit use of import restrictions and export subsidies distort trade.

Our main concern is the extent to which government policies might distort indices of revealed comparative advantage. There is a wealth of literature on the welfare gains from agricultural trade liberalisation, e.g. Tyers and Anderson (1988 and 1992) and OECD (1995), which implies that agricultural policies must have an impact on trade flows (i.e. volume) and possibly on trade patterns (i.e. direction). However, Peterson and Valluru (2000) fail to show that government policies significantly affect the pattern of agricultural trade. They conclude that natural factor endowments are of prime importance, as predicted by conventional trade theory, with agricultural policies affecting flows but not underlying patterns. Earlier, Vollrath and Vo (1990) found export performance to be more affected by economic fundamentals than by government intervention, whereas the reverse applied to import behaviour. This led Vollrath (1991) to recommend the use of B and lnRXA in preference to RTA and RC, as mentioned in section 5.2.2. Furthermore, Vollrath (1989) noted that government intervention and competitiveness tend to be inversely related. This suggests that those product groups revealing a comparative advantage could become even more competitive if markets were to become more open. Indeed, one of the stylised facts in the literature of political economy of agricultural policy is that the level of protection and comparative advantage is negatively correlated (e.g. van Bastalaer, 1998, Olper, 2001).

In the specific case of agri-food trade between Hungary and the EU, it may be recalled from chapter 2 (section 2.3) that official Producer Support Estimate (PSE) calculations by the OECD (1999) showed that the level of government support in Hungary was considerably lower than in the EU throughout the period under study. Hungary's total percentage PSE over 1992-98 was 15%, as against 42% for the EU. More specifically, the level of protection in Hungary was lower than that in the EU for all of the main commodities except pigmeat, poultrymeat and eggs. Furthermore, levels of PSE in Hungary were negative for a number of commodities in a number of years. Levels of PSE in Hungary were highest for sugar, milk and eggs; in the EU they were high for all of the land-based commodities. Although the precise effect on trade of the interaction of these levels of government intervention are unknown, a strong case could be made that their combined effect has been to disadvantage Hungary in its trading with the EU. Thus, any comparative advantage revealed by the trade data could well be strengthened in the absence of government intervention.

Ideally, what is needed to resolve the issue of government intervention and the credence placed on any RCA type index is a model which would allow the effects of all government intervention to be removed. This is beyond the scope of the current research. Indeed, it is extremely unlikely that an empirical model could be used at the level of data disaggregation employed here. As mentioned at the start of the chapter, the use of trade data to calculate RCA type indices is popular precisely because of the difficulty in identifying comparative advantage *ex ante*, and the impossibility of observing relative prices in an autarkic situation.

In conclusion, although the issue is not beyond doubt, it is felt that our RCA indices, particularly when used as dichotomous measures, offer a useful guide to underlying comparative and competitive advantage in Hungarian agri-food sectors.

5. 7 Summary and Conclusions

This chapter has presented an analysis of Hungary's agricultural trade in three contexts, based on four different RCA indices calculated for the period 1992 to 1998.

In the first case, when Hungarian agricultural trade performance in EU markets has been investigated using bilateral trade data, all four indices indicate that Hungary has revealed comparative advantages for 5 of the 22 aggregated product groups: live animals; meat; vegetables and fruit; oilseeds; cork and wood. Second, we calculated RCAs at the regional level, with the EU again as the comparator but using total trade data. The indices present a similar pattern, with all four showing a revealed comparative advantage for 11 of the 22 product groups: live animals; meat; cereals; vegetables and fruit; sugar; beverages; oilseeds; cork and wood; crude animal and vegetable materials, animal oils and fats and fixed vegetable oils and fats. Finally, at the global level, Hungary has comparative advantage for 12 of the 21 product groups: live animals; meat; cereals; vegetables and fruit; sugar; miscellaneous edible products; beverages; oilseeds; cork and wood; and animal and vegetable materials, oils and fats.

Our results show that Hungarian comparative advantage has widened across product groups from the bilateral to global contexts. Similar to findings by Richardson and Zhang (1999), analysis of Hungarian RCAs has yielded different results if the benchmark chosen is the EU, the world and, by implication, any other possible aggregation of countries.

These results complement recent studies which, using price and cost based methods, have found that Hungarian arable production is internationally competitive (see section 2.4.2 in chapter 2). Our findings suggest that, in addition, Hungary has a comparative advantage for animal and meat products. Since our calculations are based on observed trade data, attention has been drawn to the possible influence of government-induced distortions in the functioning of international markets. Whilst this is an issue that has been extensively researched, the impact on identification of comparative advantage via RCA indices is inconclusive.

Despite significant changes in Hungarian agriculture during transition, our calculations indicate that the distribution of the RCA indices from 1992 to 1998 has remained fairly stable. A second main observation is that the pattern of comparative advantage in Hungarian agriculture exhibits a declining trend. In other words, Hungarian agriculture has lost comparative advantage for some product groups over time. Another feature of the RCA indices is that their pattern has converged during the analysed period. The stability of the value of RCA indices for particular product groups from the starting period to the ending period displays a less persistent pattern. The results suggest that the B indices are strongly stable from 1992 to 1998 for observations with comparative disadvantage. But, product groups with weak to strong comparative advantage report a significant variation in their pattern.

Our results show that Hungarian agriculture has lost or suffered a worsening in its comparative advantages despite the presence of government support. This is equally true for product groups with high protection levels (milk, eggs, meat, sugar, etc.). This sheds light on the failures of Hungarian agricultural policy. Target and production support and export subsidies may be rational in the short term, but competitiveness can only be improved in the longer term by other means. These include better access to international markets, improving technology and input quality, and encouraging the establishment of marketing institutions.

Finally, two methodological comments are presented here. First, consistency tests suggest that any results need to be interpreted with care. The RCA indices are less satisfactory as cardinal than ordinal or binary measures. Second, despite normalisation of the B index suggested by Dalum et al. (1998) and Laursen (1998) to alleviate the inherent skewness problem, our findings show that normalised B indices also suffer from non-normality problems.

CHAPTER 6 MEASUREMENT OF INTRA-INDUSTRY TRADE

Hecksher-Ohlin-Samuelson trade theory focuses on comparative advantage in the explanation of trade flows where countries exchange products originating from different industries; this is called *inter-industry trade*. However, a considerable proportion of the growth in world trade, especially among developed countries, relates to products belonging to the same industry. Such trade is known as *intra-industry trade*. Tharakan (1985, p. 63.) describes this kind of trade as

"the simultaneous import and export of products which are close substitutes for each other in terms of factor inputs and consumption".

Helpman and Krugman (1989, p.133.) define intra-industry trade as:

"two-way exchange of goods in which neither country seems to have a comparative cost advantage".

In this chapter the concept of intra-industry trade is introduced and different versions of its measurement are discussed. Some potential problems of the most common measures are investigated. Also, some possible recommendations for their improvement are analysed. Finally, the chapter explores recent developments in measuring intra-industry trade. An empirical analysis of intra-industry trade between Hungary and the EU follows in chapter 7.

6.1 Measuring Static Intra-Industry Trade

Different measures of intra-industry trade were available before the seventies (Verdoorn, 1960, Kojima, 1964, Balassa, 1966). However, Grubel and Lloyd (1971, 1975) were the first who discussed explicitly the measurement problems of intra-industry trade. They devoted a separate chapter of their book (Grubel and Lloyd, 1975) to an investigation of indices used in previous studies and then proposed one of their own, thereafter known as the Grubel-Lloyd (GL) index. The GL index is a modification of that which Balassa (1966) used to assess the impacts of the Common Market on the international specialisation of the EEC countries. Balassa's index is calculated as:

$$(1)\ C_j = \frac{|Xj - Mj|}{(Xj + Mj)}$$

where X_j and M_j are the value of exports and imports of product category j in a particular country. Summing across n industries and taking the arithmetic average results in a measure (C) of the extent of a country's *inter*-industry specialisation:

$$C = \frac{1}{n}\sum_{j=1}^{n} C_j .$$

If export and import values are close to each other in each industry, the index is near to zero, which means a high degree of intra-industry specialisation. If exports and imports differ entirely the index approaches unity, and it indicates a low level of intra-industry specialisation. Grubel and Lloyd (1975) criticised the Balassa index for two reasons. First, it fails to reflect the different weights of each industry. Second, it does not take into account the requirement to correct for aggregate trade imbalances. Grubel and Lloyd suggested the following measure, a simple transformation of Balassa's index:

$$(2)\ GL_j = 1 - \frac{|Xj - Mj|}{(Xj + Mj)},$$

or $GL_j = (1 - C_j)$.

This index varies between 0 (complete inter-industry trade) and 1 (complete intra-industry trade). Measures of intra-industry are generally calculated at the three-digit level of the Standard International Trade Classification (SITC). The analysis of intra-industry trade can be extended in two direction. First, at this level of aggregation one investigates the distribution of these indices among all industries. Second, the measure of intra-industry trade can be calculated at a different level of aggregation.

For the first line of analysis, if trade at the three-digit level is small in relation to total trade, a simple mean of the GL index will overestimate the importance of intra-industry trade, as is the case for the Balassa index. Therefore computation of the GL index at the aggregated level needs appropriate weights. Grubel and Lloyd (1975) offer the following formula:

$$(3)\ \ GL = 1 - \frac{\sum |X_j - M_j|}{\sum (X_j + M_j)},$$

or $GL = \sum_{j=1}^{n} GL_j w_j$, where $w_j = \frac{(X_j + M_j)}{\sum_{j=1}^{n} (X_j + M_j)}$.

The measurement of intra-industry trade has two well known shortcomings. The first problem is the treatment of trade imbalances. The second one is the inappropriate grouping of industrial activities.

6.1.1 The Trade Imbalance Problem

The trade imbalance problem arises because the GL index makes no allowance for any imbalance in total trade. When a country has a considerable trade imbalance (deficit or surplus), the GL index will be biased downwards and the true extent of intra-industry trade will be underestimated. Several suggestions have been made as to how to approach this issue; however there is no single solution which has general acceptance in the literature. Grubel and Lloyd (1975) recognised that their measure was biased downward, and therefore suggested that the GL index in (3) should be adjusted for the impact of the overall trade imbalance by calculating intra-industry trade as a share of total trade minus the trade imbalance:

$$(4)\ \ GL_{adj} = \frac{\sum (X_j + M_j) - \sum |X_j - M_j|}{\sum (X_j + M_j) - |\sum X_j - \sum M_j|},$$

or $GL_{adj} = GL/(1\text{-}k)$,

where GL equals (2) and $k = \frac{|\sum X_j - \sum M_j|}{\sum (X_j + M_j)}$.

Comparing (4) with (3), it is clear that the denominator in (3) is reduced by the amount of the total trade imbalance. Consequently, the greater the trade imbalance the greater will be the difference between GL and GL_{adj}. Obviously, if a country's total trade is defined as severely imbalanced, GL_{adj} is the preferred measure.

The numerical example in Table 6.1 illustrates this adjustment. It can be seen from Table 6.1 that GL_{adj} gives a mean level of intra-industry trade of 0.94 compared with 0.71 for the GL index.

Table 6.1 Comparing GL and GL_{adj}

Product groups	X_j	M_j	$\|X_j-M_j\|$
1.	50	30	20
2.	40	50	10
3.	70	40	30
4.	80	40	40
5.	60	20	40
Σ	300	180	140

$$GL=\frac{(480-140)}{480}=0.71$$

$$GL_{adj}=\frac{(480-140)}{(480-120)}=0.94$$

This approach also has some disadvantages. First, it reflects trade imbalances only at an aggregated level, thus it does not take into account that the overall trade imbalance must have an imbalancing effect on particular trade flows. Aquino (1978) pointed out that GL_{adj} is itself a weighted average of the individual product group ratios, GL. But these are also biased downward if country's total trade is imbalanced. Hence, it is not enough to correct the summary formula GL by the total trade imbalance to obtain GL_{adj}; it is necessary to adjust for each GL_j. A second issue is when, for all j, either X_j exceeds M_j

or falls short of it, in which case GL_{adj} equals unity regardless of the size of trade imbalances (Kol and Mennes, 1989).

Both problems are illustrated in the following example (Table 6.2). Two hypothetical cases are shown. In both cases, the overall trade imbalance (surplus) is the same.

Table 6.2 Distortion effects of trade imbalance using GL and GL_{adj}

Product group	Case 1			Case 2		
	X_j	M_j	$\lvert X_j-M_j \rvert$	X_j	M_j	$\lvert X_j-M_j \rvert$
1.	10	5	5	45	5	40
2.	30	15	15	15	15	0
3.	40	20	20	20	20	0
Σ	80	40	40	80	40	40

(Case 1) $GL=\frac{(120-40)}{120}=0.67$, (Case 2) $GL=\frac{(120-40)}{120}=0.67$

(Case 1) $GL_{adj}=\frac{(120-40)}{(120-40)}=1$, (Case 2) $GL_{adj}=\frac{(120-40)}{(120-40)}=1$

The average value of the GL is 0.67 in both cases. But, due to trade imbalance the GL index displays a downward biased estimate of the true level of intra-industry trade. However, using GL_{adj} one obtains 1 in both cases. Aquino argues that the adjustment is correct in the first case, but incorrect in the second case. In the first case, all trade is intra-industry trade and the ratio of exports-to-imports is the same for all product groups. Hence, it is appropriate to adjust the average level of intra-industry trade by the size of the total trade imbalance. But it is not valid for the second case, where there is specialisation towards product group 1 relative to groups 2 and 3. Despite this fact, the value of GL_{adj} is the same in both cases. Also, the numerical example illustrates the second issue. If the total trade balance has the same sign for all product groups, the value of GL_{adj} will be unity regardless of the size of trade imbalances.

To correct for the first deficiency, Aquino (1978) suggested that one should adjust the X_j and M_j values in (3) by a factor representing the aggregate imbalance. He proposed the following method.

$$(5)\ Q=1-\frac{\sum\left|X_{jq}-M_{jq}\right|}{\sum\left(X_j+M_j\right)},$$

where $X_{jq}=X_j\frac{0.5\sum\left(X_j+M_j\right)}{\sum X_j}$ and $M_{jq}=M_j\frac{0.5\sum\left(X_j+M_j\right)}{\sum M_j}$.

The Aquino correction has two advantages over the GL index (Vona, 1991). First, it avoids the problem of correction for overall trade imbalance. Second, it is independent of the values of the expression $\sum_j\left|X_j-M_j\right|$, which makes the GL index dependent on the level of aggregation. However, the Aquino index has also been a subject of criticism. Greenaway and Milner (1981) showed that Aquino's attempt to adjust for trade imbalances is based on the underlying assumption that trade imbalances are spread equiproportionally in all industries. Therefore this procedure may lead to a fall in intra-industry trade in product groups where $X_j=M_j$. Equiproportionality may cause a change in the ranking of industries by the value of intra-industry trade.

Table 6.3 gives an example for the Aquino correction and its distortions. The data used are those in Table 6.2. Q equals unity in the first case and 0.56 in the second case. Contrary to Aquino's intention, in the latter case his formula results in a lower estimate of intra-industry trade than given by the GL index (0.67). Moreover, in the second case, when the assumption of equiproportionality is not valid, the value of Q is lower than the GL index for product groups where $X_j=M_j$. This leads to a change in the ranking of industries according to the value of intra-industry trade.

Table 6.3 Distortion effects of Aquino correction

Product group	Case 1			Case 2		
	X_{jq}	M_{jq}	$\|X_{jq}-M_{jq}\|$	X_{jq}	M_{jq}	$\|X_{jq}-M_{jq}\|$
1.	7.5	7.5	0	33.75	7.5	26.25
2.	22.5	22.5	0	11.25	22.5	11.25
3.	30	30	0	15	30	15
Σ	60	60	0	60	60	52.5

(Case 1) $Q=\frac{(120-0)}{(120)}=1$, (Case 2) $Q=\frac{(120-52.5)}{(120)}=0.56$

However, Tharakan (1984, 1986) argues that Aquino's adjusted values of intra-industry trade indices are highly correlated with unadjusted GL indices. Thus, the choice between two indices for empirical analysis may be not a serious problem.

As Aquino (1978) noted, his measure is equivalent to the Michaely-index (F) (Michaely, 1962):

$$(6)\ F=1-\frac{1}{2}\sum\left|\frac{X_i}{\sum X_i}-\frac{M_i}{\sum M_i}\right|$$

The Michaely index identifies similarity of trade shares rather than the extent of intra-industry trade, and therefore the Aquino measure does the same. The Q index has the same value as long as the proportions of sectoral exports in total exports, and the shares of sectoral imports in total imports, remain unchanged, regardless of the size of sectoral trade flows and of the trade imbalances involved. Hence, this approach yields a similar disadvantage to the one mentioned above in the case of GL_{adj}.

Balassa (1979, 1986) applied an Aquino-type of correction. But he modified the Aquino index, in that only the imbalance in all commodity trade is considered as the basis for correction. Balassa's correction is as follows. All commodity exports and imports are defined, X and M respectively, and the values of exports and imports at the industry level, Xj and Mj, are corrected in the following way:

$$(7)\ X_j^b = X_j \frac{X+M}{2X}$$

$$(8)\ M_j^b = M_j \frac{X+M}{2M}$$

From (7) and (8) it follows that all Xj and Mj are multiplied with the same factor, (X+M)/2X and (X+M)/2M respectively, to yield X_j^b and M_j^b. In the case of an overall trade deficit or trade surplus, all Xj and Mj are increased proportionally. Consequently, the Balassa index, using the Aquino correction, is distributed over sectoral trade flows equiproportionally. Thus, disadvantages arising from equiproportionality are the same, as mentioned above in the case of the Aquino index.

However, Balassa's correction has some distinguishing characteristics compared to the Aquino index. Kol and Mennes (1989), using a numerical example, show that Balassa's correction does not balance trade at the disaggregated level, and that therefore trade balances at the aggregated level have the same size, but different signs. The total amount of trade does not change as a consequence of the Balassa correction, but this may not hold at the disaggregated level. On the other hand, the Balassa correction simulates multilateral trade balance, thus the extent of bilateral intra-industry trade measured between the countries i and j will probably differ when using trade data of country i or country j. Furthermore, the amount of intra-industry trade at the industry level may change using the Balassa correction. Contrary to Balassa's (1979) contention that the Aquino index may overestimate the extent of intra-indutry trade, Kol and Mennes (1989) presented some counterfactual evidence, showing that the level of intra-industry trade decreased using the Aquino index, but increased using the Balassa index, compared to the unadjusted GL index.

Bergstrand (1983, p. 208) pointed out that "a theoretically appropriate measure of intra-industry trade should be constructed from bilateral disaggregate trade flows adjusted to simulate multilateral aggregate trade balance". Bergstrand's procedure is as follows:

X_{ij}^{k} is exports from country i to country j of industry k,

$X_i = \sum_k \sum_j X_{ij}^{k}$ denotes exports from country i to all destinations j in all industries k,

$M_i = \sum_k \sum_j X_{ji}^{k}$ describes imports by country i from all origins j in all industries k,

$X_j = \sum_k \sum_i X_{ji}^{k}$ is exports from country j to all destinations i in all industries k,

$M_j = \sum_k \sum_i X_{ij}^{k}$ is imports by country j from all origins i in all industries k.

The index of intra-industry trade is:

$$(9)\ \ IIT_{ij}^{k*} = 1 - \frac{\left|X_{ij}^{k*} - X_{ji}^{k*}\right|}{\left(X_{ij}^{k*} + X_{ji}^{k*}\right)}.$$

The Bergstrand index is the same as the GL index – apart from the asterix – in industry k for bilateral trade between country i and country j. The asterix denotes that trade flows are corrected for trade imbalance. The Bergstrand correction is defined:

$$(10)\ \ X_{ij}^{k*} = 0.5\left[\frac{(X_i + M_i)}{2X_i} + \frac{(X_j + M_j)}{2M_j}\right] X_{ij}^{k}$$

$$(11)\ \ X_{ji}^{k*} = 0.5\left[\frac{(X_j + M_j)}{2X_j} + \frac{(X_i + M_i)}{2M_i}\right] X_{ji}^{k}$$

Bergstrand (1983) noted that his procedure assumes that the multilateral aggregate trade imbalances affect equiproportionally individual industries, as in the Aquino (and Balassa) correction. The Bergstrand correction is an iterative one. If X_{ij}^{k} is corrected to X_{ij}^{k*} with respect to all industries k and all destinations j (and similarly for X_{ji}^{k}), it is not necessarily the case that these changes yield a situation of balanced trade for all countries, and a new round of corrections is needed. The correction procedure will continue until all countries will be in multilateral trade balance. Bergstrand offered a convergence criterion for iterative computations:

$$(12)\ \frac{\left(X_{ij}^{k*}\right)_{t}-\left(X_{ij}^{k*}\right)_{t-1}}{\left(X_{ij}^{k*}\right)_{t-1}}\leq 0.001.$$

The critics of the Bergstrand correction emphasised that it is very demanding in terms of data processing (Kol and Mennes, 1989), and moreover is rather complicated and time-consuming (Vona, 1991). On the other hand, if research focuses on only bilateral intra-industry trade between two countries, the other countries should be taken into account as a rest of world group. But, in this case, this "country aggregation" should influence the outcome of the Bergstrand correction (Kol and Mennes, 1989). Finally, as a consequence of the correction procedure, the relative situations are significantly changed in the new artificial world of balanced trade, and thus it is not superior to Aquino's proposal (Vona, 1991).

Glejser et al. (1982) offered an entirely different approach to the measurement of intra-industry trade by examining exports and imports separately. They suggested an index for exports as:

$$(13)\ \xi=\frac{1}{n}\sum_{x_j=1}^{n}\log\left(\frac{X_j}{X}\right)/\left(\frac{Xg_j}{Xg}\right).$$

The corresponding index for imports is:

$$(14)\ \mu=\frac{1}{n}\sum_{M_j=1}^{n}\log\left(\frac{M_j}{M}\right)/\left(\frac{Mg_j}{Mg}\right),$$

where subscript g refers to the total trade of a country group (e.g. the EU), subscript j refers to trade in a particular product category, n represents the total number of product groups considered, and variables without subscripts describe a single country. If intra-industry trade specialisation is predominant within the area, one should expect indices to be close to 1 for each product group j. Furthermore, if intra-industry specialisation in product group j is important for any particular country with respect to the reference group, one would expect the variance to be small, as given by:

$$(15)\ \frac{1}{n}\sum_{j=1}^{n}\left(\xi_j-\xi\right)^2=s_\xi^2 .$$

The index (15) can be used to measure whether intra-industry specialisation in product group j has grown over time. If intra-industry specialisation increases over time the variance should be smaller (using an F-test) in the base year than in a subsequent year. Kol and Mennes (1986) compared the Glejser index with other measures which are well known from the literature on intra-industry trade and revealed comparative advantage. They concluded that the Glejser index cannot be considered as an alternative measure of intra-industry trade. It is more appropriate for measuring similarity of trade patterns, where patterns refer to commodity shares rather then trade flows. Greenaway and Milner (1986) reached a similar conclusion: the Glejser index is rather an indicator of competitiveness or comparative performance, than a measure of intra-industry trade.

Greenaway and Milner (1981, p. 759) questioned the whole rationale for trade imbalances on the grounds:

"... we have no a priori knowledge of the particular set of transactions which will be balanced in equilibrium nor do we know the nature and the effects of the (balance of payments) adjustments forces initiated by imbalance."

More recently Vona (1991) pointed out that the adjustment argument is not theoretically sound and leads to an inappropriate adjustment method because it measures similarity of product shares, not trade overlap. His results indicate that the more plausible values of intra-industry trade are generated by the unadjusted GL index. Stone and Lee (1995) argued that the GL index is negatively correlated with overall trade imbalance, hence the estimated coefficients in any regression analysis of trade flows will be biased if the trade imbalance is correlated with any of the explanatory variables in the model. Therefore they followed the proposal by Lee and Lee (1993) and included a measure of trade imbalance as an explanatory variable in their regressions.

In short, there is no consensus among scholars on how to adjust appropriately for trade imbalances when measuring intra-industry trade. The most common procedure in empirical analysis has remained the use of the unadjusted GL.

6.1.2 The Categorical Bias

Perhaps the most controversial issue in the measurement of intra-industry trade relates to the definition of industry used in compiling the data set. Sceptics in the intra-industry trade literature, such as Finger (1975), Lipsey, (1976) and Rayment (1976) argued that almost all measured intra-industry trade is arising only from categorical aggregation in the compiling of international data bases. The main problem relating to categorical aggregation is when product groups are misclassified because the products that constitute the group have differing factor ratios. In other words, they have different production functions within the same product group categories. This obviously yields a distorted measure of intra-industry trade at the aggregated level.

The categorical bias consists of two conceptually distinct components: an opposite sign effect and a weighting effect (Gray, 1979). The opposite sign aspect of categorical aggregation occurs when sub-group industries at a lower level of aggregation have offsetting trade imbalances, i.e. if sub-group trade imbalances have opposite signs. This results in an inflated value of the GL index.

The weighting effect relates closely to the opposite sign effect. If the sub-group trade imbalances have the same signs for all product groups, the GL index should be a sum of the individual trade weighted sub-group indices. However, this is not true if sub-groups' trade imbalances have opposite signs. Furthermore, there is good reason to believe that misclassification may appear itself if in opposite-signed sub-group imbalances. Consequently, the opposite sign effect and weighting effect can offset each other (Greenaway and Milner, 1983).

There is a possible solution of cleansing data of categorical bias by reclassifying basic data such that the resulting categories conform to a theoretical definition of an industry. Balassa (1966) regrouped similar three and four-digit SITC data into 91 industries according to the substitutability in production. Aquino (1978) reclassified 2, 3 and 4-digit data into 25 industries on the basis of technological intensity.

The main difficulty with this option is that the definition of an "industry" with respect to product homogeneity is still under dispute. There are two basic approaches to identifying an industry. One concentrates on production, the other on consumption. Finger (1975) defined an industry as being where the products produced are similarly related to their factor intensities. Similarly, Falvey (1981) focused on the specificity of factors and described an industry by the range of products that a particular type of capital equipment can produce.

In the second approach, contrary to previous definitions, Lancaster (1980, p. 153.) looked at the consumption side:
"...a product class in which all products, actual and potential, possess the same characteristics, different products within the group being defined as products having these characteristics in different proportions".

By contrast, Krugman (1979) defined an industry producing differentiated consumer products by a group of commodities which are arguments of a sub-utility function, $u(x_1, \ldots, x_n)$ where n is the finite number of such products in the group. Consequently, an industry is defined only if all consumers in the world economy have the same preferences with respect to grouping of products.

It is clear from the previous discussion that there is no unique criterion for regrouping the data. Furthermore, as Greenaway and Milner (1983) highlighted, none of these definitions copes appropriately with the problem of how to allocate trade in parts and components in any reclassified scheme. In short, it is ambiguous whether the regrouping would yield any improvement on established trade classification systems. This raises the question: how to evaluate the impact of categorical aggregation? Greeneway and Milner (1983, 1986) offered three procedures by which one can attempt to identify the influence of categorical bias.

First, the most well known method for evaluating the effect of categorical aggregation is to investigate the development of GL indices at the different aggregation levels (Grubel and Lloyd, 1975; Gray, 1979; Pomfret, 1979). One could expect that the unweighted average level of GL indices to decrease as one disaggregates. The fall in the average level of intra-industry trade from one digit level to another could be an indicator of the presence of categorical bias. However there is no absolute standard as to how one should evaluate the correct significance of any decrease in the GL index from a higher aggregation to a lower one. Thus, as Greenaway and Milner (1983) noted, this test is more suggestive than conclusive.

The second procedure is to test the sensitivity of GL indices based on alternative trade classification systems. This evaluation requires that trade data are available on both Standard Industrial Classification (SIC) and SITC systems. The classification of SIC is based rather on the distinction between industries according to process characteristics, whereas the SITC system emphasises product characteristics. Furthermore, the two data sets can be mapped onto each other, which can enable the comparison of GL indices based on the two different trade classification systems. The similarity of, and consistency in, the ranking of GL indices presents some further evidence for the level of aggregation used.

The third, and more formal and systematic, method for evaluation of the extent of categorical bias is to calculate an adjusted GL index in (16) at the third digit level (Greenaway and Milner, 1983):

$$(16)\ GL_{adj} = 1 - \frac{\sum \left| X_{ij} - M_{ij} \right|}{\sum \left(X_{ij} + M_{ij} \right)},$$

where j is the jth of n industries at a given level of aggregation and i denotes the component of sub-group categories at the j-1 level of aggregation. If all fourth-digit trade imbalances have the same signs then $GL=GL_{adj}$, and if they have differing signs, then $GL_{adj}<GL$. Consequently, there is the following relationship between the two indices:

$$(16a)\ 0 \leq GL_{adj} \leq GL \leq 1.$$

The numerical example in Table 6.4. illustrates the proposal by Greenaway and Milner (1983). Assume a three-digit level commodity group j, which contains three four-digit product groups A, B and C.

Table 6.4 An Example for the Greenaway-Milner method

Product subgropus	X_j	M_j	$\lvert X_j - M_j \rvert$	Trade balance sign
A	15	15	0	0
B	50	30	20	+
C	10	20	10	-
Σ	75	65	30	+

$$GL = \frac{140-10}{140} = 0.93$$

$$GL_{adj} = \frac{140-30}{140} = 0.79$$

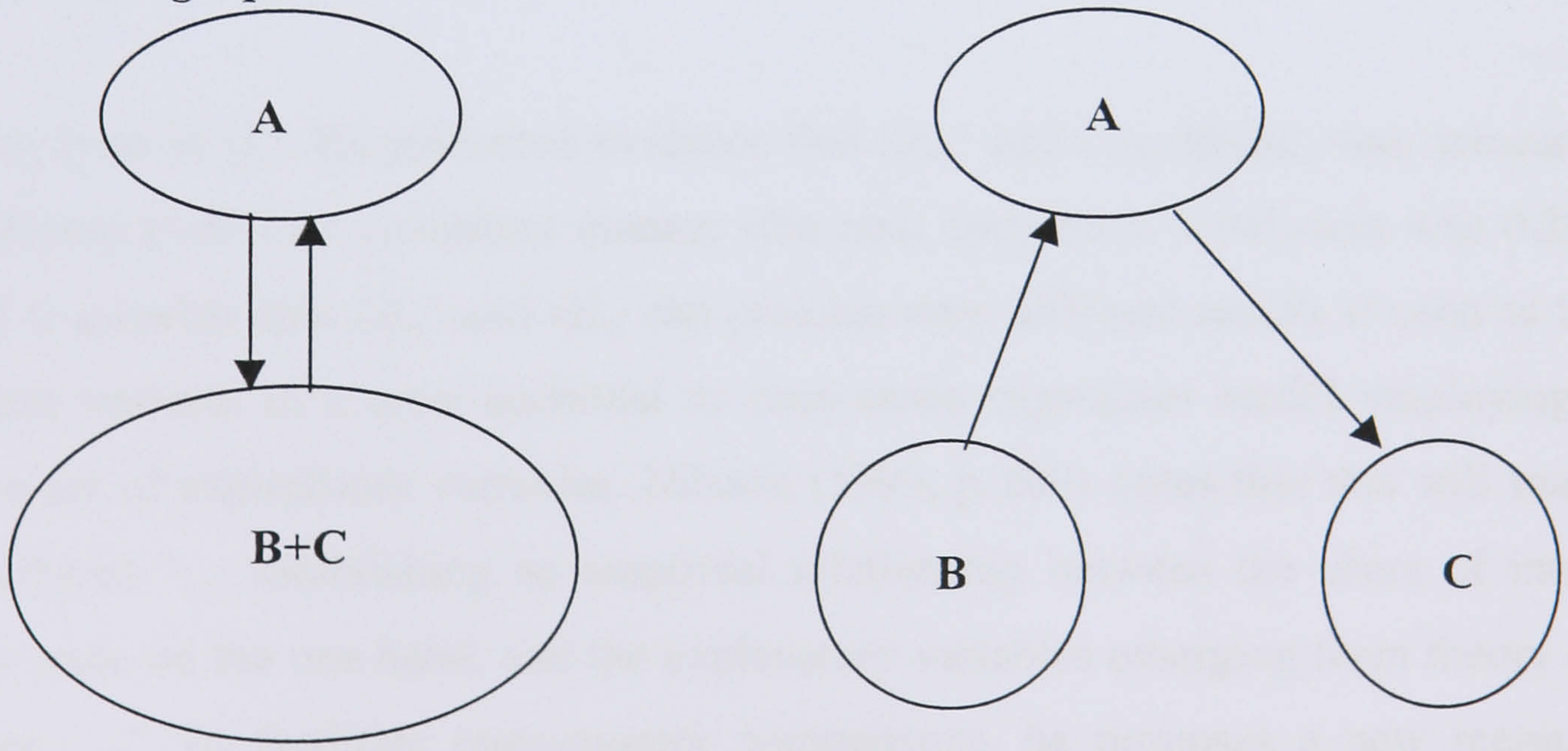
The conventional Grubel-Lloyd formula for measuring intra-industry gives the level of intra-industry trade for commodity group j as 0.93. It is obvious that some aggregation bias exists because the product subgroups have different signs. The extent of aggregation bias may be calculated by employing the formula for GL_{adj}. It can be seen from Table 6.4 that the value of this index is 0.79, somewhat lower than the GL measure. The difference indicates the degree of aggregation bias.

This adjustment approach proceeds on the assumption that categorical aggregation is related to the opposite signs of trade imbalances at lower levels of aggregation. But, if this initial assumption is not valid, then the adjusted GL index will also be a biased measure of intra-industry trade. In the absence of prior information about where categorical bias exists, one cannot select between the two indices for an appropriate measure of intra-industry trade.

6.1.3 Geographical Bias

Geographical bias arises when different countries are put together as a basis of calculating intra-industry trade (Fontagné and Freundenberg, 1997). Figure 6.1 illustrates this problem. Assume that country A trades a particular product group with countries B and C. If countries B and C are put together as a single trade bloc, then the trade between A and B+C will be perfect intra-industry trade. However, investigating the trade flows between A, B and C countries on a strict bilateral basis, we can observe only one-way trade, namely A imports from B and exports to C.

Figure 6.1 Geographical bias



As we can see, the sign of trade (exports or imports) may change for each partner, therefore an aggregation of these trade flows for the same product group will yield multilateral intra-industry trade, which is only an artificial phenomenon. Consequently, in empirical research intra-industry trade should be calculated on a pure bilateral basis.

6.1.4 The Degree and Level of Intra-Industry Trade

The GL index suffers from an additional shortcoming. Rajan (1996) highlights the importance of distinguishing between the *degree* of intra-industry trade, as measured by the GL index, and the *level* of intra-industry trade, which can be defined as total trade (X+M) minus inter-industry trade, or the trade imbalance, |X-M|. Rajan demonstrates that the standard GL index fails to correctly reflect the level of intra-industry trade in the presence of trade imbalance, i.e. there may be a high GL index but a low level of intra-industry trade.

This problem is strictly related to the weighting considerations of the GL index. Milner (1988) pointed out that the GL index is appropriate for comparing inter-industry differences in the share of intra-industry trade in each industry's total trade, but it is not suitable for measuring the absolute amount of two-way trade and to compare this on an inter-industry basis. For the purpose of comparing absolute amounts of intra-industry trade between two industries he suggested the following:

(17) $GL_j' = GL_j w_j$,

where w_j is as in (3). He presented evidence that GL_j' and GL_j do not rank measured intra-industry trade in a consistent manner (the rank correlation coefficient was 0.28). Thus, it is possible that GL_j' and GL_j can produce very different results if used as the dependent variable in a cross-sectional or time-series regression model employing a common set of explanatory variables. Nilsson (1999, p 109) notes that this will make more difficult "... establishing an empirical relationship between the share of intra-industry trade on the one hand, and the explanatory variables emerging from theory on the other, ..." To facilitate inter-country comparisons, he proposes a new measure (Nilsson, 1997 and 1999). The bilateral level of intra-industry trade between two countries i and j is divided by the total number of products they trade with each other. This procedure yields an average level of intra-industry trade per product as follows:

(18) $IITp_{ij}$=Level of IIT_{ij}/Number of products traded.

This measure can be applied at various levels of aggregation. According to Nilsson (1999) the main advantage is in facilitating the comparison of the extent of intra-industry trade between large and small countries, hence displaying a less biased picture of the level and the degree of intra-industry trade compared to use of the GL index. Furthermore, Nilsson (1997) presents evidence that his index and the actual level of intra-industry trade are highly correlated, therefore making it an appropriate proxy for the level of intra-industry trade.

6.2 Vertical and Horizontal Intra-Industry Trade

The definition of intra-industry trade emphasises "two-way trade in similar products". Therefore, in empirical work it is necessary to define what is meant by "similar" products and "two-way" trade. The similarity of product groups also has significance from theoretical point of view. An important distinction exists in the theoretical literature between horizontal and vertical product differentiation. The former occurs when different varieties of a product are of a similar quality, the latter when different varieties are of different qualities. The significance of this distinction arises from the fact that different industry and country characteristics may relate to trade in the different types of product (Greenaway et al. 1994 and 1995). There is a vast literature on intra-industry trade, both empirical and theoretical, but many of these studies have supposed that traded products are mainly horizontally differentiated. Although some models were developed in the early stages of intra-industry trade theory associated with vertically differentiated products (e.g. Falvey, 1981, and Falvey-Kierzkowski, 1985), empirical investigations employing regression analysis usually have not distinguished between vertically and horizontally differentiated products.

There exists an additional reason for the underlying importance of vertical intra-industry trade. Namely, it has some potential concerns for welfare analysis of economic integration (Blanes-Martinez, 2000). Intra-industry trade models based on horizontally differentiated products predict low adjustment costs from regional integration. However, adjustment costs can differ significantly for vertically differentiated products, for two reasons. First, the factor content of exports and imports may be different, as with inter-industry trade (Greenaway and Hine, 1991). Second, the poorest countries tend to produce the lower quality varieties, whilst higher quality varieties are produced by richer countries. If intra-industry trade exists, the lower quality products may be displaced by higher quality products (Shaked and Sutton, 1994; and Motta, 1992). This could cause the bankruptcy of firms in the poorest countries, and thus unemployment. If these negative impacts could not be compensated by growth in consumer welfare arising from lower prices and access to higher quality products, then negative effects will dominate in the poorest countries.

6.2.1 Distinguishing Vertical and Horizontal Intra-Industry Trade

It is clear from the previous discussion that it is necessary to have appropriate measures for horizontal and vertical intra-industry trade. Over the last decade several methods have been developed for measuring the two types of intra-industry trade based on product similarity. Cooper et al. (1993) applied a hedonic regression to identify the relative importance of a range of product characteristics in influencing price. But, as the authors stressed, this method is very data intensive and is more satisfactory for the analysis of a particular product than for a multi-product investigation.

A second approach is to infer quality differences from measurement of demand elasticities among products from different sources. Following this procedure, Brenton and Winters (1992) investigated the effects of the common market for Germany, and interpreted the low demand elasticities of domestically produced items compared to demand elasticities for imports as an indicator for their higher quality.

Unit values, which measure the average price of a particular item, can also be used for analysing product quality in trade data. The underlying assumption for applying the unit value as an indicator of quality is that relative prices are likely to reflect relative qualities (Stiglitz, 1987). However, using unit value as a measure of quality has some disadvantages. High price can be associated with imperfect information. In the short run, consumers may buy high price items due to inertia of ignorance or because it is costly to shift to other suppliers (Oulton, 1991). Despite these drawbacks, price may be a satisfactory measure of quality because it is a reasonable source of information about consumer assessments of products.

Unit values can be calculated in several ways: per item, per tonne, per square metre, etc. The computation of unit values in any way has some problems (Greenaway et al., 1994). First, unit values per item can be associated with size as well as other characteristics which are more closely related to quality, like durability and reliability. However, the latter attributes can be inversely associated with size, causing interpretation problems. Nevertheless, this disadvantage of unit values as an indicator of quality may be not a serious problem for a wide range of products.

Second, unit values per tonne are also problematic. A higher quality product may be made out of heavier material, therefore its unit price per tonne is lower than that of an inferior quality product made out of lighter material. Although Greenaway et al. (1994) cite an investigation where the unit values per item and unit values per tonne are highly correlated, there is no unambiguous evidence that unit price per item and unit price per tonne are highly associated.

Third, the unit values of two bundles of products may differ for two reasons. First, prices of individual products may differ between the two bundles. Second, the mix of products may differ in such a way that one bundle has of a higher share of higher quality goods. Thus, the unit values of two bundles need to be adjusted for individual price differences in individual items in the bundles.

Despite the shortcomings, unit values have became a common indicator for the measurement of horizontal and vertical intra-industry trade. Abd-el-Rahman (1991) proposed first using unit values per tonne to distinguish horizontally and vertically differentiated products. His method was developed by Greenaway et al. (1994, 1995). They defined trade flows that are horizontally differentiated as being where the spread in the unit value of exports, relative to the unit value of imports, was less than 15 per cent at the five-digit SITC level. Where relative unit values were outside this range products were considered as vertically differentiated. It is assumed that transport and other freight costs do not cause a difference in export and import values of more than 15 per cent. Formally, bilateral trade of horizontally differentiated products includes goods i, where unit values of exports (UV_i^x) and imports (UV_i^m) for a particular dispersion factor (α=0.15) satisfy the following condition:

$$(19)\ 1-\alpha \leq \frac{UV_i^x}{UV_i^m} \leq 1+\alpha.$$

Similarly, bilateral trade flows of vertically differentiated products are defined where the relative unit value of exports and imports is outside this range:

$$(20)\ \frac{UV_i^x}{UV_i^m} < 1-\alpha, \text{ or } \frac{UV_i^x}{UV_i^m} > 1+\alpha.$$

As mentioned earlier, vertical intra-industry trade records specialisation in varieties of different qualities that may require different factor intensity and/or technical knowledge. Blanes and Martin (2000) define high and low vertical intra-industry trade as follows. When the relative unit value of a good is below the limit of 0.85, it is treated as low vertical intra-industry trade. Where the unit value ratio exceeds 1.15, it indicates high vertical intra-industry trade.

Furthermore Abd-el-Rahman (1991) and Greenaway et al. (1994, 1995) have demonstrated that the classification a products as horizontally or vertically differentiated does not change considerably when the spread is increased from 15 to 25 per cent

Empirical intra-industry trade studies implicitly assume that all simultaneous exports and imports may be considered as a two-way trade, independent of the extent of the difference in value between exports and imports. However, Fontagné and Freundenberg (1997, p. 30) define two-way trade more strictly:
"Trade in an item is considered to be "two-way" when the value of the minority flow (for example imports) represents at least 10 % of the majority flow (exports in this case)".

In other words, trade overlap in product j is defined if the following condition is satisfied, where X and M describe the value of exports and imports:

$$(21)\ \frac{\text{Min}(X_j, M_j)}{\text{Max}(X_j, M_j)} \geq 10\%$$

When the minority trade flow is below this level, it cannot be considered sufficiently important to be a structural feature of trade.

If trade flows for a given product between two partner countries satisfy the two conditions of similarity (horizontally differentiated good) and trade overlap, one may identify both exports and imports as intra-industry trade in similar products. Applying the two criteria to total trade for a particular year, one can distinguish three types of trade (Table 6.5):

(i) intra-industry trade in horizontally differentiated products (significant trade overlap and low unit value differences; first column and first row)

(ii) intra-industry trade in vertically differentiated products (significant trade overlap and high unit value differences; first column and second row)

(iii) inter-industry trade (no, or not significant, trade overlap; second column).

Table 6.5 Distinguishing trade types

Minority flow / Unit price	10 per cent	<10 per cent	Total
15 per cent	Horizontal two-way trade	One-way trade	Total horizontal trade
> 15 per cent	Vertical two-way trade	One-way trade	Total vertical trade
Total	Total two-way trade	Total one-way trade	Total trade

Noteworthy is that this trade classification by Fontagné and Freundenberg (1997) rejects the Grubel and Lloyd based dividing line between inter-industry trade and intra-industry trade. If the minimum condition of two-way trade is fulfilled, both exports and imports are treated as of two-way trade, being horizontal or vertical intra-industry trade, otherwise trade flows are described as one-way (inter-industry) trade. Using this method, total trade can be classified according to these criteria, with both imports and exports being part of one and the same category. Contrasting with the Grubel and Lloyd related methodology, each of these three trade types may contain a trade deficit or surplus.

6.2.2 Measuring Vertical and Horizontal Intra-Industry Trade

Following an analogy with computation of the standard GL index, matched bilateral trade flows of horizontally differentiated products are calculated at a very disaggregated level of product categories (e.g. five-digit level of SITC) and then summed for a given sub-sector to obtain the numerator of the horizontal GL index. A corresponding procedure is applied for vertically differentiated product categories. Greenaway et al. (1994, 1995, 1999) employ two approaches to identify vertical and horizontal intra-industry trade:

(22a) $$GL_j = 1 - \frac{\sum \left| X_{ij}^{p} - M_{ij}^{p} \right|}{\sum \left(X_{ij}^{p} + M_{ij}^{p} \right)},$$

(22b) $$GL_j = \frac{\sum (X_{ij}^{p} + M_{ij}^{p}) - \sum \left| X_{ij}^{p} - M_{ij}^{p} \right|}{\sum \left(X_{ij} + M_{ij} \right)},$$

where p refers to horizontally (H) or vertically (V) differentiated products, and i denotes five-digit SITC goods in a particular three-digit industry (j). Equations 22a and 22b differ in their denominator (total horizontal/vertical trade and total trade, respectively).

Total intra-industry trade (A_j) can be divided into horizontal intra-industry trade (HA_j) and vertical intra-industry trade (VA_j):

(23) $A_j = HA_j + VA_j$.

It is important to note that the sum of horizontal and vertical bilateral intra-industry trade is not necessarily the same as total bilateral intra-industry trade, due to undetermined unit vales of exports and imports that can not be identified as bilateral trade of either horizontally differentiated products or vertically differentiated goods.

The approach suggested by Fontagné and Freundenberg (1997) yields different measures of vertical and horizontal intra-industry trade from the proposal by Greenaway et al. (1994, 1995, 1999) in equations 22a and b. They define the share of two-way trade (TWT) as follows:

$$(24)\ TWT = \frac{\sum (X_{ij}^{p} + M_{ij}^{p})}{\sum (X_{ij} + M_{ij})},$$

The numerical example in Table 6.6 illustrates these differences in measuring various trade types. The top half of the table displays a country's trade relations for a particular product with four partners (A, B, C and D) and the bottom half the various indices.

Table 6.6 Numerical example for various indices.

Partner	Value		PD	Balanced trade		Total trade		Trade types		
	X	M		H	V	H	V	HTWT	VTWT	OWT
A	30	20	H	40		50		50		
B	40	10	H	20		50		50		
C	5	120	V		10		125			125
D	125	50	V		100		175		175	
Total	200	200		60	110	100	300	100	175	125

Summary statistics and indices

		(Equation 22a and b)			(Equation 24)		
		H	V	H+V	HTWT	VTWT	OWT
Values	Balanced trade	60	110	170			
	Total trade	100	300	400	100	175	125
Indices	(Equation 22a)	0.60	0.37	0.425			
	(Equation 22b)	0.15	0.275	0.425			
	Trade types				0.25	0.438	0.313

Note: Total trade: (X+M)

Balanced trade: (X+M)-|X-M|

PD: Product differentiation

H: horizontal product differentiation

V: vertical product differentiation

HTWT: horizontal two-way trade

VTWT: vertical two-way trade

OWT: one-way trade

Equation 22a yields 0.60 for horizontal intra-industry trade and 0.37 for vertical intra-industry trade. In that case, the total intra-industry trade (TIIT) is a weighted mean of the two. Table 6.6 illustrates that: TIIT: (100/400)*0.6+(300/400)*0.37=0.425. Employing equation 22b we obtain the same results for total intra-industry trade, but different values for horizontal and vertical intra-industry trade (0.15 and 0.275). In our example, horizontal intra-industry trade is four times more important in the calculation based on equation 22a (0.60) than when using equation 22b (0.15). Furthermore, the horizontal intra-intra trade dominates vertical intra-industry trade in first case, whereas the reverse is true for the second case. The results based on equation 22b suggest that the two-way trade is more important in vertical than horizontal trade. But this arises from the simple fact that the volume of vertically differentiated trade is larger than that a horizontally differentiated trade. The diverging results based on various methodologies in Table 6.6 shed light on the importance of the choice of a particular index, when we test econometrically the predictions of intra-industry trade theory. This is especially true when the empirical investigation relates directly to a horizontally or vertically differentiated intra-industry trade model.

Table 6.7 summarises these different measures of intra-industry trade, taking into account product differentiation. The denominator is different between equation 22a and the equation 22b, as we mentioned before. We note that the total intra-industry trade index, based on equations 22a and 22b, is the same (degree of total intra-industry). The common attribute of these indices is that they measure both inter-industry trade and intra-industry trade. In other words, the dividing line between inter-industry trade and intra-industry trade is within the same trade flow. Fontagné and Freundenberg (1997) point out that Grubel-Lloyd related measures focus on the intensity of overlap in trade, whilst their proposal concentrates on the relative importance of each of the various trade types in all trade. Therefore the two approaches are more complementary than substitutes. As a final point, it is important to note that all of the distinctions between horizontal and vertical intra-industry trade presented above are also subject to the criticism by Nilsson (1997, 1999). In other words, these measures fail to reflect correctly the *level* of horizontal and vertical intra-industry trade.

Table 6.7 Different measures of IIT taking into account product differentiation

	Horizontal (H)	Vertical (V)	Total
Equation 22a	$\frac{BT^H}{TT^H}$ Degree of horizontal IIT	$\frac{BT^V}{TT^V}$ Degree of vertical IIT	$\frac{BT^H + BT^V}{TT^H + TT^V}$ Degree of (horizontal and vertical) IIT
Equation 22b	$\frac{BT^H}{TT^H + TT^V}$ Proportion of horizontal IIT in total trade	$\frac{BT^V}{TT^V + TT^H}$ Proportion of vertical IIT in total trade	$\frac{BT^H + BT^V}{TT^H + TT^V}$ Degree of (horizontal and vertical) IIT
Equation 24	$\frac{TT^H}{TT}$ (HTWT) Share of two-way trade in horizontally differentiated products in total trade	$\frac{TT^V}{TT}$ (VTWT) Share of two-way trade in vertically differentiated products in total trade	$\frac{TT^H + TT^V}{TT}$ (TTWT) Share of two-way trade in total trade

Note: Total trade: TT=(X+M)

Balanced trade: BT=(X+M)-|X-M|

Source: Fontagné and Freundenberg (1997, p. 40).

6.3 Marginal Intra-Industry Trade and Adjustment Costs

Balassa (1966) was the first to claim that observed growth in intra-industry trade may indicate that the negative impacts of adjustment to freer trade have been generally overestimated. The effects of closer integration on trade depend on whether trade is of an inter-industry or intra-industry nature. Whereas the former indicates a reallocation between industries, the latter suggests a reallocation within industries, and thus factor substitution may proceed at relatively low adjustment costs. The assumption that intra-industry trade leads to lower costs of factor-market adjustment than inter-industry trade is referred to as the 'smooth-adjustment hypothesis' (Brülhart, 1999, 2000) [9]. It had been implicitly assumed in the literature on trade liberalisation that a high level of static intra-industry trade (GL index) was positively correlated to low adjustment costs. The traditional GL index is most appropriate for measuring an industry's trade pattern in a single period of time, in other words the GL index is a static indicator of intra-industry trade. But adjustment cost is a dynamic phenomenon. Consequently, the GL index can not be a suitable measure of adjustment cost. Therefore recent theoretical developments in measuring intra-industry trade stress the importance of the concept of *marginal* intra-industry trade.

Marginal intra-industry trade is used to interpret the adjustment cost of trade liberalisation. Several marginal intra-industry trade (MIIT) indices have been developed in recent years.

The first, and up to the mid 1990s most commonly used technique, is the difference in the GL indices for different time periods:

$$(24)\ \mathrm{MIIT_{GL}} = \Delta GL = GL_t - GL_{t-n} = \left(1 - \frac{|M - X|}{(M + X)}\right)_t - \left(1 - \frac{|M - X|}{(M + X)}\right)_{t-n},$$

where M denotes imports, X is exports, t is the end year and n is the number of years separating the base and end years.

However this method has some drawbacks as theoretical research in the last decade has highlighted. First, Hamilton and Kniest (1991) argued that the growth in inter-industry trade flows can be caused by an increase in the GL index, when an increase in inter-industry trade will reduce the trade balance in the measured sector. Consequently, comparison of the GL indices between two time periods can be misleading for analysing the structure of the change in trade flows. But Brülhart (1994) noted that despite this shortcoming, time-series analysis of corresponding GL indices can be meaningful when the object of the research is to compare the structure of trade at different points in time. Another drawback of the intertemporal comparison of the GL indices emerges in the

[9] Lovely and Nelson (2000) question this informal assumption and show that within a general equilibrium

case of the one-country analysis. The growth in GL indices over time could indicate both the erosion of a net exporting position or the balancing of a sectoral deficit. Obviously, the two options have quite different implications for adjustment in a particular sector or country.

Thus, Hamilton and Kniest (1991) proposed the following measure of MIIT:

(24) $MIIT_{HK}$: $\frac{X_t - X_{t-n}}{M_t - M_{t-n}}$ for M_t-M_{t-n} > X_t-X_{t-n} > 0

$\frac{M_t - M_{t-n}}{X_t - X_{t-n}}$ for X_t-X_{t-n} > M_t-M_{t-n} > 0

undefined for X_t<X_{t-n} or M_t<M_{t-n},

where X_t (M_t) and X_{t-n} (M_{t-n}) are exports (imports) of a given industry in years t and t-n, and n denotes for the number of years separating the two years of measurement.

This method overcomes the first failure of the $MIIT_{GL}$ index in analysing the change of trade structure. But, Greenaway et al. (1994) noted that undefined observations, due to decreasing exports or imports between two points in time, can lead to a non-random omission of a considerable number of statistical observations in the sample, and hence to misleading results. Furthermore, Hamilton and Kniest (1991) claimed that any situation where their index was undefined, as recording a growth in exports and a fall in imports (or vice versa), suggests inter-industry trade. However, their measure is also undefined when both exports and imports decrease, and in this situation should be presented as MIIT. In short, contrary to the intentions of the authors, their index does not report any information about the structure of MIIT, when the index is undefined.

Greenaway et al. (1994) stressed that the $MIIT_{HK}$ index takes into account only the changes in nominal value of exports and imports. If, between two periods of time, inflation occurs in an economy, then this measure will be biased upwards. But, as Brülhart (1994) noted, this issue is valid for all MIIT indices, and consequently export and import data should be adjusted for inflation.

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context IIT can induce inter-industry adjustment.

Greenaway et al. (1994) suggested another measure of MIIT:

$$(25)\ MIIT_{GHME}=[(X+M)-(X-M)]_t-[(X+M)-(X-M)]_{t-n}$$

or $MIIT_{GHME}=\Delta[(X+M)-|X-M|]$.

This index, in contrast to the $MIIT_{HK}$ measure, is always defined. However it suffers from the same problem as $MIIT_{GL}$. Brülhart (1994, 1999) argued that the $MIIT_{GHME}$ index is similar to the $MIIT_{GL}$ index, because it reflects the difference of GL indices between two periods. Hence the $MIIT_{GHME}$ index is also an inaccurate measure for the assessment of the structural change in trade patterns. Consequently, the criticism of Hamilton and Kniest is also valid for the method of comparison of the GL index. But Brülhart noted that the $MIIT_{GHME}$ measure does differ basically from the $MIIT_{GL}$ and $MIIT_{HK}$ indices in that it shows intra-industry trade in absolute values rather than as a proportion. As a consequence of this feature, the $MIIT_{GHME}$ measure, in contrast to traditional indices, cannot reflect the ratio of marginal intra-industry trade relative to inter-industry trade. However, it might be scaled by production or sales in a given industry, which is important for the analysis of the adjustment process.

Brülhart (1994) recommended the following index of MIIT:

$$(26)\ A_j=1-\frac{|\Delta Xj-\Delta Mj|}{|\Delta Xj|+|\Delta Mj|},$$

where the individual variables (X_j and M_j) have the same meaning as in the case of GL index and Δ is the difference of trade flows between two years. Like the GL index, the values of the A_j index vary between 0 and 1, the extreme values meaning that the change in trade flows in commodity group j is perfectly attributed to inter-industry trade (0) or intra-industry trade (1). The A index can be aggregated, as with the GL indices, by using the following formula:

$$(27)\ A_{tot} = \sum_{j=1}^{n} w_j A_j ,$$

$$\text{where } w_j = \frac{|\Delta X|_j + |\Delta M|_j}{\sum_{j=1}^{n}\left(|\Delta X|_j + |\Delta M|_j\right)},$$

and where A_{tot} is the weighted average of MIIT over all industries of the economy, or over all the sub-industries of an industry described by j.

As with to the $MIIT_{HK}$ measure, the A index records the structural change in trade flows. However, the A index is always defined, in contrast to $MIIT_{HK}$, and it has many of the familiar statistical properties of the GL index. The A index is relevant first of all for multilateral studies relating to the overall adjustment process. But its usefulness is limited for one-country studies, due to its inability to provide any information about the distribution of trade-induced gains and losses among countries or sectors.

Therefore Brülhart (1994) proposed another index:

$$(28)\ B = \frac{\Delta X - \Delta M}{|\Delta X| + |\Delta M|},$$

where $|B| = 1 - A$.

The values of the B measure range between –1 and 1. The B index is two-dimensional; it provides information about both the share of MIIT and country-specific sectoral performance. First, B is equal to zero when marginal trade in a particular industry is perfectly intra-industry in type, whereas at both –1 and 1 it records inter-industry type marginal trade. Second, sectoral performance is defined as the change in exports and imports in relation to each other, hence B is directly related to sectoral performance. When B>0, ΔX is $>\Delta M$ and when B<0, ΔX is $<\Delta M$. However, unlike the A index, B cannot be aggregated across industries. The B index is relevant for industry-industry assessment of MIIT and sectoral performance.

Following Hamilton and Kniest (1991), Brülhart (1994) also recognised that adjustment costs depend on changes in trade flows. His approach supposes that growth in exports over a particular period matched by a similar increase in imports does not lead to factor reallocation. This assumption indicates therefore that matched changes in trade may not be related to high adjustment costs.

Brülhart (1994) suggested a third method of accounting for matched changes in trade:

(29) $C = \left(|\Delta X| + |\Delta M|\right) - |\Delta X - \Delta M|$,

which can be scaled at the disaggregated level:

(30) $C_V = \frac{C}{V}$,

where V is any relevant scaling variable, e.g. gross trade, production, sales or employment. Brülhart emphasised that the C index has three advantages compared to the $MIIT_{HK}$ measure. First, it is defined for all cases. Second it can be scaled with any relevant variable. Finally, it can be aggregated across industries to produce true sectoral aggregates.

The A index has become the most popular measure in recent empirical studies of marginal intra-industry trade (e.g. Fidrmuc et al. 1999, Brülhart and Hine, 1999, Brülhart and Thorpe, 2000). Although Brülhart's measure of marginal intra-industry trade overcomes various problem associated with earlier attempts (e.g. Hamilton and Kniest, 1991, Greenaway et al. 1994), this index has been also criticised.

Oliveras and Terra (1997) investigated two statistical properties of the A index which are different from those of the GL index. They pointed out that there is no general relationship between the A index of a certain period and the corresponding index of its sub-periods. They also found that there is no general relationship between the A index of a given industry and corresponding indices of its sub-industries. Consequently, results based on the A index are very sensitive to period choice and aggregation level. In other words, there are weak, or no, connections among A indices for the whole period in question and for its sub-periods. Therefore, Oliveiras and Terra (1997) suggested that it is necessary to select a period when there are no significant swings in the time series trade data. Also, it is highly recommended that the MIIT be measured at different levels of aggregation, in order to reduce the chance of incorrect interpretation of the adjustment process of an industry compared to all its sub-industries.

Menon and Dixon (1997) criticised the C index because it does not indicate the amount of trade change requiring inter-industry factor movements. Therefore they proposed the following index which focuses on *un*matched or *inter*-industry trade:

$$(31)\ \ \mathrm{UMCIT} = |\Delta X - \Delta M|.$$

This measure also can be scaled and aggregated. Menon and Dixon (1997) presented situations when Brülhart's measure does not respond to different inter-industry factor movements, while UMCIT does. Hence, they argued that although the C index is a good indicator of the amount of trade change, it is inappropriate to account for inter-industry factor movement. They found very weak correlation, or correlation with an unexpected sign, between UMCIT and any of Brülhart's indices. In sum, they concluded "it is unlikely that measures of matched changes in trade could be useful as indicators of adjustment costs" (p. 168). Brülhart (1999) argued that C and UMCIT have a disadvantage, namely they are difficult to interpret in isolation because they can not present any information about the share between intra- and inter-industry trade, which is crucial for the definition of intra-industry trade.

Dixon and Menon (1997) developed two indicators for measuring factor market disruption due to trade growth. First, they defined the following index:

$$(32)\ \ \mathrm{Ciit}_j = \frac{\Delta\left[\left(X_j + M_j\right) - \left|X_j - M_j\right|\right]}{\left(X_j + M_j\right)}.$$

This index provides an accurate measure of the increase in intra-industry trade relating to total trade growth. But the authors emphasised that it can be misleading, when the research focus is on adjustment costs arising from trade growth, because this index will tend to overestimate the contribution of an increase in non-disruptive trade. To avoid this problem they suggested a new measure:

$$(33)\ \mathrm{Cdiit}_j = \frac{\left[\left(\Delta X_j + \Delta M_j\right) - \left|\Delta X_j - \Delta M_j\right|\right]}{\left(X_j + M_j\right)}.$$

This index records the contribution of dynamic intra-industry trade or matched trade. Dixon and Menon (1997) proved that Ciit_j is never less than Cdiit_j, and may often be larger. Moreover, they illustrated with Australian manufacturing data that the bias in Ciit_j is considerable, therefore using both indices is preferable for analysing factor market disruption.

As mentioned earlier, intra-industry trade can be classified in two forms – horizontal and vertical. Conventionally, the former occurs when products are differentiated and consumers express preferences for product variety, the latter arises when different varieties offer different levels of quality. Thom and McDowell (1999) argued that whilst Brülhart's A index is an appropriate measure of horizontal intra-industry trade, it cannot distinguish between horizontal and vertical intra-industry trade. Hence, it may underestimate the importance of intra-industry trade and overestimate the importance of adjustment costs. This offers a further insight into the link between MIIT and adjustment costs, because vertical IIT is associated with factor endowments and specialisation and is therefore closer to inter-industry trade. However, Thom and McDowell (1999) define vertical IIT in an unconventional way, as involving the separation of the processes by which a final good is produced, that is, where the production process is vertically disintegrated, e.g. the production of feed wheat and beef cattle in agriculture; horizontal IIT is defined, more conventionally, as occurring when consumers express preferences for product variety. Effectively, this distinction requires MIIT to be measured at both the industry and sub-industry levels. Their method of classifying horizontal and vertical MIIT is as follows. A_w, the weighted version of Brülhart's index is calculated over the N sub-industries that comprise industry j,

$$(34)\ A_w = \sum_{i=1}^{N} Aiwi,$$

where w_i are appropriate weights.

A_j measures total marginal intra-industry trade.

$$(36)\ Aj = 1 - \frac{|\Delta Xj - \Delta Mj|}{\sum_{i=1}^{N} |\Delta Xi| + \sum_{i=1}^{N} |\Delta Mi|},$$

where $X_j = \sum_{1}^{N} Xi$ and $M_j = \sum_{1}^{N} Mi$. A_w is signed horizontal marginal intra-industry trade, and A_j-A_w is defined as vertical marginal intra-industry trade.

Thom and McDowell (1999) presented some empirical evidence on the importance of the distinction between vertical and horizontal MIIT using the above indices to analyse trade flows between the EU and three Central-European countries. But they noted that calculation of these indices is not sufficient to draw definitive conclusions on adjustment costs arising from trade liberalisation. The main reason for this is that empirical investigation of trade flows is always subject to the criticism that the data set may not relate to the underlying economic frontiers between industries defined in terms of end-use. Therefore any results must be interpreted with care due to distortions in definition of industries in trade data.

6.4 Summary

To summarise on the measurement of IIT, a considerable amount of work has been undertaken in three streams. First, the early period of intra-industry trade research focused on searching for an appropriate measure of static intra-industry trade. Despite great efforts to improve the classic GL index, the unadjusted version of the GL index has remained the most accepted measure of static intra-industry trade. A second line of research is targeted at distinguishing vertical and horizontal intra-industry trade. The procedure established by Greenaway et al. (1994) based on unit values enjoys wide acceptance in the literature. Finally, research has concentrated on the relationship between intra-industry trade and adjustment costs. In the past decade a number of indices have been developed for measuring marginal intra-industry trade. Thus far there is no agreement among scholars as to which index is best, but Brülhart's indices have became popular in empirical analysis.

CHAPTER 7 EMPIRICAL ANALYSIS OF INTRA-INDUSTRY TRADE IN HUNGARIAN AGRI-FOOD PRODUCTS

Following the discussion of the theoretical basis for the measurement of intra-inudstry trade in chapter 6, this chapter investigates intra-industry trade in agri-food products between Hungary and the EU over the period 1992-1998. The first section reviews empirical studies on intra-industry trade in agri-food products. The second section analyses the pattern of intra-industry trade, including use of the classic Grubel-Lloyd index, and measures of vertical and horizontal intra-industry trade, and of marginal intra-industry trade. The third section attempts to identify the determinants of Hungary's intra-industry trade in agri-food products with the EU. The final section summarises the main findings of the empirical analysis.

7.1 Empirical Studies on Intra-Industry Trade in Agri-Food Products

Empirical studies of intra-industry trade for agricultural and food products fall into two groups. The first group includes studies which provide documentary evidence for the level of intra-industry trade. The second group concentrates on whether the existing level of intra-industry trade is confirmed by the predictions of theory. Until now empirical investigations on intra-industry trade in agri-food industries have focused almost exclusively on US and EU trade.

7.1.1 The Levels of Intra-Industry Trade

McCorriston and Sheldon (1991) investigated the extent of intra-industry trade for highly processed food products for the US and the EU. They calculated the volume of intra-industry trade at the three-digit SIC level using an adjusted version of the Grubel-Lloyd index for the US, the EC-9, the rest of the OECD and the EC excluding intra-EC trade, for 1986. They found that US trade in processed food products was characterised by inter-industry specialisation with the exception of trade with Canada. However, EC trade was characterised by intra-industry specialisation, which was mainly due to intra-industry trade within the EC. They offered some explanations for this different specialisation between the US and the EC, but without econometric investigation of the determinants of intra-industry trade. They emphasised the importance of distance from foreign markets, especially for the EC case, in which economic integration, proximity to community countries and other European markets due to geographical patterns, and economic links with ex colonial countries as factors that influenced trade. They also stressed the role of proximity for the pattern of intra-industry trade between the US and Canada. They suggested that growth in US foreign direct investment in the processed food sector could be an explanation for the relatively lower level of intra-industry trade for the US. However, the considerable extent of foreign investment in the US food sector by European firms undermines this statement to some extent.

A more recent study by Handy et al. (1996) for the US processed food sector provides a detailed picture of intra-industry trade for 1994, using an unadjusted Grubel-Lloyd index based on four-digit SIC data across 48 industries. The results show that the values of the index exceeded 0.5 for 26 industries. In the processed food industry across all 48 industries, the trade-weighted average of intra-industry trade was 57 per cent, which indicated a significantly higher level of trade overlap than McCorriston and Sheldon (1991) reported for the US food industry for 1986. The level of intra-industry trade varied significantly by industries. Industries with higher indices were those with a greater level of processing. Intra-industry trade with the most important trading partners (NAFTA, EC, South America and a group of Asian countries) for the US was also calculated. The Grubel-Lloyd index exceeded 0.5 for 28 industries in US-NAFTA trade, 15 industries in US-EU trade, 11 industries in US-Asian trade and 8 industries in US-South-American trade. Comparison across regions indicates that geographical proximity, participation in a custom union, regions with similar factor endowments and similar economies are positively related to intra-industry trade in the processed food industries.

Quasmi and Fausti (1999, 2001) investigate NAFTA's impact on intra-industry bilateral trade in agricultural and food products. They focus on bilateral trade among US, Canada and Mexico and their trade with rest of the world between 1990 and 1995. They presented documentary evidence for the nature of the intra-industry trade, but without econometric tests on the determinants of intra-industry trade. They find that bilateral intra-industry trade in food products has increased since the NAFTA agreement, but this growth differed across product groups. The increase of intra-industry trade was higher for food products where greater processing was involved. But inter-industry trade played a substantial role for the US in bulk commodities which require little processing. Consistent with the predictions of intra-industry trade theory, US trade with Canada is dominated by intra-industry trade, but US and Canadian trade with Mexico is dominated by inter-industry trade. While Mexican intra-industry trade in food products has been enhanced with its North American partners since the implementation of NAFTA, in relative terms, it has been minimal compared to the significant growth in intra-industry trade between the US and Canada. However, US. intra-industry trade as a percentage of the total value of trade with the rest of world decreased sharply from 1990 to 1995, while the absolute value of total trade in food products grew significantly. The authors offered two possible explanations. First, the absolute advantage of the US in the production of these particular food products has grown. Second, America's intra-industry trade has shifted towards Canada and Mexico due to the NAFTA.

Van Berkum (1999) investigates the patterns of intra-industry trade in agri-food products between the EU and ten Central-European countries for the period 1988-1997. He used the unadjusted Grubel-Lloyd index to measure intra-industry trade at the three-digit level of SITC. The results show that the level of intra-industry trade was relatively high, almost 0.4. In the first years of the analysed period the index was rather moderate, 0.2, but later increased to about 0.4, and then stabilised around this level. Vertical intra-industry trade was dominant in total intra-industry trade throughout the period. This suggests that bilateral trade between the EU and Central European countries was characterised by increasing EU exports of high quality products, while exports by Central European countries focused mainly on lower quality products. He pointed out that this implies a further division in specialisation of agricultural production between the two regions. In other words, Eastern and Western European agriculture became increasingly complementary in nature. However, the pattern of intra-industry trade between the EU and Central European countries as a whole differs significantly by countries. The level of intra-industry trade was relatively high for five countries (Bulgaria, Czech Republic, Hungary, Poland and Slovenia) compared to the Baltic States. The share of intra-industry trade in total trade during the analysed period has grown sharply in Hungary, Poland, Romania and Slovakia, while it was high at the beginning of the period in the case of Bulgaria, Czech Republic and Slovenia. EU countries also showed different patterns of intra-industry trade. The Grubel-Lloyd index for Germany with Central European countries displayed continued growth. France showed a lower level of intra-industry trade at the beginning and end of the period, after some years of increase. The Netherlands recorded the highest index in the first years but then displayed a continuous fall.

7.1.2 Hypothesis Testing for the Determinants of Intra-Industry Trade

Hirschberg et al. (1994) analysed the determinants of intra-industry trade in food processing for a panel data set of thirty countries over the period 1964-1985. This study differs from previous investigations by employing a weighted tobit model with fixed effects to account for the censored cross-section time-series nature of the data. Intra-industry trade was calculated by both adjusted and unadjusted versions of the Grubel-Lloyd index. Their econometric analysis focused on country-specific factors in explaining intra-industry trade. Explanatory variables included bilateral inequality between GDP per capita, index of the size differential of the GDP, GDP per capita, absolute value of the annual proportional change in the exchange rate between the reporting and partner country, distances between countries, common borders, and membership in the same custom area. The results of this study provide support for two predictions of the Helpman and Krugman (1985) model; that the level of intra-industry trade is positively correlated to countries' GDP per capita and to the equality of GDP per capita between countries. They also noted that membership of a custom area or free trade area and a common border increase the extent of intra-industry trade. The long-run exchange rate variation and distance had negative effects on intra-industry trade. However, the latter effect becomes less obvious at certain distances, which may be due to economies of scale in transportation over some distances.

Hirschberg and Dayton (1996) investigated the patterns of intra-industry trade in each processed food product under SIC=20 level (SIC=Standard Industrial Classification), in contrast to aggregating over all processed food industries, as in Hirschberg et al. (1994). However, they followed the form of the regression estimated in Hirschberg et al. (1994), thus explanatory variables were inter-country comparisons of capital/labour ratios, difference between sizes of the economies, distance between trading partners, long-term fluctuations in exchange rates, common borders and membership in custom union/free trade zones. They estimated forty-nine separate models, one for each of the sectors. But the interpretation of their results is complicated due to the number of parameters estimated (92 per sector), hence a specialised form of cluster analysis is employed. Their findings were similar to those of the earlier study conducted by Hirschberg et al. (1994). However they found some different results: GDP size did not have a significant effect on intra-industry trade for a majority of sectors, and nine of twenty parameters for GDP per capita variables had a negative sign, contrary to IIT theory. The cluster results were similar to the regression estimates, and also strongly supported the Helpman and Krugman hypotheses, but with several exceptions; the parameters on both the inequality between GDP size and GDP per capita were not significantly different from zero.

Chirstodolou (1992) attempted to determine factors explaining cross-country differences in the level of intra-industry trade in the EEC meat and meat products industries in the late 1980s. The explanatory variables used to test specific hypotheses were country-specific factors on the demand side of the market and industry-specific factors on the supply side. Country-specific variables were market size, taste overlap and market proximity; industry-specific factors included product differentiation, scale economies, market structures, technological progressiveness and processing stage. Market size and taste overlap were expressed by GDP and GDP per capita in purchasing power parity, respectively. The Hufbauer index was used to approximate the degree of product differentiation. Scale economies were used to measure the minimum efficient scale of operation compared to the size of the market. The proportion of turnover accounted for by the largest firms was used as a proxy for the market structure. Technological progressiveness was measured by the proportion of wages on the value added by the firm's operations. Intra-industry trade was calculated by unadjusted versions of the Grubel-Lloyd index. The results suggest that taste overlap and geographical proximity on the demand side, and imperfect competition on the supply side were the most important factors in explaining intra-industry trade in the EEC meat market. Interestingly, intra-industry trade was more significant for raw products (and for highly processed products) than for lightly processed products. Christodolou argued this could be due to countries trading in raw material for their processing activities and then re-trading highly processed products.

Hartman et al. (1993) examined the determinants of variation across industries in levels of intra-industry trade for a sample of 36 processed food and beverage industries for the US in 1987. Intra-industry trade was calculated at the four-digit level of SIC using the unadjusted Grubel-Lloyd index. The average level of the index was 0.329, but it varied substantially by product groups. A large per cent of categories (44 per cent) displayed a near zero value and only 11 per cent of all product groups were between 0.8 and 1. Based on the earlier empirical studies, they employed a reduced-form model explaining variation in the level of intra-industry trade across product groups and tested this using OLS regression. Explanatory variables were product differentiation, concentration, economies of scope, similarity of tariffs, economies of scale, categorical aggregation, seasonality, and degree of integration of an industry into the global economy. The results suggested that cross-industry variation in intra-industry trade in the US for 1987 was positively related to product differentiation, economies of scope, and similarity of trade barriers, and negatively correlated to industry concentration. The other variables were statistically insignificant.

Pieri et al. (1997) examined the determinants of intra-industry trade in the EU dairy products industry during 1988-92. They assessed both the country-specific and industry-specific factors in explaining bilateral trade flows. Country-specific variables included taste overlap, market size, market proximity, trade imbalance; industry specific factors were product differentiation, market structure, raw material availability and scale economies. In addition they used retailing-specific factors: the average degree of retail concentration within a pair of countries and its degree of inequality. The values of unadjusted Grubel-Lloyd indices showed that intra-industry trade was rather high only for some pairs of countries. They were higher than 0.5 for 17 pairs out of 55 in 1988 and 22 in 1992. The results indicate that the European dairy market consists of two integrated groups of countries. The first one contains France, Belgium-Luxembourg, the Netherlands, Germany and Denmark; the second one constitutes Greece, Spain and Portugal. The Grubel-Lloyd indices were higher than 0.6 within both groups. The results of this study suggest that variables indicating equality between the two countries are positively related to the level of intra-industry trade. In other words, the level of intra-industry trade is greater, the more similar are the countries. The industry-specific variables indicated that the presence of large firms with an absolute cost advantage over small firms stimulates intra-industry trade through increasing non-price competition. Surprisingly, concentration in the retail sector had a negative effect on intra-industry trade, contradicting the *a priori* expectation.

De Frahan and Tharakan (1998) were the first to investigate horizontal and vertical intra-industry trade in the European processed food industry. They classified total intra-industry trade into horizontal and vertical intra-industry trade to determine the relevance to each of the country-specific and industry-specific factors. Their sample included bilateral trade of the EU with major partner countries for 18 food, drink and tobacco industries for 1980 and 1990. Following previous empirical studies for manufacturing sectors (e.g. Greenaway et al. 1994, 1995), the study used unit values as a proxy for product quality to determine whether trade flows are based on vertically differentiated or horizontally differentiated products. The econometric results were consistent with the horizontal intra-industry trade models. Average market size and the average level of economic development of the trading partners, trade preferences, location advantage and horizontal differentiation of the sub-sector all have positive effects on the level of horizontal intra-industry trade. Factor endowment and market size differences between pairs of countries, and scale economies of the sub-sectors, have negative effects on the level of horizontal intra-industry trade. In the case of vertical intra-industry trade, they found a positive effect on its level related to the average size of the trading partners, the location advantage, and vertical differentiation of the sub-sector. Scale economies of the sub-sector and per capita income differences had negative effects on vertical intra-industry trade. The latter contradicts the theory, and did not support the hypothesis that vertical intra-industry trade can be explained by differences in factor endowments or scale economies.

Chang et al. (2001) analysed the patterns and determinants of the level of intra-industry trade in the agri-food sector between Taiwan and ASEAN-5 (Indonesia, Malaysia, the Philippines, Thailand and Singapore) between 1970 and 1995. Intra-industry trade was computed at the four-digit level of SITC employing the unadjusted Grubel-Lloyd index and the Aquino measure. They found that bilateral intra-industry trade between Taiwan and ASEAN-5 had increased during the analysed period. They attempted to identify both country-specific and industry-specific determinants of the level of intra-industry trade. Country-specific variables were market size, taste overlap, degree of openness, the inequalities of economic size and resource endowment. The results indicated that market size had a positive and significant effect on the level of intra-industry trade. The inequalities in market size and resource endowment are negatively related to the level of intra-industry trade, but most of the estimates were not significant. Taste overlap effect was negative and significant which is inconsistent with the *a priori* expectation, whilst the influences of degree of openness were ambiguous. Industry-specific variables included degree of product differentiation of the export and import goods measured by the Hufbauer index, and tariff level. Surprisingly, product differentiation of export commodities were negatively related to the level of intra-industry trade, whilst product differentiation of import commodities had a positive but insignificant effect on the level of intra-industry trade. The negative signs associated with import tariff were consistent with the theory, but they unfortunately were insignificant.

7.1.4 Summary

In summary, these recent empirical studies have focused on describing trade flows and exploring the possible determinants of IIT. The growing importance of IIT for processed foods among developed countries is confirmed by empirical studies. The results support the view that IIT is increasing and determined mainly by distance between partner countries and membership of a free trade area or similar. Market size, market structure, GDP measures and taste overlap may be important, but are not unambiguous as explanatory variables. There would also appear to be a relevant distinction between horizontal and vertical IIT. Despite recent efforts, this research area thus far is underdeveloped. There is still a large gap between the theory of IIT in terms of distuinguishing of horizontal and vertical IIT, and empirical studies on food products.

7.2 The Pattern of Intra-Industry Trade between Hungary and the EU in Agri-Food Products

7.2.1 Traditional Measure of Intra-Industry Trade

Once again, we focus on Hungary's agricultural trade with the fifteen member states of the EU during the period 1992-98. In calculating levels of intra-industry trade, all trade flows refer to those between Hungary and each of the EU countries, i.e. bilateral flows.

Following the literature, we use the unadjusted Grubel-Lloyd index to identify the extent of intra-industry trade. A high level of intra-industry trade between two countries suggests an advanced degree of economic integration and a high level economic development. Thus, 'the catching-up' of Hungary to the development level of industrial countries and its integration into the EU can be expected to increase intra-industry trade. The Association Agreement between Hungary and the EU, which has brought about a partial trade liberalisation, should also have a positive effect on intra-industry trade according to the prediction of theory.

Table 7.1 displays Grubel-Lloyd indices of Hungarian agricultural trade with the member states of the EU over the period of 1992 and 1998. First, there is an upward trend in intra-industry trade, but values of the GL indices are relatively low, below 0.3. Second, at the more aggregated level (EU-15) the value of GL index is higher, as we would expect. Third, the level of intra-industry trade varies significantly among EU member countries across years. The coefficient of variation by countries has fluctuated between 60 and 82 per cent. The value of the GL index is relatively high in Austria, Netherlands, France and Germany, and below 0.1 in Italy, Spain, Greece and Ireland over the period in question. These results indicate that there are significant differences in the structure of intra-industry trade development between EU countries and Hungary. In other words, the EU is not homogeneous with respect to trade with Hungary. The differences imply that an increase in trade between Hungary and the EU will affect member countries differently.

It is interesting to note from casual inspection of Table 7.1 that, contrary to the prediction of intra-industry trade theory, taste overlap appears not to be a good explanatory factor. Hungary's GL indices with rich EU member countries (e.g. Austria, Germany, Netherlands, France) are relatively high, while in the cases of poorer EU member countries they are extremely low, except Portugal (1993 and 1996-97).

Noteworthy also is that Italy has a low value of the GL index (<0.1), although it is one of the most important trading partners for Hungary. Conversely, in some years Finland (1998) and Portugal (1993, 1996-1997) have relatively high levels of GL indices (>0.22), although these countries have no significant role in Hungarian agricultural trade. As was explained in chapter 6, the value of the GL index and the *level* of intra-industry trade do not necessarily correspond.

Table 7.1 Grubel-Lloyd indices of Hungarian agri-food trade

Year	1992	1993	1994	1995	1996	1997	1998
Austria	0.20	0.18	0.25	0.27	0.21	0.24	0.25
Belgium	0.11	0.15	0.17	0.08	0.09	0.08	0.15
Denmark	0.13	0.16	0.07	0.05	0.06	0.13	0.06
Finland	0.05	0.02	0.08	0.01	0.02	0.06	0.23
France	0.09	0.12	0.14	0.10	0.14	0.16	0.21
Germany	0.12	0.13	0.15	0.13	0.13	0.14	0.15
Greece	0.01	0.00	0.01	0.01	0.02	0.01	0.01
Ireland	0.00	0.01	0.00	0.04	0.00	0.02	0.03
Italy	0.04	0.04	0.05	0.04	0.05	0.07	0.09
Netherlands	0.14	0.16	0.16	0.16	0.17	0.23	0.20
Portugal	0.01	0.23	0.00	0.11	0.28	0.22	0.14
Spain	0.03	0.02	0.03	0.02	0.01	0.03	0.04
Sweden	0.02	0.04	0.06	0.06	0.09	0.13	0.08
UK	0.07	0.04	0.07	0.05	0.07	0.14	0.09
EU15	0.17	0.18	0.27	0.22	0.21	0.23	0.25

Source: Author's calculations based on SITC data at the four-digit level, aggregated using trade share weights.

The level of intra-industry trade in agricultural trade is low compared to the manufacturing sector. The value of GL indices between Hungary and EU-10 from 1990 to 1996 in the manufacturing sector ranged between 0.47 and 0.57 (Fidrmuc, 2000). The pattern of intra-industry trade was similar for selected EU countries (Austria, Germany, Italy, Netherlands and Sweden); their GL indices fluctuated between 0.42 and 0.64 in 1996 (Fidrmuc et al. 1999).

Grubel-Lloyd indices are also calculated by commodity groups, based on four-digit level data, which are then aggregated to the two-digit level (Table 7.2). The indices do not exhibit a clear pattern, but vary by year and by product group. However, there are some commodity groups with high values: dairy products; coffee, tea, cocoa; feedstuff for animals; tobacco; hides, skins; textiles fibres; crude animal and vegetable materials; and animal oils and fats.

Table 7.2 Grubel-Lloyd indices of Hungarian agri-food trade with the EU by product group, 1992-98

SITC product group – two digit level	1992	1993	1994	1995	1996	1997	1998
00: Live animals	0.06	0.06	0.08	0.06	0.08	0.09	0.17
01: Meat and meat preparations	0.04	0.15	0.24	0.16	0.07	0.12	0.16
02: Dairy products and birds' eggs	0.25	0.21	0.31	0.43	0.44	0.24	0.54
03: Fish, crustaceans, molluscs	0.05	0.05	0.15	0.14	0.08	0.09	0.09
04: Cereals and cereal preparations	0.21	0.35	0.39	0.18	0.29	0.25	0.19
05: Vegetables and fruits	0.12	0.16	0.22	0.18	0.17	0.22	0.18
06: Sugar, sugar preparations and honey	0.28	0.18	0.17	0.15	0.19	0.26	0.38
07: Coffee, tea, cocoa, spices,	0.55	0.45	0.46	0.58	0.45	0.41	0.38
08: Feedstuff for animals	0.52	0.38	0.36	0.37	0.54	0.45	0.44
09: Miscellaneous edible products	0.18	0.21	0.17	0.29	0.29	0.19	0.14
11: Beverages	0.21	0.19	0.15	0.10	0.17	0.16	0.17
12: Tobacco and tobacco manufactures	0.42	0.33	0.54	0.12	0.37	0.23	0.24
21: Hides, skins and furskins, raw	0.62	0.77	0.80	0.56	0.56	0.69	0.78
22: Oil seeds and oleaginous fruits	0.07	0.04	0.12	0.21	0.05	0.09	0.36
23: Crude	0.10	0.05	0.12	0.21	0.11	0.45	0.49
24: Cork and wood	0.14	0.12	0.10	0.09	0.11	0.13	0.13
26: Textiles fibres and their wastes	0.24	0.25	0.25	0.29	0.32	0.61	0.61
29: Crude animal and vegetable materials,	0.46	0.41	0.39	0.42	0.50	0.55	0.48
41: Animal oils and fats	0.16	0.39	0.48	0.60	0.37	0.57	0.35
42: Fixed vegetable oils and fats, crude, refined or fractionated	0.04	0.02	0.03	0.10	0.07	0.19	0.35
43: Processed Animal and vegetable oils and fats	0.14	0.13	0.11	0.06	0.05	0.07	0.06
59211/12 Starch	0.43	0.49	0.92	0.41	0.00	0.22	0.04

Source: Author's calculation based on SITC data at four-digit level, aggregated to two-digit level using trade share weights.

Table 7.3 displays summary statistics (mean and coefficient of variation) for GL indices by commodities for Hungarian agricultural trade with the EU. The mean value of the GL indices has ranged between 0.176 and 0.205. The coefficient of variation is relatively high and its pattern is fairly stable.

Table 7.3 Statistical description of Grubel-Lloyd indices by commodities

	1992	1993	1994	1995	1996	1997	1998
mean	0.191	0.185	0.198	0.178	0.188	0.176	0.205
coefficient of variation (%)	150.3	141.9	142.1	151.5	143.7	169.3	139.7

Source: Author's calculation based on SITC code data at four-digit level.

Table 7.4 summarises this information in a frequency distribution. It suggests that the more significant changes occurred in the middle range of the GL indices (0.4 to 0.6), where the share of products more than doubled between 1992 and 1998. The shares in the lower and upper ranges of the frequency distribution tended to decline.

Table 7.4 Frequency distribution of Grubel-Lloyd indices of Hungarian agri-food trade with the EU, 1992-98 (per cent)

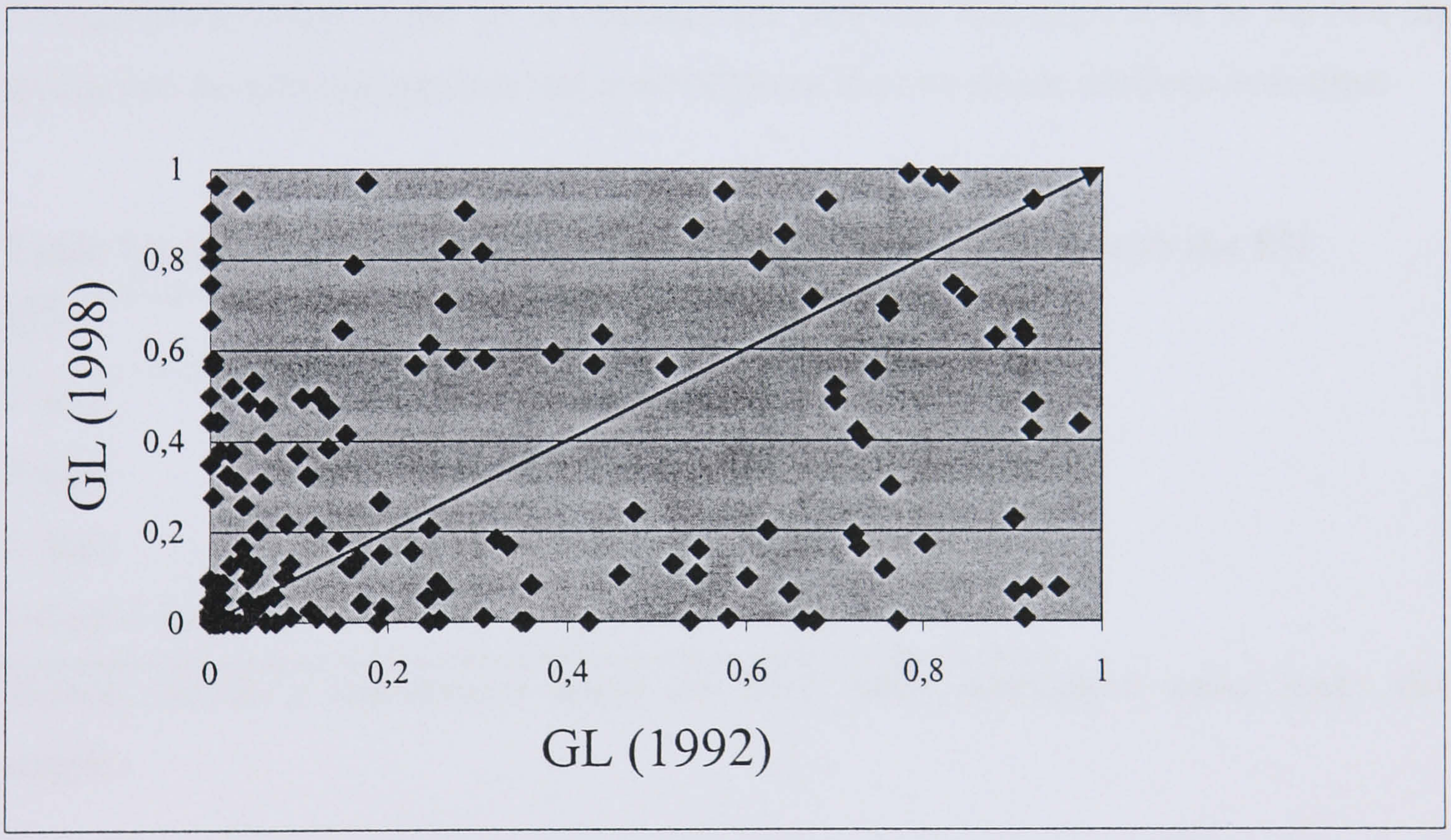
GL index	1992	1993	1994	1995	1996	1997	1998
0.0 - 0.2	71.0	68.3	67.0	71.3	67.9	69.4	67.4
0.2 - 0.4	8.6	11.8	11.8	9.1	11.4	12.2	8.2
0.4 - 0.6	5.1	8.6	8.7	7.8	7.1	8.2	11.4
0.6 - 0.8	8.6	7.0	5.5	5.8	9.8	5.1	6.2
0.8 - 1.0	6.7	4.3	7.0	5.9	4.0	5.1	6.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Author's calculations based on SITC data at the four-digit level.

However, a different picture emerges if we present the GL indices for 1992 and 1998 in the form of a scatter diagram, with the horizontal axis representing 1992 values and the vertical axis the corresponding 1998 values (Figure 7.1). A point lying on the leading diagonal indicates that no change has occurred in the value of the GL index between

1992 and 1998. A point that lies above (below) the diagonal represents an increase (decrease) in the GL index over the two years. The vertical distance between the diagonal and any point above (below) it represents the absolute increase (decrease) in the GL index over the period. Significant changes occurred in the pattern of IIT between 1992 and 1998; there are only a small number of points close to the diagonal. Although Table 7.4 suggests that there is very little change in the lower end of distribution, the scatter diagram displays a different picture. Many products with a GL index of between <0.2 in 1992 reveal a much higher index in 1998, and likewise many products with higher indices in 1992 moved into the <0.2 range in 1998. These gross movements counter each other, such that there is little change in the frequency distribution.

Figure 7.1 Scatter Diagram for GL indices (1992, 1998)



Source: Author's calculation based on SITC code data at four-digit level.

From Table 7.4, there is no change in the share (6.7 per cent) of products in the upper end of the distribution (0.8-1.0), but again Figure 7.1 reveals a number of high-to-low and low-to-high movements. This relatively high variance in the pattern of IIT between Hungary and the EU reflects perhaps that economic restructuring is still much in evidence.

The measuring of intra-industry has two major problems, both well known. The first is the treatment of trade imbalances. As we mentioned in the previous chapter, several suggestions have been made as to how to approach this problem, however none has general acceptance in the literature. The adjusted GL index is calculated to check whether trade imbalance is problem for our dataset. Results suggest that adjusted GL indices are higher than unadjusted GL indices. But there is a high correlation (0.81) between adjusted and unadjusted GL indices.Therefore, the choice between two indices for empirical analysis may not be a serious problem. The second problem is the inappropriate grouping of industrial activities. Following Greenaway and Milner (1983, 1986), the influence of categorical bias is assessed by the use of two approaches. First, GL indices are calculated at different levels of aggregation. Table 7.5 shows that the values of the GL indices increase with the higher level of aggregation, as we expect. The growth in value of the GL is considerable from the four-digit level to the two digit levels, but the relative gap (see last row) between the two levels declines over time.

Table 7.5 Grubel-Lloyd indices of Hungarian agri-food trade with the EU

SITC	1992	1993	1994	1995	1996	1997	1998
4-digit	0.17	0.18	0.27	0.22	0.21	0.23	0.25
3-digit	0.31	0.36	0.39	0.36	0.31	0.34	0.36
2-digit	0.35	0.44	0.49	0.42	0.38	0.40	0.40
2-digit/4-digit	2.01	2.46	1.82	1.89	1.82	1.78	1.64

Source: Author's calculations based on SITC data, aggregated using trade share weights.

The second, and more systematic, method for evaluating the extent of categorical bias is to compare the adjusted GL index with the unweighted GL index at the three-digit level of statistical aggregation. Table 7.6 shows that the value of the adjusted GL index is lower than that for the classic GL index for all main product categories (SITC 0-2, 4). One notable feature of the table is the significant variance in the value of both conventional and adjusted GL indices by product groups and over time. Our results suggest that a considerable categorical bias exists.

Table 7.6 Evaluation of categorical bias

		1992	1993	1994	1995	1996	1997	1998
Index	'SITC product group'							
GL	0	0.35	0.55	0.64	0.47	0.42	0.49	0.52
	1	0.82	0.88	0.96	0.96	0.81	0.69	0.76
	2	0.48	0.49	0.56	0.58	0.51	0.55	0.58
	4	0.53	0.84	0.66	0.43	0.46	0.28	0.32
GL_{adj}								
	0	0.26	0.33	0.36	0.33	0.28	0.30	0.33
	1	0.59	0.76	0.72	0.54	0.49	0.43	0.44
	2	0.42	0.39	0.41	0.43	0.38	0.46	0.49
	4	0.16	0.30	0.36	0.26	0.20	0.20	0.24
$(GL-GL_{adj})/GL$ (in per cent)								
	0	24.4	39.7	43.4	30.1	33.2	38.8	37.2
	1	28.6	13.7	24.2	43.7	40.3	37.7	41.9
	2	12.5	19.6	27.1	25.4	25.0	17.3	15.7
	4	70.1	64.5	45.9	38.4	57.1	28.1	26.8

Source: Author's calculations based on SITC data at the three-digit level.

In addition to the methodological shortcomings of the GL index mentioned above, we noted in chapter 6 that Rajan (1996) highlights the importance of distinguishing between the *degree* of IIT, as measured by the GL index, and the *level* of IIT. Nilsson (1997) proposed a new measure of intra-industry trade to avoid the difficulties associated with the GL index.

In Table 7.7, Hungary's IIT with each member state of the EU, for agri-food products in aggregate, is ranked by the level of IIT, Nilsson's measure of IIT per product and the GL index, for 1992 and 1998. The ordering of the top six countries in 1992, and top three in 1998, is the same whether the ranking is by level of IIT or IIT per product. However, the rankings by level of IIT and GL index are significantly different. Correlation coefficients of the rankings between the level of IIT and IIT per product are

0.975 and 0.938, in 1992 and 1998 respectively; and between the level of IIT and GL index are 0.833 and 0.556, respectively. This result reinforces that the GL index is a poor indicator of the *level* of IIT.

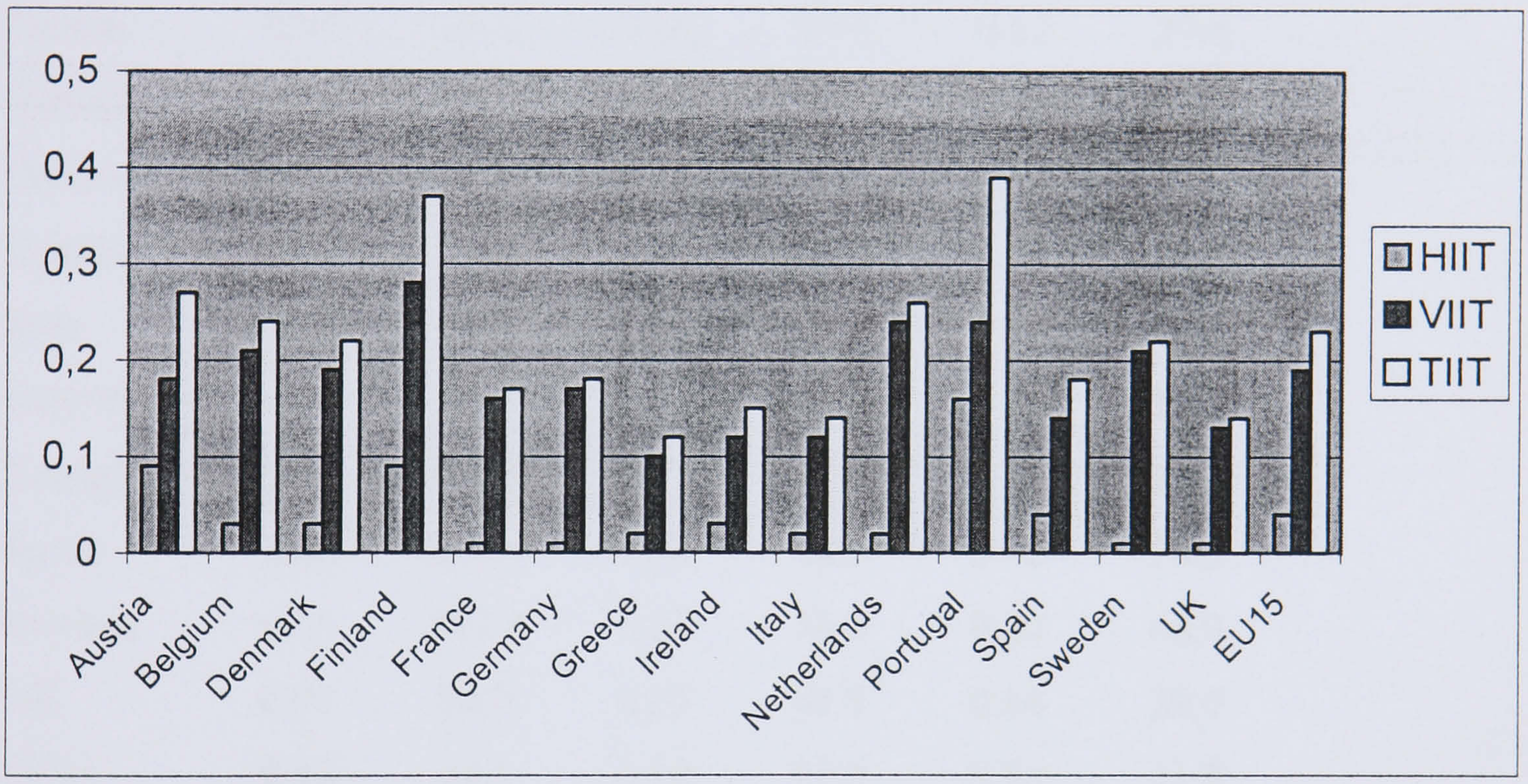
Table 7.7 Ranking of EU member states by level of IIT, IIT per product and GL index

	1992			1998		
	level of IIT	IIT/product	GL	level of IIT	IIT/product	GL
Germany	1	1	4	1	1	6
Austria	2	2	1	2	2	1
Netherlands	3	3	2	3	3	4
Italy	4	4	9	4	5	8
France	5	5	6	5	4	3
Belgium	6	6	5	6	6	5
UK	7	9	7	7	10	9
Denmark	8	8	3	10	11	11
Spain	9	7	10	8	8	12
Sweden	10	12	11	9	9	10
Finland	11	11	8	11	7	2
Greece	12	12	12	13	13	14
Ireland	13	13	14	12	12	13
Portugal	14	14	13	14	14	7

Source: Author's calculation based on SITC data at the four-digit level.

Table 7.8 displays correlation coefficients to indicate the similarity between the intra-industry trade of the EU countries' total agricultural trade and the intra-industry trade of the EU countries with Hungary. There are two main findings. The first important result is that the coefficients of correlation are low (all of them are below 0.4), which indicates a significant dissimilarity in intra-industry agri-food trade patterns between Hungary and the EU. In other words, Hungary shows only a minor similarity with the general pattern of the intra-industry trade of the EU. Second, intra-industry trade similarity has varied sharply by countries and years. Austrian, German and Italian trade with Hungary displays the largest similarity (correlation coefficients are above 0.2, except Italy in 1995). This can be explained partly in that they are the most important trading partners trade in agri-food products with its EU partners was mainly vertically differentiated during the analysed period. The share of vertical intra-industry trade in total intra-industry trade was above 60 per cent for all countries. Furthermore this ratio was higher than 80 per cent in the case of nine countries. But, these results should be interpreted with care, because coefficients of variation are high, especially for horizontal intra-industry trade indices, implying significant variability from year to year.

Figure 7.2 Vertical, horizontal and total IIT by countries (mean, 1992-1998)



Source: Author's calculation based on SITC code data at four-digit level.

Another stylised fact is that the EU countries differ considerably in terms of their relative horizontal, vertical and total intra-industry trade. The average horizontal intra-industry trade is very low in France, Germany, Sweden and the UK (0.01), while somewhat higher in Austria, Finland and Portugal (>0.09). The mean value of vertical intra-industry trade is below 0.15 for Greece, Ireland, Italy and the UK, but above 0.2 in Belgium, Finland, Netherlands, Portugal and Sweden. The total intra-industry trade levels are lower than 0.15 for Greece, Italy and the UK, while higher than 0.25 for Austria, Finland, Netherlands and Portugal.

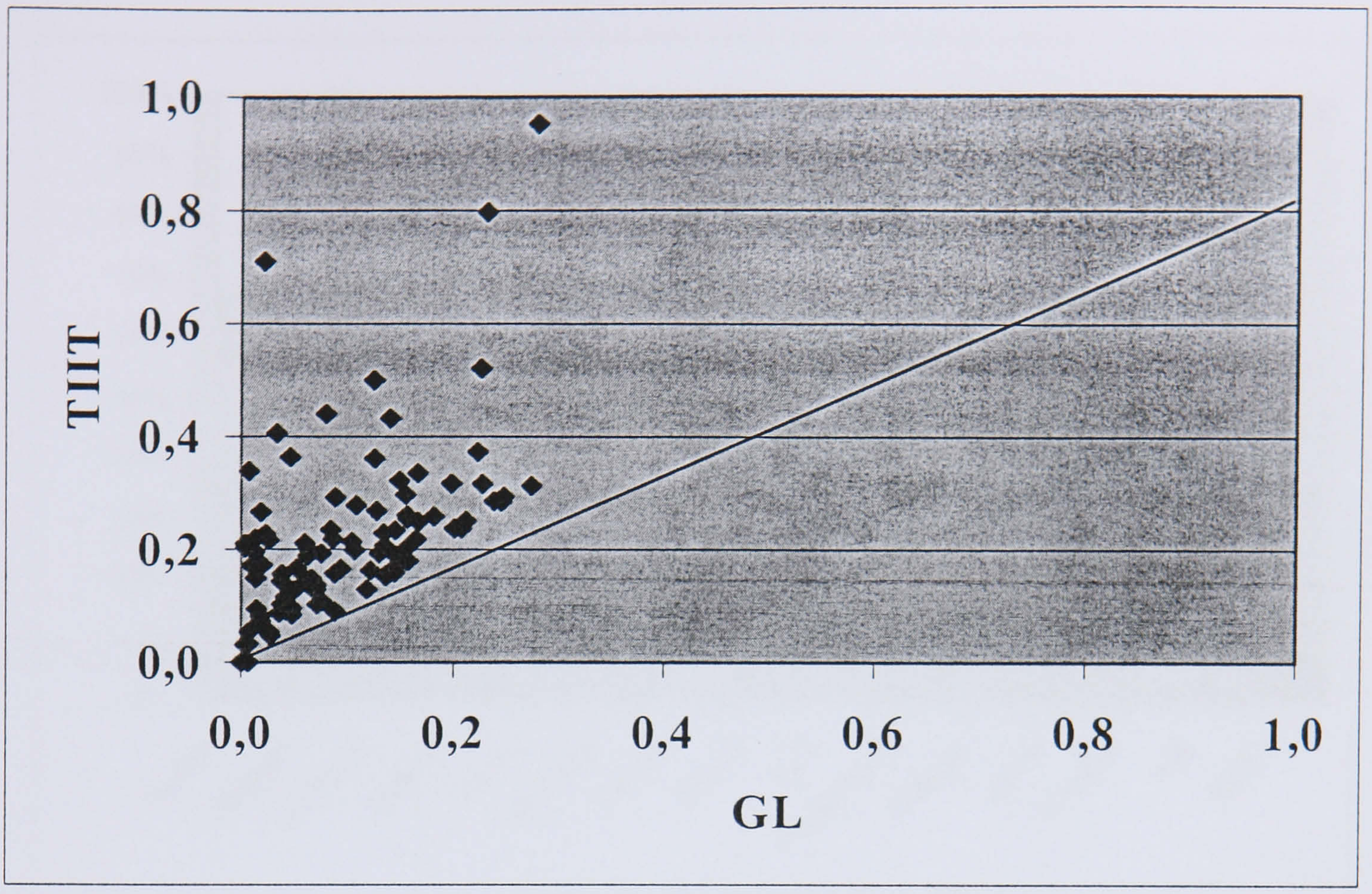
Table 7.9 Horizontal and vertical intra-industry trade in agri-food trade between Hungary and the EU, 1992-98

Country	HIIT		VIIT		TIIT	
	mean	coefficient of variation (per cent)	mean	coefficient of variation (per cent)	mean	coefficient of variation (per cent)
Austria	0.09	44.8	0.18	20.8	0.27	9.7
Belgium	0.03	147.1	0.21	47.2	0.24	36.7
Denmark	0.03	103.6	0.19	43.9	0.22	39.1
Finland	0.09	115.1	0.28	70.6	0.37	52.9
France	0.01	34.0	0.16	28.4	0.17	27.5
Germany	0.01	48.8	0.17	20.5	0.18	18.5
Greece	0.02	243.3	0.10	74.5	0.12	59.7
Ireland	0.03	226.6	0.12	102.7	0.15	75.5
Italy	0.02	88.7	0.12	25.4	0.14	20.7
Netherlands	0.02	88.9	0.24	18.9	0.26	17.3
Portugal	0.16	190.4	0.24	144.7	0.39	94.2
Spain	0.04	123.0	0.14	68.5	0.18	74.5
Sweden	0.01	117.8	0.21	69.9	0.22	66.9
UK	0.01	84.9	0.13	41.9	0.14	39.0
EU15	0.04	49.1	0.19	12.8	0.23	11.8

Source: Author's calculation based on SITC code data at four-digit level.

Figure 7.3 shows the GL index and the total intra-industry trade measure (TIIT) from 1992 and 1998 for 98 observations (7 years and 14 countries). It suggests that TIIT indices are higher than the GL indices. Another feature of this figure is that the two measures of intra-industry trade do not display a consistent pattern. The correlation coefficient between them is 0.536, indicating a serious problem for econometric work in explaining total intra-industry trade.

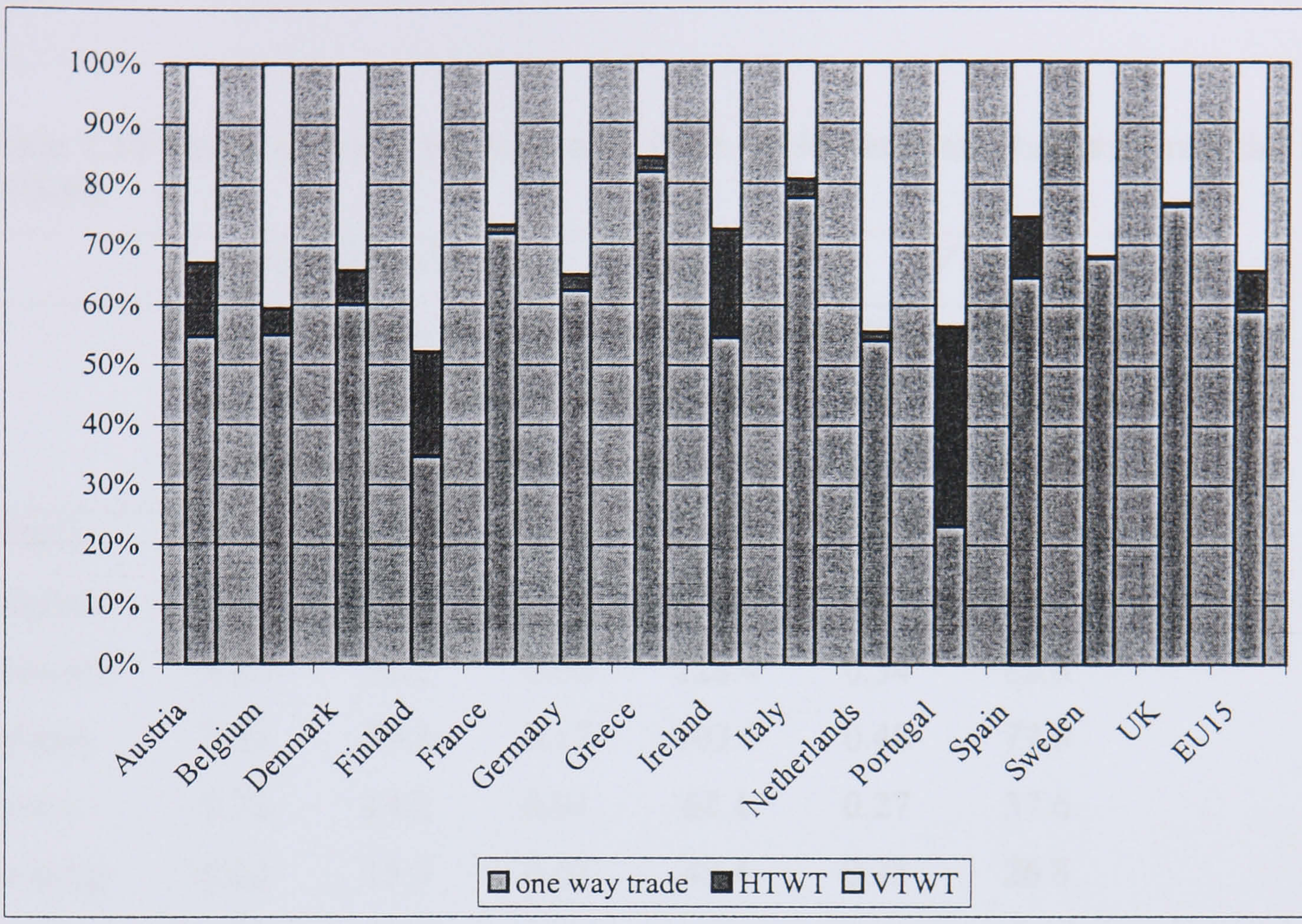
Figure 7.3 Comparison of the GL and TIIT indices



Source: Author's calculation based on SITC code data at four-digit level.

Following the method suggested by Fontagné and Freundenberg (1997) we identify the nature of trade relations in terms of three trade types (horizontal two-way trade, vertical two-way trade and inter-industry or 'one-way' trade) between Hungary and the EU. Figure 7.4 and Table 7.10 display summary statistics (mean and coefficients of variations) for the three trade types (detailed calculations are presented in Appendix 7).

Figure 7.4 The share of trade types by countries (in per cent)



Source: Author's calculations based on SITC code data at four-digit level.

Our results suggest that most important type of trade between Hungary and the EU countries from 1992 and 1998 is one-way trade (except Finland and Portugal), indicating a still strong complementarity between partners. Another characteristic of trade relations is that the role of vertical intra-industry trade is greater than that of horizontal intra-industry trade in total trade for each bilateral route. This result is consistent with our previous findings based on the Greenaway et al. (1994) procedure. The coefficients of variation for one-way trade are generally lower than horizontal and vertical intra-industry trade, indicating a relatively more stable pattern of one-way trade over time.

Some considerable differences can be observed in trade relations between Hungary and its EU partners. The share of one-way trade in total trade is especially high (>0.75) for Greece, Italy and the UK, whilst it is extremely low (0. 17) for Portugal. The role of horizontal intra-industry trade in total trade is usually very small; it does not reach the level of 0.1 for 9 of the 14 member states, and is higher than 0.2 only in the case of Portugal. The ratio of vertical intra-industry trade to total trade ranges between 0.16 and 0.48.

Table 7.10 Share of trade types in agri-food trade between Hungary and the EU, 1992-98

	One-way trade		HTWT		VTWT	
	mean	coefficient of variation (per cent)	mean	coefficient of variation (per cent)	mean	coefficient of variation (per cent)
Austria	0.55	9.9	0.12	39.5	0.33	24.9
Belgium	0.55	35.7	0.04	117.7	0.41	53.4
Denmark	0.60	51.2	0.06	128.4	0.34	82.8
Finland	0.35	89.2	0.17	103.6	0.48	77.5
France	0.72	14.2	0.01	68.1	0.27	37.6
Germany	0.62	15.5	0.03	49.4	0.35	26.8
Greece	0.82	22.2	0.02	264.6	0.16	108.9
Ireland	0.47	98.3	0.15	243.9	0.24	156.8
Italy	0.78	8.3	0.03	87.1	0.19	34.0
Netherlands	0.54	20.4	0.01	103.3	0.44	24.1
Portugal	0.17	212.5	0.24	167.2	0.31	144.1
Spain	0.65	55.0	0.10	120.6	0.25	94.0
Sweden	0.68	30.1	0.00	156.5	0.32	63.5
UK	0.75	10.8	0.01	104.8	0.23	30.0
EU15	0.59	9.4	0.07	40.7	0.34	16.1

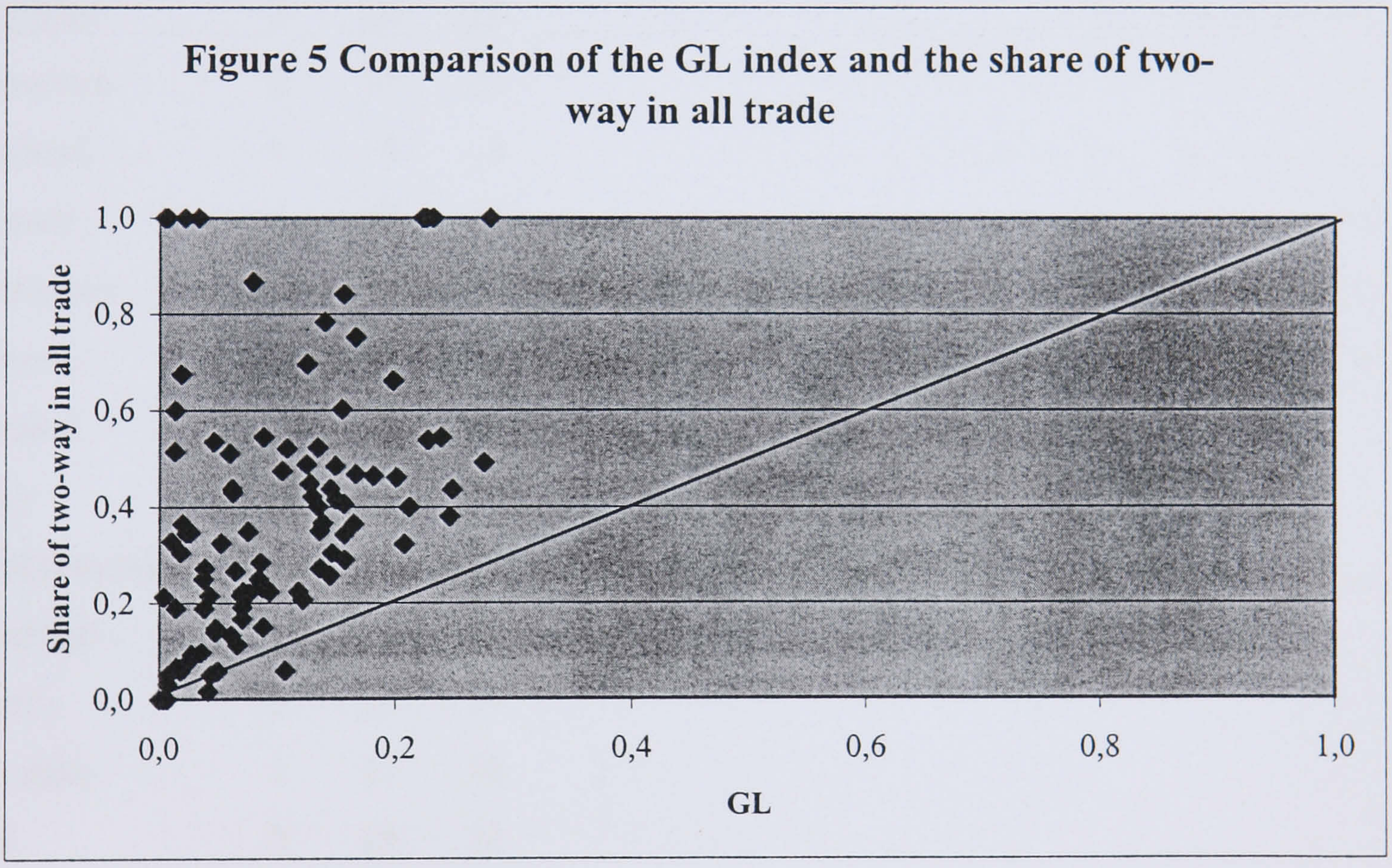
Source: Author's calculation based on SITC code data at four-digit level.

Note: HTWT is horizontal two-way trade, and VTWT is vertical two-way trade.

In summary, Hungarian agricultural trade with the EU countries was basically dominated by one-way trade and vertical intra-industry trade during the analysed period. However, high coefficients of variation suggest considerable variability in the pattern of intra-industry trade over the period.

Figure 7.5 displays the GL index and the share of the Fontagné and Freundenberg total two-way trade in all trade from 1992 and 1998 for 98 observations (7 years and 14 countries). It indicates that the GL indicators are generally lower than the total two-way trade indices. Contrary to Fontagné and Freundenberg (1997) findings, the GL indices and the shares of two-way trade in total trade do no give a coherent picture about total intra-industry trade. Our results are similar to the previous comparison between the GL and TIIT indices, in that the two indicators do not yield a consistent pattern of total intra-industry trade, which is reinforced by the correlation coefficient between them (0.428).

Figure 7.5 Comparison of the GL index and the share of two-way in all trade



Source: Author's calculation based on SITC code data at four-digit level.

However, the TIIT and TWT indices result in a relatively consistent pattern of total intra-industry trade; the correlation coefficient for them is 0.823. In short, use of the GL index as an appropriate measure of total intra-industry trade can be questioned by these two kinds of total intra-industry indicators. These findings shed light on the importance of the measures chosen for econometric work in explaining total intra-industry trade.

In addition to measuring the incidence of horizontal and vertical intra-industry trade based on the two different methods, we have also calculated the product coverage of Hungarian agricultural trade with the EU countries. Table 7.11 reveals some interesting differences across trading partners (detailed calculations are in Appendix 6).

Table 7.11 Product coverage of Hungary's IIT by partner country between 1992-1998 (mean)

Partner country	Number of SITC 4-digit products		
	HIIT	VIIT	TIIT
Austria	13	72	85
Belgium	3	24	27
Denmark	2	11	13
Finland	1	4	5
France	4	28	32
Germany	10	81	91
Greece	0	5	5
Ireland	1	2	3
Italy	4	47	52
Netherlands	4	52	56
Portugal	1	1	2
Spain	2	10	11
Sweden	1	11	12
UK	3	19	22
EU 15	20	123	144

Source: Author's calculation based on SITC code data at four-digit level.

Note: Data relate to Table 7.9.

First, there is a small share of the original sample (255 product groups for each bilateral route) involved in intra-industry trade for all member states. Germany has a highest share with 91 of all product groups which relates to total intra-industry trade, whilst this number is 5 or less for Finland, Greece, Ireland and Portugal. Another interesting finding is the extremely low number of product groups involving horizontal intra-industry trade; the highest number is for Austria (13) and the lowest is Greece (0). Our results suggest a relatively high proportion of product groups for vertical intra-industry trade in the case of Austria, Germany, Italy and the Netherlands.

Comparing Table 7.11 with Tables 7.9 and 7.10 we can observe that the greater values of horizontal, vertical or total intra-industry trade indices do not necessarily coincide with a higher share of product group in a particular intra-industry trade type. For example, Portugal has a relatively high mean value of horizontal (0.16-0.24) and vertical (0.24-0.31) intra-industry trade indices, but each trade type exists only in one product group on average. This implies that the *level* of various types of intra-industry trade differs from the *degree* of intra-industry trade, as shown in chapter 6 following Nilsson (1997 and 1999). Table 7.12 confirms that there is no significant correlation between the *level* and the *degree* of horizontal, vertical and total intra-industry trade based on either the Greenaway et al. or Fontagné and Freundenberg methods. But Nilsson's type measures report a moderate correlation with the level of intra-industry trade. In other words, Nilsson's criticism is also valid for the measurement of horizontal and vertical intra-industry trade. (Nilsson did not split intra-industry trade into its horizontal and vertical components.)

Table 7.12 Correlation coefficients among level of intra-industry trade and various measures of intra-industry trade

	HIIT	HTWT	HIIT/product
Level of HIIT	-0.016	-0.039	0.686
	VIIT	VTWT	VIIT/product
Level of VIIT	0.082	0.115	0.541
	TIIT	TTWT	TIIT/product
Level of TIIT	-0.129	-0.115	0.598

Source: Author's calculation based on SITC code data.

In short, our results indicate that various measures of horizontal and vertical intra-industry trade may not yield necessarily a consistent pattern, causing a serious problem for econometric investigations in explaining different types of intra-industry trade. There is no consensus in the recent literature about an appropriate measure of horizontal and vertical intra-industry trade in empirical analysis. Furthermore, we have no theoretical *a priori* knowledge as to which measure is the best.

7.2.3 Marginal Intra-Industry Trade

The GL indices in Tables 7.1 and 7.2 indicate a slightly upward trend in IIT. However, the GL index is most appropriate for measurement over a single period of time, i.e. it is regarded as a static indicator of IIT.[10] An assumption, sometimes implicit, in the literature on trade liberalisation has been that the GL index, as a measure of IIT, is negatively correlated with factor market adjustment costs. But adjustment costs are dynamic phenomena, and the static GL index is not a suitable measure in this instance. As mentioned in the previous chapter, recent theoretical developments stress the importance of *marginal* IIT (MIIT) in the context of the adjustment costs of trade liberalisation (Hamilton and Kniest, 1991; Greenaway et al., 1994; Brülhart, 1994, 1999 and 2000; Azhar et al., 1998; Thom and McDowell, 1999).[11] Thus, "... it is the structure of the *change* in flows of goods (MIIT) which affects adjustment rather than the trading pattern in any given time period (IIT)" (Brülhart, 1994, p. 609).

Using the Brülhart A index, MIIT in agricultural and food products between Hungary and each of the member states of the EU, between 1992 and 1998, is very low, <0.2, with neighbouring Austria recording the highest value of 0.19 (Table 7.13, middle column). These estimates suggest that the *change* in agri-food trade between Hungary and the EU during the period was almost entirely of an *inter*-industry nature. Marginal IIT in each of the member states' total agri-food trade over the period is much higher (Table 7.13, last column), suggesting that whilst the role of IIT in the change in total agri-food trade was important for EU countries, this was not the case in their trade with Hungary.

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[10] Even though the GL index measures trade *flows* and therefore is not static in the strict sense.
[11] Menon and Dixon (1997) argue a counter case, that when dealing with adjustment costs the focus should be on the measure of inter-industry trade (see chapter 6).

Table 7.13 Marginal intra-industry trade in agri-food products, 1998/92

Country	Hungary	All
Austria	0.19	0.46
Belgium	0.09	0.55
Denmark	0.04	0.24
Finland	0.09	0.28
France	0.10	0.29
Germany	0.11	0.28
Greece	0.00	0.15
Ireland	0.06	0.20
Italy	0.03	0.17
Netherlands	0.08	0.34
Portugal	0.09	0.24
Spain	0.03	0.32
Sweden	0.01	0.34
UK	0.09	0.33
EU15	0.13	0.63

Source: Author's calculations based on SITC data at four-digit level, aggregated using trade share weights.

As with the GL indices, the A indices are also calculated by product groups, based on four-digit level data and then aggregated to the two-digit level. The degree of MIIT differs considerably between 1992 and 1998 (Table 7.14, first column of figures), but the indices are below 0.2 for 18 of the 22 product groups, again suggesting that *inter*-industry trade was dominant.

Table 7.14 Marginal intra-industry trade between Hungary and the EU, by product group

SITC product group – two digit level	1998/92	1994/92	1998/95
00: Live animals other than animals of division 03	0.00	0.29	0.03
01: Meat and meat preparations	0.06	0.28	0.70
02: Dairy products and birds' eggs	0.14	0.97	0.94
03: Fish, crustaceans, molluscs and preparations thereof	0.05	0.69	0.37
04: Cereals and cereal preparations	0.07	0.68	0.67
05: Vegetables and fruits	0.09	0.44	0.91
06: Sugar, sugar preparations and honey	0.12	0.54	0.59
07: Coffee, tea, cocoa, spices, and manufactures thereof	0.40	0.45	0.68
08: Feedstuff for animals (excluding unmilled cereals)	0.18	0.00	0.39
09: Miscellaneous edible products and preparations	0.08	0.21	0.78
11: Beverages	0.15	0.19	0.18
12: Tobacco and tobacco manufactures	0.41	0.52	0.50
21: Hides, skins and furskins, raw	0.05	0.45	0.20
22: Oil seeds and oleaginous fruits	0.58	0.50	0.46
23: Crude rubber (including synthetic and reclaimed)	0.11	0.11	0.63
24: Cork and wood	0.10	0.18	0.78
26: Textiles fibres and their wastes	0.32	0.88	0.95
29: Crude animal and vegetable materials, n.e.s.	0.16	0.84	0.72
41: Animal oils and fats	0.11	0.10	0.86
42: Fixed vegetable oils and fats, crude, refined or fractionated	0.01	0.01	0.55
43: Processed Animal and vegetable oils and fats	0.01	0.23	0.43
59211/12 Starch	0.02	0.00	0.89

Source: Author's calculations based on SITC data at four-digit level, aggregated using trade share weights.

Brülhart's A index overcomes various problems associated with earlier attempts to measure MIIT (e.g. Hamilton and Kniest, 1991; Greenaway et al., 1994), but has been subject to criticism. As mentioned in chapter 6, Oliveras and Terra (1997) investigate statistical properties of the index and point out that there is no general relationship between the A index of a certain period and the corresponding indices of any sub-periods. They also find that there is no general relationship between the A index of a given industry and the corresponding indices of any sub-industries. Consequently, results based on the A index are very sensitive to choice of period and industry aggregation. The first of these problems is illustrated by splitting our period into two sub-periods, 1992-94 and 1995-98 (Table 7.14 second and third columns of figures). Correlation coefficients between the whole period and these two sub-periods are 0.30 and 0.06, respectively. However, as Oliveras and Terra note, this inconsistency may provide additional information about the adjustment process.

Thom and McDowell (1999) argue that whilst Brülhart's index is an appropriate measure of horizontal intra-industry trade, it can not distinguish between horizontal and vertical intra-industry trade, and hence it may underestimate the importance of intra-industry trade (refer to chapter 6). They offer an alternative method of classifying the different types of marginal intra-industry trade – horizontal MIIT, vertical MIIT and total MIIT .As can be seen from Table 7.15, Hungary's total MIIT (A_j) with the member states of the EU is high. However, there are considerable differences among member states, with values ranging from 0.93 for trade with Portugal to 0.39 for trade with Sweden. It is interesting to note that there is little similarity between the values of A_j and the GL indices of Table 7.1, i.e. there are trading partners with a high level of total MIIT and a low GL index, and vice versa. Moreover, the values in Table 7.15 highlight the difference between total MIIT (A_j) and horizontal MIIT (A_w). The A_j index of Thom and McDowell (op. cit.) reveals the importance of vertical MIIT, the highest value of which is for Hungary's trade with Portugal (0.84). Indeed, the largest share of the change in IIT over the period is attributable to vertical MIIT in eight of the member states. Similarly, for the EU as a whole, vertical MIIT (0.51) is shown to dominate marginal inter-industry trade (0.36) and horizontal MIIT (0.13). In short, our results confirm our expectation, namely neglecting the distinction of horizontal and vertical IIT produce the risk of underestimating the extent of intra-industry trade and overestimating the importance of adjustment costs arising from the partial trade liberalisation due to the Association Agreement.

Table 7.15 Decomposition of the change in Hungarian agri-food trade flows with the EU, 1998/92

Member state	TMIIT	HMIIT	VMIIT	MiIT
	(Aj)	(Aw)	(Aj-Aw)	(1-Aj)
Austria	0.92	0.19	0.72	0.08
Belgium	0.68	0.09	0.59	0.32
Denmark	0.44	0.04	0.40	0.56
Finland	0.70	0.09	0.62	0.30
France	0.53	0.10	0.43	0.47
Germany	0.86	0.11	0.51	0.37
Greece	0.47	0.00	0.47	0.53
Ireland	0.65	0.06	0.59	0.35
Italy	0.45	0.03	0.42	0.55
Netherlands	0.54	0.08	0.46	0.46
Portugal	0.93	0.09	0.84	0.07
Spain	0.71	0.03	0.68	0.29
Sweden	0.39	0.01	0.38	0.61
UK	0.80	0.09	0.72	0.20
EU15	0.64	0.13	0.51	0.36

Source: Author's calculations based on SITC data at four-digit level, aggregated using trade share weights.
Note: TMIIT is total marginal intra-industry trade, HMIIT is horizontal marginal intra-industry trade, VMIIT is vertical marginal intra-industry trade, and MiIT is marginal inter-industry trade.

In short, our results confirm our expectation, namely that neglecting the distinction between horizontal and vertical MIIT produces the risk of underestimating the extent of IIT and, *ceteris paribus*, overestimating the importance of adjustment costs arising from the partial trade liberalisation due to the Association Agreement. However, as Thom and McDowell (1999) point out, the estimates of various marginal IIT indices do not necessary allow definitive inferences to be made on adjustment costs, because empirical measures of trade flows are open to the criticism that datasets may not correctly reflect the economic frontiers between industries in terms of end-use. This may also contribute to differences in measures of MIIT obtained from different approaches. In sum, our results need to be interpreted with care.

7.3 Testing for the Determinants of Intra-Industry Trade

In this section, we test for the determinants of intra-industry trade between Hungary and its EU partners. We examine whether the hypothesised relationships between various determinants and intra-industry trade arising from previous empirical works hold for trade between Hungary and its trading partners. It is clear from the literature review of empirical studies about agri-food trade that there is no widely accepted procedure to test the hypotheses stemming from intra-industry trade theory. Many studies do not relate directly to a specific model of intra-industry trade, rather they attempt to regress an index of intra-industry trade on a variety of explanatory variables suggested by various models. Another feature of these papers is that they have not distinguished between horizontal and vertical intra-industry trade, but have focused exclusively on total intra-industry trade as measured by the GL index, except for de Frahan and Tharakan (1998, 1999).

Following the method proposed by Greenaway et al. (1994, 1995, 1999) we test for the determinants of various types of intra-industry trade separately employing similar independent variables. Lack of appropriate data means that we focus only on the country-specific variables in explaining intra-industry trade. We are also interested in which measure is best for each type of intra-industry trade, therefore we apply different indices of intra-industry trade as the dependent variable. Our hypotheses regarding the country characteristics that determine the extent of intra-industry trade are based on the previous empirical works discussed in section 7.1.2 and the suggested various models of intra-industry trade.

(i) Tastes and per capita income. The extent of intra-industry trade is positively correlated with similarity of the per capita income between trading partners implying a greater similarity in their demand pattern (Linder, 1961). We test this hypothesis by a measure of *dissimilarity* between per capita income in Hungary and each of its partner countries (DGDPC). But, per capita income has also been used as an indicator of

relative factor endowments. Regarding horizontal intra-industry trade, this does not result in a serious problem, because the expected effect of both attributes is negative. However, it may be problematic for vertical intra-industry trade, because the models of Falvey (1981) and Shaked and Sutton (1984) predict a positive relationship between vertical intra-industry trade and the difference in factor endowment or per capita income.

(ii) Differences between the sizes of the partner countries. Following Helpman (1981) we test whether the difference between the sizes of the trading countries is negatively related to the extent of intra-industry trade. This variable is measured by the difference of the GDP between Hungary and its partner countries (DGDP).

(iii) Market size. According to Lancaster (1980) and Bergstrand (1990) we expect that the greater the average market size of two partner countries the larger the scope for product differentiation and the larger the demand for the import of horizontally differentiated products. In other words, the market size is positively correlated to intra-industry trade. It is measured by the average GDP of Hungary and its trading partners (AVGDP).

(iv) Transportation costs. The geographical distance between the two trading countries reflects transportation costs which are generally considered a determinant of intra-industry trade. The extent of intra-industry trade is influenced positively by the market proximity. This variable is measured by the geographical distance between Budapest and each of Hungary's trading partner's capital (DIS).

The data set includes 14 countries and 7 years, so the total number of observations is 98. Previous empirical studies have used different estimation methods, including simple ordinary least squares with a linear and lin-log, log-log, logit transformation of the logistic specifications, non-linear least squares of the logistic function and tobit procedures. In this case, we have many zero values for intra-industry trade, implying perfect inter-industry trade. Therefore, we can not apply specifications with a logged dependent variable or its logit transformation. For most of the cases the non-linear least squares methods and tobit estimations could not be run due to identification problems. So, we test the determinants of the extent of intra-industry trade employing a linear and log-linear function and ordinary least squares method. Lack of sufficient time series data precluded the application of integration tests. All the OLS equations and diagnostic tests were estimated by the software package Easyreg. The general specification of the model of intra-industry trade is as follows.

(1) $IIT_{ij}=\alpha_0+\alpha_1 DGDPC_{ij}+\alpha_2 DGDP_{ij}+\alpha_3 AVGDP_{ij}+\alpha_4 DIS_{ij}+\varepsilon_j$,

where

IIT_{ij}: the extent of intra-industry trade (total, horizontal, vertical).

$DGDPC_{ij}$: difference in per capita income measured by per capita GDP between Hungary and its trading partners in US dollar (i=Hungary, j=trading partner), calculated from the Euromonitor's database.

$DGDP_{ij}$: difference in GDP between Hungary and its partner countries in US dollar, computed from the Euromonitor's database.

$AVGDP_{ij}$: average GDP of Hungary and its trading partners in US dollar, calculated from the Euromonitor's database.

DIS_{ij}: distance between Budapest and partner country's capital in kilometres, calculated from www.indo.com program.[12]

The expected signs are $\alpha_1 < 0$ for total and horizontal intra-industry trade and $\alpha_1 > 0$ for vertical intra-industry trade, $\alpha_2 < 0$, $\alpha_3 > 0$, and $\alpha_4 < 0$.

7.3.1 Regression Results for Total Intra-Industry Trade.

We have estimated five specifications regarding alternative measures of total intra-industry trade as the dependent variable: the GL index, total intra-industry trade (TIIT), total two-way trade (TTWT), the average level of intra-industry trade per product groups based on the GL index (IIT/p) and average level of total intra-industry trade per product groups (TIIT/p).

Table 7.16 displays that for the linear specification of the OLS regressions the coefficients are insignificant for the models with dependent variables of TIIT and

TTWT. Variables are not significant and have opposite signs in many cases. The model with the GL index has a poor explanatory power, but DGDPC and DIS are significant at the 10 per cent level.

[12] Descriptive statistics for all dependent and independent variables are given in Appendix 9.

Table 7.16 Hungary's total IIT regression results

INDEPENDENT VARIABLE	Dependent variable				
	GL	TIIT	TTWT	IIT/p	TIIT/p
Constant	-0.00533	0.15107	0.48947	122191.678	557640.468
	(-0.074)	(0.961)	(1.728)*	(0.767)	(0.932)
DGDPC	0.00000	0.00000	0.00001	3.67761	2.38189
	(1.979)*	(1.139)	(1.348)	(1.186)	(1.063)
DGDP	0.00000	0.00000	0.00000	0.00000	0.00000
	(-1.323)	(0.126)	(1.064)	(-1.387)	(-0.432)
AVGDP	0.00000	0.00000	0.00000	0.00001	0.00001
	(1.323)	(-0.154)	(-1.088)	(1.472)	(0.499)
DIS	-0.00003	0.00005	0.00008	-184.846	-334.841
	(-1.686)*	(1.305)	(1.275)	(-5.139)***	(-2.480)**
Statistics					
N	98	98	98	98	98
adjusted R^2	0.152	0.028	0.018	0.569	0.346
F(4,93)	5.35	1.70	1.45	32.97	13.83
Diagnostics					
A: Normality $\chi^2_{2,5\%} = 5.99$	26.600	218.079	4.099	4.125	210.467
B: Heteroscedasticity $\chi^2_{4,5\%} = 9.49$	20.580	68.706	35.420	8.392	16.594

t statistics are shown in parentheses
Note: Diagnostics are: A: Jarque-Bera/Salmon-Kiefer test; B: Breusch-Pagan test; significance levels are ***=1 per cent, **= 5 per cent, *=10 per cent.

However, last two models have produced better results. Overall, the regressions explain 35 and 57 per cent of the variation in Hungarian intra-industry trade with the EU countries employing ITT/p and TIIT/p as dependent variables. In terms of the hypotheses arising from the theoretical models of intra-industry trade, our results show the expected signs, except for the first hypothesis, but most of the coefficients are not significant. The inequality per capita GDP measures (DGDPC) show positive signs and are not significant. The coefficients of inequality of GDP (DGDP) have negative signs as theory predicts, but they are not significant. The average GDP is positively related to the extent of intra-industry trade, but estimates are not significant. The distance variable contributes negatively to intra-industry trade, and estimates are significant. In other words, our results support the hypothesis that greater distances lower the extent of intra-industry trade. In short, the model with dependent variable IIT/p has produced the best estimation results, furthermore diagnostic tests suggest that it is does not suffer from the problem of non-normality and heteroscedasticity as do the other specifications.

Table 7.17 shows that the OLS regressions have produced better results with linear-logarithmic specifications than with simple linear functions. The explanatory power of the models has increased for all cases. Despite this improvement, the models with dependent variables of TIIT and TTWT are again the weakest. The estimation with the GL index reports three significant coefficients, but two of them have unexpected signs. The DGDPC is not significant with unexpected sign, whilst DIS is highly significant with the predicted sign.

The coefficients of the models with Nilsson's type dependent variables (IIT/p and TIIT/p) have also improved; the overall explanatory powers are 0.36 and 0.62. All coefficients for the IIT/p model are significant and they have the predicted signs except DGDPC. Estimation with TIIT/p reports unexpected signs for DGDPC and DGDP, but the coefficients are not significant except for DIS. We observe that all models are heteroscedastic, and three have normality problems.

In short, the OLS regressions indicate that the models with dependent variables related to the *degree* of total intra-industry trade report insignificant or weak estimation results with unexpected signs for many cases. The models with Nilsson's type of dependent variables display much better results. However, our results do not support the prediction of Helpman and Krugman's (1985) model, that inequality in per capita GDP negatively influences the extent of intra-industry trade.

Table 7.17 Hungary's total IIT regression results

Independent variable (log)	Dependent variable				
	GL	TIIT	TTWT	IIT/p	TIIT/p
Constant	0.60525	1.54056	0.82245	-1915630.9	-3630294.9
	(1.827)*	(2.014)**	(0.597)	(-2.612)**	(-1.253)
DGDPC	0.02219	0.02125	0.08103	56621.779	47854.3
	(1.500)	(0.622)	(1.318)	(1.729)*	(0.370)
DGDP	0.04029	0.05206	-0.05816	-106256.48	313.130
	(1.887)*	(1.056)	(-0.655)	(-2.248)**	(0.002)
AVGDP	-0.05555	-0.11523	0.00663	234736.530	283255.559
	(-1.808)*	(-1.624)	(0.052)	(3.451)***	(1.055)
DIS	-0.04728	0.01467	0.01826	-240381.37	-473992.18
	(-3.539)***	(0.476)	(0.329)	(-8.130)***	(-4.059)***
Statistics					
N	98	98	98	98	98
adjusted R^2	0.255	0.037	0.029	0.618	0.359
F(4,93)	9.30	1.94	1.72	40.17	14.56
Diagnostics					
A: Normality $\chi^2_{2,5\%}= 5.99$	46.567	245.496	3.752	5.949	205.319
B: Heteroscedasticity $\chi^2_{4,5\%}= 9.49$	24.145	63.329	40.374	19.889	19.918

t statistics are shown in parentheses
Note: Diagnostics are: A: Jarque-Bera/Salmon-Kiefer test; B: Breusch-Pagan test; significance levels are ***=1 per cent, **= 5 per cent, *=10 per cent.

7.3.2 Regression Results for Horizontal Intra-Industry Trade

Table 7.18 shows that the overall explanatory level is very low for the two models with dependent variables of HIIT (horizontal intra-industry trade) and HTWT (horizontal two-way trade). All coefficients are insignificant and they have unexpected signs, except DGDPC.

Table 7.18 Hungary's horizontal IIT regression results

Independent variable	Dependent variable		
	HIIT	HTWT	HIIT/p
Constant	0.10487	0.23298	1658854.51
	(1.054)	(1.362)	(2.084)**
DGDPC	-9.13E-7	-9.12E-7	2.30137
	(-0.478)	(-0.274)	(0.148)
DGDP	5.91E-13	2.22E-12	-1.18E-7
	(0.560)	(1.147)	(-0.013)
AVGDP	-1.21E-12	-4.52E-12	8.49E-7
	(-0.580)	(-1.166)	(0.047)
DIS	1.44E-5	5.01E-5	-975.127
	(0.623)	(1.297)	(-5.426)***
Statistics			
N	98	98	98
adjusted R^2	0.017	0.050	0.399
F(4,93)	1.41	2.29	17.10
Diagnostics			
A: Normality	5540.471	961.163	52.354
$\chi2_{2,5\%}$= 5.99			
B: Heteroscedasticity	136.936	105.785	28.734
$\chi2_{4,5\%}$= 9.49			

t statistics are shown in parentheses.
Note: Diagnostics are: A: Jarque-Bera/Salmon-Kiefer test; B: Breusch-Pagan test; significance levels are ***=1 per cent, **= 5 per cent, *=10 per cent.

The model with dependent variable HIIT/p (horizontal intra-industry trade per product group) reports much better results. The explanatory power of model is 0.4 with predicted signs consistent with expectatations, except DGDPC, and the DIS variable is strongly significant. But all models suffer from normality problems and heteroscedasticity.

The linear-logarithmic specifications yield somewhat better results (Table 7.19). The overall explanatory power remains very low and coefficients are insignificant for the models with HIIT and HTWT. However, all variables have predicted signs for the model of HTWT, whilst the model with HIIT has expected signs for DGDPC and DIS. The model with HIIT/p as the dependent variable has also improved. Its explanatory power has increased (0.56) and it has two significant coefficients (AVGDP and DIS). But, normality problems and heteroscedasticity have remained for all models.

Table 7.19 Hungary's horizontal IIT regression results

Independent variable (log)	Dependent variable		
	HIIT	HTWT	HIIT/p
Constant	1.02179	0.74098	283139.24
	(2.116)**	(0.889)	(0.085)
DGDPC	-0.02860	-0.02597	24357.284
	(-1.327)	(-0.698)	(0.163)
DGDP	0.01417	-0.05749	-330153.88
	(0.455)	(-1.070)	(-1.531)
AVGDP	-0.03834	0.04224	671695.284
	(-0.856)	(0.547)	(2.164)**
DIS	-0.01172	-0.00212	-1233282.8
	(-0.602)	(-0.063)	(-9.141)***
Statistics			
N	98	98	98
adjusted R^2	0.033	0.057	0.556
F(4,93)	1.84	2.46	31.32
Diagnostics			
A: Normality	6170.373	978.873	101.124
$\chi2_{2,5\%}$= 5.99			
B: Heteroscedasticity	143.808	133.884	34.427
$\chi2_{4,5\%}$= 9.49			

t statistics are shown in parentheses.
Note: Diagnostics are: A: Jarque-Bera/Salmon-Kiefer test; B: Breusch-Pagan test; significance levels are ***=1 per cent, **= 5 per cent, *=10 per cent.

If we compare the results of the total intra-industry trade models (excluding the GL and IIT/p related models) with those of the horizontal intra-industry trade models, we may observe that the explanatory powers are somewhat higher for the latter. They have more significant coefficients with predicted signs than in the case of the total intra-industry trade models. We may conclude, tentatively, that the intra-industry trade hypotheses are supported more by horizontal intra-industry trade measures than with total intra-industry trade measures.

7.3.3 Regression Results for Vertical Intra-Industry Trade

Table 7.20 shows the OLS regression results for vertical intra-industry trade with linear specifications. We ran regressions with four independent variables as applied above, but omitting DGDP has produced better results. The models with dependent variables of VIIT and VTWT have very low explanatory power. All coefficients are insignificant, except DGDPC for the model of VIIT. They have predicted signs only for DGDPC. Both models fail the normality and heteroscedasticity tests.

The third specification (VIIT/p) displays much better results. The equation has an overall explanatory power of 54 per cent and it is possible to accept the null hypothesis of homoscedasticity, but the normality hypothesis is rejected. All coefficients are strongly significant and they have expected signs.

Table 7.20 Hungary's vertical IIT regression results

Independent variable	Dependent variable		
	VIIT	VTWT	VIIT/p
Constant	0.07302	0.16902	467218.75
	(0.969)	(1.231)	(1.771)*
DGDPC	0.00000	0.00001	25.54176
	(1.769)*	(1.652)	(2.808)***
AVGDP	0.00000	0.00000	0.00000
	(-1.230)	(-0.891)	(6.315)***
DIS	0.00003	0.00003	-326.3369
	(1.088)	(0.480)	(-3.038)***
Statistics			
N	98	98	98
adjusted R^2	0.014	0.003	0.544
F(4,93)	1.45	1.11	39.63
Diagnostics			
A: Normality	643.135	28.702	6.003
$\chi2_{2,5\%}$= 5.99			
B: Heteroscedasticity	63.106	29.955	7.708
$\chi2_{4,5\%}$= 9.49			

t statistics are shown in parentheses.
Note: Diagnostics are: A: Jarque-Bera/Salmon-Kiefer test; B: Breusch-Pagan test; significance levels are ***=1 per cent, **= 5 per cent, *=10 per cent.

Table 7.21 reports that estimations with linear-logarithmic specifications have yielded somewhat better results than with the linear functional form. The explanatory power has remained at a similarly low level for models with VIIT and VTWT, but the DGDPC variables are significant with predicted signs. The other two coefficients are insignificant with unexpected signs. Estimation for the case of VIIT/p is similar to the linear specification. Explanatory power is almost the same, and all variables are significant with predicted signs. The null hypothesis of heteroscedasticity is rejected, but normality is accepted. In summary, our results tend support to the hypotheses based on vertical intra-industry trade theory.

Table 7.21 Hungary's vertical IIT regression results

Independent variable (log)	Dependent variable		
	VIIT	VTWT	VIIT/p
Constant	0.11623	0.08424	-7259387.9
	(0.239)	(0.096)	(-4.204)***
DGDPC	0.05543	0.10708	257156.35
	(1.876)*	(2.007)**	(2.454)**
AVGDP	-0.02420	-0.03639	318077.08
	(-1.637)	(-1.363)	(6.066)***
DIS	0.02234	0.02022	-382740.97
	(0.832)	(0.417)	(-4.017)***
Statistics			
N	98	98	98
adjusted R^2	0.017	0.016	0.530
F(4,93)	1.57	1.54	37.42
Diagnostics			
A: Normality	746.295	25.688	3.156
$\chi^2_{2,5\%} = 5.99$			
B: Heteroscedasticity	52.109	34.210	14.788
$\chi^2_{4,5\%} = 9.49$			

t statistics are shown in parentheses.
Note: Diagnostics are: A: Jarque-Bera/Salmon-Kiefer test; B: Breusch-Pagan test; significance levels are ***=1 per cent, **= 5 per cent, *=10 per cent.

7.4 Summary

This chapter has presented an analysis of the intra-industry nature of agri-food trade between Hungary and the EU for the period 1992 to 1998. There has been a slight growth in IIT as measured by the GL index. However, this increase is not uniform by country or product group, and probably reflects different patterns of bilateral integration and progress in economic restructuring. Also, the relatively high variance in the temporal pattern of IIT suggests that restructuring is far from complete. Our results reinforce the importance of distinguishing between the degree and the level of IIT, and accord with the general finding that the GL index is a poor indicator of the latter.

Intra-industry trade between Hungary and the EU in agri-food trade was mainly characterised by vertical IIT. However, another finding is that the agri-food trade between trading partners was predominantly one-way trade. Similar to the GL index, the pattern of various types of trade has presented a relatively high variance by countries and temporally. Our results suggest that different measures of horizontal and vertical IIT do not reflect correctly the level of IIT. Furthermore various indices of horizontal and vertical IIT may yield a different pattern, resulting in a serious measurement problem for econometric work.

Marginal IIT, which is now regarded as a more appropriate measure in the context of economic adjustment costs, would appear to be low for agri-food trade between Hungary and the EU, but assumes greater significance when the index is broadened to include vertical as well as horizontal IIT. The structure of the change in agri-food trade between Hungary and the EU during the period therefore was predominantly intra–industry of a vertical nature or *inter*-industry. Both are believed to incur adjustment costs that are higher than with horizontal IIT, but the dominance of vertical IIT suggests that the agri-food industries of Hungary and the EU may be developing in a complementary manner, involving somewhat lower adjustment costs than might have been feared.

Finally, we have attempted to test the determinants of intra-industry trade between Hungary and its EU partners in agri-food trade, based on recent empirical studies. Our results suggest that separating the measure of intra-industry trade into vertical and horizontal intra-industry trade may provide a better estimation of their determinants and clarifies some contradictory findings of earlier studies. This is especially true for variables of inequality in GDP per capita, which have resulted in opposite signs in various studies. Our results support the hypothesis of different determinants for horizontal and vertical intra-industry trade. Another finding is that Nilsson's type measures of intra-industry trade have resulted in much better estimation results than the GL based indices. Consequently, the use of Nilsson's measure in empirical analysis may be recommended not for only traditional GL based investigations, but also for tests of determinants of horizontal and vertical intra-industry trade.

CHAPTER 8 CONCLUSIONS

Hungary will become a member of the European Union (EU) in 2004. As a precursor to full accession, an Association Agreement, signed in 1991, has promoted partial liberalisation of bilateral trade over the past decade. This thesis has investigated systematically the pattern of agricultural trade between Hungary and the EU between 1992 and 1998, employing various theoretical concepts and empirical methodologies. This final chapter will summarise the main results, present some conclusions and then point to potential directions of further research, emerging out of the present study.

8. 1 Findings

The structure of the Hungarian economy was remarkably stable over the period under study, considering the upheaval generally associated with transition from a centrally-planned to market-driven economy (Chapter 2). Gross Domestic Product (GDP) increased moderately at an annual average rate of 1.6%, due mainly to a significant increase in manufacturing output. The overall employment level in the economy fell by 9%, though the structural pattern of employment remained relatively stable. Surprisingly, unemployment statistics also fell markedly, by 40%, suggesting an anomaly in the official data. Price inflation was high at around 20% per year, though this rate was falling over the latter part of the period. Real earnings were static, despite an increase in real GDP per head, suggesting higher returns to capital. High inflation also caused the real foreign exchange rate to rise, by around 15% against most trading partners, making Hungarian exports less competitive and imports more competitive.

For agriculture, GDP was virtually unchanged in real terms over the period, though its contribution to the overall economy fell and its share of total employment fell by more than a third. GDP per person in agriculture increased faster than in the general economy but this was not reflected in higher real earnings. The shares of the food industry in total GDP and employment also fell and both the agricultural and food sectors had labour productivity less than the national average. Although prices for food increased slightly faster than for all goods and services, agriculture's terms of trade worsened during the second half of the period, as a result of higher rises in input prices.

Against this economic background, the general question posed (Chapter 1) was:

What have been the effects of the Association Agreement on the agricultural trade flows between Hungary and the EU, and what are the implications for Hungarian agriculture?

This question was split into five specific research questions. These are addressed separately below.

1. How has the pattern of Hungarian agricultural trade with the EU developed over the period? What have been the major characteristics?

Since the early 1990s the orientation of Hungary's economic and trade policies has been determined principally by the goal of accession to the EU. Meanwhile, Hungary has followed active trade diplomacy with developed and transition countries. All OECD countries granted Hungary Most Favoured Nation (MFN) treatment in 1992, and most have extended their Generalised System of Preference (GSP) schemes to Hungary. However, during the first half of 1990s Hungary negotiated several agreements that superseded the MFN-GSP system. These were:

(i) the Association (European) Agreement with the EU;

(ii) an agreement with the European Free Trade Association (EFTA);

(iii) the Central European Free Trade Agreement (CEFTA).

Moreover, Hungary ratified the Uruguay Round Agreement of GATT (General Agreement on Tariffs and Trade) in 1995.

Of these various trade agreements, the Association Agreement with the EU has been the most important. It covers around two-thirds of agricultural trade and serves as a precursor to full EU membership. However, the benefits have been limited. The literature suggests that this has been due mainly to a lack of competitiveness and insufficient export availability on the part of Hungary (and other Central and East

European countries) leading to unfilled preferential quotas, especially in the early years of the Agreement. The agreement with EFTA is of little consequence to agricultural trade, and whilst the benefits of CEFTA are potentially greater, in that the agreement provides for a greater coverage of agricultural products, they are still less than under the Association Agreement.

As already mentioned, perhaps one of the most surprising outcomes of the various changes that took place in Hungary during the 1990s is that the structure of the economy remained remarkably stable. This was due, at least in part, to Hungary's 'early start' in the transition process. As a consequence of the various trade policies outlined above, the Hungarian economy became more open during the 1990s. However, the level of protection in agriculture remained higher than in the industrial sectors. Government support of agriculture, in terms of budgetary cost, remained at a considerable level during the period, although the importance of export subsidies was reduced significantly (Chapter 2). Official Producer Support Estimate (PSE) calculations by the OECD show that the level of government support in Hungary was lower in the later years, as well as considerably lower than in the EU throughout the period. These PSE measures also show that the pattern of support between Hungary and the EU was dissimilar, both across commodities and years.

The general pattern of Hungary's agricultural trade, with special emphasis on trade with the EU, was outlined in Chapter 3. Hungary is a major exporter of agri-food products; it maintained a large positive balance in this trade with the world throughout the period. Exports are highly concentrated, with over 50% accounted for by three of the 22 two-digit product groupings; meat and meat preparations; cereals and cereal preparations; and vegetables and fruits.

Surprisingly, given the Association Agreement signed in 1991, Hungary's agricultural exports to the EU did not increase over the period, and fell as a proportion of total agricultural exports. Hungary's agricultural imports from the EU did increase somewhat, though they also fell as a proportion of total agricultural imports. Nevertheless, Hungary was the only Central and East European country to maintain a positive balance in agricultural trade with the EU during the 1990s.

As with total agricultural exports, Hungary's exports to the EU are highly concentrated, with over 50% accounted for by just two product groups: meat and meat preparations; and vegetables and fruits. They are also strongly concentrated by EU member state (Austria, Germany and Italy). Hungary's agricultural imports from the EU are far less concentrated.

Despite the fundamental transformation of Hungarian agriculture (e.g., changes in farm structures, the food industry, food retailing and agricultural policy, and price and import liberalisation) the pattern of Hungarian agricultural trade remained fairly stable over the period, for both total trade and trade with the EU. Hungarian agricultural trade was rather complementary in nature in relation to both the world and EU. However, whilst there is similarity in the pattern of agricultural exports to the world and the EU, this is not so evident for imports.

As regards the implications for international trade in agricultural and food products with the EU, the various economic indicators and policy measures highlighted suggest that changes taking place in the Hungarian economy over the period probably served to worsen the prospects for Hungarian exports. Agriculture and food processing were declining sectors within the Hungarian economy, and in the second half of the period the agricultural terms of trade worsened. The real exchange rate rose, making Hungarian exports less competitive and imports from the EU (and elsewhere) more competitive. Only for poultry, eggs and pigmeat were levels of support in Hungary generally higher than in the EU, though in the case of pigmeat, an important enterprise in Hungarian agriculture, they were nevertheless at very low levels by the end of the period. Recent studies of the competitiveness of Hungarian agriculture, based on price and cost comparisons, show that arable production is more competitive than livestock production, and that the former is competitive in the international arena. Whether these findings are supported by the trade data was investigated in Chapters 4 and 5.

2. Which factors explain Hungary's agricultural trade performance in EU markets? Which product groups have been competitive and which have been uncompetitive in EU member states during the analysed period?

Constant Market Shares (CMS) models were used in Chapter 4 as a starting point in the analysis of Hungary's agricultural trade performance. The growth in Hungary's agricultural exports to the EU over the period was very limited. The CMS models suggest that the main source of growth, where it occurred, has been the rise of total agricultural imports in the EU market. A clear result from the CMS models is that, in general, the competitiveness of Hungarian agricultural exports to the EU has deteriorated. Although this result relies on the dominance of the residual (competitive) component in the CMS decomposition and is therefore somewhat unsatisfactory, the analysis clearly suggests that Hungary has performed poorly in terms of maintaining or increasing market share. Specifically, Hungarian agricultural exports were focused on those product groups where import demand in the EU markets increased below average. However, competitiveness did increase for some specific products, namely meat, cereals, sugar, feedstuff for animals, beverages, tobacco, cork and wood, and processed vegetable oils and fats (Table 8.1, first column). The inclusion of cereals, sugar and vegetable oils in this list supports those price and cost based studies referred to that have found arable production to be internationally competitive. But the inclusion of meat as a specific product group exhibiting competitiveness in EU markets is less in accord with these studies.

Table 8.1 Comparison of Hungary's competitiveness, revealed comparative advantage and IIT

Two-digit SITC group	CMS	RCA^1	RCA^2	GL	MIIT
00: Live animals other than animals of division 03		*	*		
01: Meat and meat preparations	*	*	*		
02: Dairy products and birds' eggs				*	
03: Fish, crustaceans, molluscs					
04: Cereals and cereal preparations	*		*		
05: Vegetables and fruits		*	*		
06: Sugar, sugar preparations and honey	*		*		
07: Coffee, tea, cocoa, spices				*	*
08: Feedstuff for animals	*			*	
09: Miscellaneous edible products & preparations					
11: Beverages	*		*		
12: Tobacco and tobacco manufactures	*			*	*
21: Hides, skins and furskins, raw				*	
22: Oil seeds and oleaginous fruits		*	*		*
23: Crude rubber					
24: Cork and wood	*		*		
26: Textiles fibres and their wastes	*			*	*
29: Crude animal and vegetable materials, n.e.s.			*	*	
41: Animal oils and fats		*	*	*	
42: Fixed vegetable oils and fats			*		
43: Processed animal and vegetable oils and fats	*				
59212: Wheat/Maize starch					

Source: CMS results from Table 4.2; RCA results from Tables 5.1 and 5.10; GL results from Table 7.2; and MIIT results from Table 7.14.
Notes:
A * in the CMS column indicates competitiveness according to equation 4a in section 4.3.1.
A * in an RCA column indicates revealed comparative advantage according to bilateral trade (RCA^1) and regional trade (RCA^2) as defined in sections 5.3 and 5.4, respectively.
A * in the GL column indicates an index >0.3.
A * in the MIIT column indicates a value of >0.3 in the Brülhart index.

The CMS analyses by EU member state showed that Hungary's competitiveness, in general and specific terms, has worsened in its most important trading partners, namely Austria, Germany and Italy. Again, this loss of competitiveness is indicated by the residual element, but it underlines that Hungary has performed poorly in terms of its geographical markets, as well as in important product markets. Export competitiveness was enhanced in some geographical markets, including the UK, but these markets were of far lesser importance in terms of Hungary's exports. In short, positive impacts were occurring in the wrong places, whilst negative impacts were occurring in the historically important markets. This suggests that Hungary needs to reassess its export positioning, both in terms of products and geographical markets.

Sensitivity tests confirmed that the CMS findings are not severely influenced by commodity aggregation or by changing the definition of reference markets. However, they are more sensitive to changes in period choice. Nevertheless, these variations are not sufficient to reject the conclusion of a general decrease in competitiveness of Hungarian agricultural exports. If this decline is to be halted or reversed, then Hungary must pay greater attention to the specific product markets and geographical markets to which it exports. A continuation of past trends will witness a further deterioration of Hungary's competitiveness, unless there is a significant change in the characteristics of these markets, for example an increase in import demand or a decrease in the performance of Hungary's competitors.

3. In which commodities does Hungary have a comparative advantage vis a vis the EU? In addition, are there any dynamics in the pattern of Hungarian comparative advantage over time?

To supplement the CMS analysis in Chapter 4, indices of revealed comparative advantage (RCA) were calculated in Chapter 5. This is an approach that has become very popular in recent analyses of East-West European agricultural trade (see for example, Eiteljörge and Hartmann, 1999 and Bojnec, 2001). However, these studies tend to use aggregate data. The analysis presented in Chapter 5 is comprehensive in coverage, based on 255 product groups and covering 7 years. Additionally, we focused not only on the simple calculation of RCA indices to identify revealed comparative advantage, but also investigated the stability in the pattern of the RCAs over the period.

Chapter 5 presented four different RCA indices in three trading contexts - bilateral, regional and global - for the period 1992 to 1998. In the first context, when Hungarian agricultural export performance is investigated in EU markets using *bilateral* trade data, all four indices indicate that Hungary has revealed comparative advantages in 5 of the 22 aggregated product groups: live animals; meat; vegetables and fruit; oilseeds; cork and wood. These do not map closely onto the measures of competitiveness as indicated by the CMS analysis (see Table 8.1, first and second columns). They coincide only for meat and meat preparations (SITC product group 01). (The mapping becomes closer with the *regional* measure of RCA - see below). That the bilateral trade data do not exhibit a revealed comparative advantage for cereals may be a reflection of the level of support that the EU affords that particular agricultural sub-sector.

In the second context, we calculated RCAs at the *regional* level, with the EU again as the comparator but using total trade data. The indices present a similar but broader pattern, with all four showing a revealed comparative advantage for 11 of the 22 product groups: live animals; meat; cereals; vegetables and fruit; sugar; beverages; oilseeds; cork and wood; crude animal and vegetable materials, animal oils and fats and fixed vegetable oils and fats. Of these groups, five are identified as competitive according to the CMS analysis (see Table 8.1).

Finally, in the *global* context, Hungary has comparative advantage for 12 of the 21 product groups: the 11 groups identified at the *regional* level plus miscellaneous edible products. Hungarian comparative advantage widens across product groups from the bilateral to the global contexts. That the analysis has yielded different RCA results if the benchmark chosen is the EU, the world and, by implication, any other possible aggregation of countries, supports the findings of Richardson and Zhang (1999).

These results complement those recent studies which, using price and cost based methods, have found that Hungarian arable production is internationally competitive. Our findings suggest that, in addition, Hungary has a comparative advantage in animal and meat products. However, since our calculations are based on observed trade data, attention has been drawn to the possible influence of government-induced distortions in the functioning of international markets.

Indeed, one of the potential weaknesses of using RCA type indices is the effect of government interventions on trade flows. Both Hungary and the EU support (most parts of) their agricultural sectors. Ideally, what is needed to resolve the issue of government intervention and the credence placed on any RCA type index is a model which would allow the effects of all government intervention to be removed. This was beyond the scope of the current research. Indeed, it is extremely unlikely that an empirical model could be used at the level of data disaggregation employed here. The use of trade data to calculate RCA type indices is popular precisely because of the difficulty in identifying comparative advantage *ex ante*, and the impossibility of observing relative prices in an autarkic situation.

However, although the precise effects on trade of the interaction of Hungarian and EU government intervention in agriculture are unknown and difficult to quantify, a strong case could be made that their combined effect has been to disadvantage Hungary in its trading with the EU. It may be recalled that official PSE calculations by the OECD (1999) showed that the level of government support in Hungary was considerably lower than in the EU throughout the period under study. Hungary's total percentage PSE over 1992-98 was 15%, as against 42% for the EU (Chapter 2). More specifically, the level of protection in Hungary was lower than that in the EU for all of the main commodities except pigmeat, poultrymeat and eggs. Furthermore, levels of PSE in Hungary were negative for a number of commodities in a number of years. Levels of PSE in Hungary were highest for sugar, milk and eggs; in the EU they were high for all of the land-based commodities. Thus, it could be argued that the comparative advantages for Hungary revealed by the trade data might be strengthened in the absence of government intervention.

Despite significant changes in Hungarian agriculture during transition, our analysis indicates that the distribution of the RCA indices from 1992 to 1998 has remained fairly stable, in accord with our observations about the economy and trade pattern in general. However, the pattern of comparative advantage in Hungarian agriculture does exhibit a declining trend. In other words, Hungarian agriculture has lost comparative advantage for some product groups over time. This is consistent with the loss of competitiveness evident in the CMS analysis of Chapter 4.

Another feature of the RCA indices is that their pattern has converged during the analysed period. The stability of the value of RCA indices for particular product groups from the starting period to the ending period displays a less persistent pattern. The results suggest that the Balassa (B) indices are strongly stable from 1992 to 1998 for observations with comparative *dis*advantage for all cases. But, product groups with weak to strong comparative advantage report a significant variation in their pattern.

Two methodological comments are also offered in Chapter 5. First, reinforcing the finding of Ballance et al. (1987), consistency tests indicate that any particular RCA measure needs to be interpreted with care. In particular, the RCA indices are less satisfactory as cardinal than ordinal or binary measures. Second, despite normalisation of the B index suggested by Dalum et al. (1998) and Laursen (1998) to alleviate the inherent skewness problem, our findings show that normalised B indices also suffer from non-normality problems, heightening concerns over care in interpretation.

In conclusion, although the issue of identification of comparative advantage via RCA indices is open to some criticism and not beyond doubt, the indices presented in Chapter 5, particularly when used as binary measures, offer a useful guide to underlying comparative advantage and disadvantage in Hungarian agri-food sectors. The main finding of the RCA analysis is the same as that of the CMS analysis: that competitiveness of Hungarian agriculture worsened over the period under study. As such, the analysis offers a further insight into the implications for trade when membership of the EU becomes a reality.

4. Which types of trade have been dominant – inter-industry or intra-industry? What might this division imply about the economic adjustment costs from partial trade liberalisation due to the Association Agreement?

As detailed in Chapter 6, much work has been undertaken, both in the theoretical and empirical literature, on intra-industry trade (IIT). One strand of this research has focused on an appropriate measure of static IIT and despite great efforts to improve the classic Grubel-Lloyd (GL) index, this, in its unadjusted form, has remained the most accepted measure. A second line of research has focused on distinguishing between vertical and horizontal IIT, and the procedure established by Greenaway et al. (1994) based on unit values enjoys wide acceptance in the empirical literature. Finally, research on the relationship between IIT and the economic adjustment costs associated with trade liberalisation has given rise to the concept of *marginal* IIT. Thus far there is no agreement among scholars as to the best index of marginal IIT, but Brülhart's indices have became popular in empirical analysis.

The growing importance of intra-industry trade for processed foods among developed countries is confirmed by recent empirical studies. The results support the view that IIT is increasing and determined mainly by distance between partner countries and membership of a free trade area or similar;

market size, market structure, GDP measures and taste overlap may be important, but are not unambiguous as explanatory variables. And the distinction between horizontal and vertical IIT would appear to be important in testing for the determinants of IIT. Despite the burgeoning of work in the area of IIT, this research is underdeveloped and a large gap still exists between the theory of intra-industry trade and empirical studies on food products.

Chapter 7 presented an empirical analysis of the intra-industry nature of agri-food trade between Hungary and the EU for the period under study. In terms of the amounts of IIT, Germany, Austria, the Netherlands and Italy were Hungary's most important trading partners. However, in general, our results revealed a low degree of IIT as measured by the unadjusted Grubel-Lloyd index. Only eight of the 22 two-digit product groups had an index of >0.3 (Table 8.1, fourth column). As to be expected, these groups reflect a higher level of processing, e.g. dairy, animal feedstuffs and animal oils and fats. The Grubel-Lloyd indices revealed a slight growth in intra-industry trade over the period. But this increase was not uniform by product group or EU member state, or over time, reflecting different patterns of bilateral integration and suggesting an economic restructuring process that is far from complete.

However, as has been stressed, horizontal and vertical intra-industry trade has different implications for adjustment costs, and thus it is not sufficient to focus only on total intra-industry trade. Employing various empirical methods to distinguish between horizontal and vertical intra-industry trade, our results suggested that intra-industry trade between Hungary and the EU in agri-food products was mainly characterised by vertical intra-industry trade, indicating higher adjustment costs (Table 8.2, part A). We also found that the pattern of various trade types revealed a relatively high variance by countries and temporally.

Table 8.2 Hungary's IIT types, EU means 1992-98

(A)	HIIT	VIIT
	0.04	0.19
	HTWT	VTWT
	0.07	0.34
(B)	HMIIT	VMIIT
	0.13	0.51

Source: Tables 7.9, 7.10 and 7.15.
Notes:
HIIT is horizontal intra-industry trade and VIIT is vertical intra-industry trade, after Greenaway, Hine and Milner (1994 and 1995).
HTWT is horizontal two-way trade and VTWT is vertical two-way trade, after Fontagné and Freundenberg (1997).

In Chapter 1 we emphasised the different implications arising from traditional and new trade theory. Specifically, the effects of partial trade liberalisation due to the Association Agreement between Hungary and the EU depend on whether *inter*-industry or *intra*-industry trade has dominated. Recent literature emphasises that the GL based indices are an appropriate measure of static intra-industry trade, but are not a good proxy for adjustment costs arising from trade liberalisation due to the latter's dynamic nature. Therefore, we applied the concept of *marginal* intra-industry trade as a better aid in commenting on adjustment costs.

Results based on the approach of Thom and McDowell (1999) show that Hungary's total marginal IIT (MIIT) with the member states of the EU is high, but ranging from 0.93 for trade with Portugal to 0.39 for trade with Sweden. There is little similarity between these values and the GL indices calculated, i.e. there are trading partners with a high level of total MIIT and a low GL index, and vice versa. This result accords with the general finding that the GL index is a poor indicator of marginal IIT. Moreover, the results highlight the difference between horizontal MIIT and vertical MIIT. Indeed, the largest share of the change in IIT over the period is attributable to vertical MIIT in eight of the member states. Similarly, for the EU as a whole, vertical MIIT (0.51) is shown to dominate horizontal MIIT (0.13) (Table 8.2, part B).

Thus, the structure of the change in agri-food trade between Hungary and the EU over time was predominantly either intra–industry of a vertical nature, or inter-industry. Noteworthy is that our results, in general, have similar implications in both static and dynamic contexts. We may conclude that adjustment costs have been higher than would have been the case with horizontal intra-industry trade. However, the dominance of vertical intra-industry trade suggests that the agri-food industries of Hungary and the EU may be developing in a complementary manner, involving somewhat lower adjustment costs than may have been feared.

Chapter 7 also presented two methodological points. First, after Rajan (1996), we showed that the standard GL index fails to correctly identify the *level* of intra-industry trade. Furthermore, our results confirmed that the index proposed by Nilsson (1997) provided a good approximation to the level of intra-industry trade. Second, various methods applied to distinguish horizontal and vertical intra-industry trade may yield quite different results, causing a potentially serious problem for subsequent empirical work.

5. Which factors explain intra-industry trade in agri-food products between Hungary and the EU?

Having looked at various ways of identifying horizontal and vertical intra-industry trade in agri-food products between Hungary and the EU member states, the logical next step was to test for the determinants of these different trade flows. Following recent studies in the empirical literature, we estimated regression models using the different measures of total, horizontal and vertical intra-industry trade.

Our results suggest that separating a measure of intra-industry trade into its horizontal and vertical components provides a better estimation of the determinants of trade and clarifies some contradictory findings in the empirical literature. This is especially the case for the inequality in GDP per capita variable, the sign of which is crucially dependent on the type of trade being modelled. Our results lend support to the contention that there are different determinants for total, horizontal and vertical intra-industry trade.

More notably, using a measure of intra-industry trade that reflects its *level*, after Nilsson (1997 and 1999), resulted in much better regression results than those based on the more commonly employed *degree* or *share* of intra-industry trade. The results, based on the Nilsson approach and reproduced in Table 8.3, also illustrate the benefits of splitting the measure of total IIT into its horizontal and vertical components. The distance variable is significant in all three (total, horizontal and vertical) specifications, emphasising the importance of proximity of the trading partner. (It may be recalled that three of the most important four of Hungary's trading partners, in terms of the level of IIT, are Germany, Austria and Italy.) Average GDP (AGDP), as a measure of market size, becomes significant when total IIT is decomposed into its horizontal and vertical components. With this split, the difference in GDP per capita (DGDPC), as a measure of the similarity in per capita income or relative factor endowments, also becomes significant for vertical IIT. In conclusion, we can say that use of Nilsson's measure in empirical analysis may be recommended not only for traditional Grubel-Lloyd-based investigations, but also for testing the determinants of horizontal and vertical intra-industry trade.

Table 8.3 Determinants of Hungary's IIT

Independent variable	Dependent variable		
(log)	TIIT/p	HIIT/p	VIIT/p
Constant	-3630295	283139	-7259388
	(-1.25)	(0.09)	(-4.20)***
DGDPC	47854	24357	257156
	(0.37)	(0.16)	(2.45)**
DGDP	313	-330154	
	(0.00)	(-1.53)	
AVGDP	283256	671695	318077
	(1.06)	(2.16)**	(6.07)***
DIS	-473992	-1233283	-382741
	(-4.06)***	(-9.14)***	(-4.02)***
N	98	98	98
Adjusted R^2	0.36	0.56	0.53
F(4,93)	14.56	31.32	37.42
A: Normality	205.3	101.1	3.16
$\chi^2_{2,5\%} = 5.99$			
B: Heteroscedasticity	19.92	34.43	14.79
$\chi^2_{4,5\%} = 9.49$			

Source: Tables 7.17, 7.19 and 7.21.
Notes: TIIT/p, HIIT/p and VIIT/p are total, horizontal and vertical IIT per product, after Nilsson (1997 and 1999).
DGDPC is difference in per capita GDP; DGDP is difference in GDP; AVGDP is average GDP; and DIS is distance.
Diagnostics are: A: Jarque-Bera/Salmon-Kiefer test; B: Breusch-Pagan test.
Significance levels are *** =1 percent, ** = 5 percent, * =10 percent.

8. 2 Directions of Future Research

As summarised in the previous section, the thesis has a number of findings and conclusions. But it also contains some implicit directions for future research in the field. This final section will elaborate on three possible directions.

One of the weaknesses of the thesis, already referred to in our discussion of the RCA indices, is that the analysis is based on observed trade patterns when, in reality, many of these trade flows are distorted by government policies and interventions. This is a particularly acute problem in agriculture, where government support of the industry and use of a plethora of instruments, including import restrictions and export subsidies, distort trade. Both inter-industry and intra-industry trade can, potentially, be influenced by trade policy. We have not dealt explicitly with these trade policy measures, as this was beyond the scope of the current analysis. Therefore, a promising direction for future research would be to develop the literature on the effects of trade barriers and other agricultural policy measures on trade patterns and flows. Attention has been drawn in the thesis to some of the literature on this subject. Much work has been undertaken on the welfare gains from agricultural trade liberalisation which implies that agricultural policies must have an impact on trade flows (i.e. volume) and possibly on trade patterns (i.e. direction). However, other research concludes that:

(i) natural factor endowments are of prime importance, as predicted by conventional trade theory, with agricultural policies affecting flows but not underlying patterns;

(ii) export performance is more affected by economic fundamentals than by government intervention, whereas the reverse applies to import behaviour; and,

(iii) government intervention and competitiveness tend to be inversely related.

Clearly, there is scope for further research in this area which would contribute to a better understanding of the linkages between governmental intervention in agricultural markets and comparative advantage, competitiveness and trade types.

In Chapter 7, lack of sufficient data meant that we tested only county-specific factors in explaining the various types of intra-industry trade. Hence, with a richer data set we could aim to incorporate industry-specific factors, (possibly including trade policy measures), for more accurate tests of hypotheses arising from the theoretical literature. The combination of country-specific and industry-specific factors in empirical analysis would allow a clearer picture of the intra-industry nature of agri-food trade between Hungary and the EU.

A third avenue for further research would be to extend the marginal intra-industry trade analysis. We stressed the importance of the concept of marginal intra-industry trade to assess economic adjustment costs arising from partial trade liberalisation. However, due to data limitations (principally industry-specific factors) we have not tested directly 'the smooth adjustment hypothesis'. Following recent advances in the literature, future research could examine the relationship between the change in trade patterns and the change in employment at the industry level. Such an investigation would shed light on the linkage between the dynamics of intra-industry trade and labour market adjustment costs in the Hungarian economy as it prepares for EU membership.

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Appendices

Appendix 1 List of agri-food commodities and their SITC 4-digit codes

SITC code
0011: Bovine animals, live
0012: Sheep and goats, live
0013: Swine, live
0014: Poultry, live
0015: Horses, asses, mules and hinnies
0019: Live animals, n.e.s.
0099: Intrastat: estimation of missing declarations of division 00
0111: Meat of bovine animals, fresh or chilled
0112: Meat of bovine animals, frozen
0121: Meat of sheep or goats, fresh, chilled or frozen
0122: Meat of swine, fresh, chilled or frozen
0123: Meat and edible offal of the poultry of 0014
0124: Meat of horses, asses, mules or hinnies
0125: Edible offal of bovine animals, swine, sheep, etc.
0129: Meat and edible meat offal, n.e.s.
0161: Bacon, ham and other dried, salted meat of swine
0168: Meat, edible meat offal, n.e.s., salted, dried; flours
0171: Extracts and juices of meat, aquatic invertebrates
0172: Sausages and similar, of meat, meat offal or blood
0173: Liver of any animal, prepared or preserved
0174: Meat, offal of poultry, prepared or preserved, n.e.s.
0175: Meat, offal of swine, prepared or preserved, n.e.s.
0176: Meat, offal of bovine an., prepared, preserved, n.e.s.
0179: Other prepared or preserved meat or meat offal
0199: Intrastat: estimation of missing declarations of division 01
0221: Milk and cream, not concentrated or sweetened
0222: Milk and cream, concentrated or sweetened
0223: Yogurt, buttermilk, acidified milk and cream; ice-cream
0224: Whey; products of natural milk constituents
0230: Butter and other fats and oils derived from milk
0241: Grated or powdered cheese, of all kinds
0242: Processed cheese, not grated or powdered
0243: Blue-veined cheese
0249: Other cheese; curd
0251: Birds' eggs, in shell, fresh, preserved or cooked
0252: Birds' eggs, not in shell, and egg yolks
0253: Egg albumin
0299: Intrastat: estimation of missing declarations of division 02
0341: Fish, fresh (live or dead) or chilled
0342: Fish, frozen (excluding fillets and minced fish)
0344: Fish fillets, frozen
0345: Fish fillets and other fish meat, fresh or chilled
0351: Fish, dried, salted or in brine, but not smoked

0352: Fish salted but not dried or smoked, fish in brine
0353: Fish (including fillets), smoked
0354: Fish liver and roes, dried, smoked, salted
0355: Fish meal fit for human consumption
0361: Crustaceans, frozen
0362: Crustaceans, other than frozen
0363: Mollusks, and aquatic invertebrates
0371: Fish prepared or preserved, n.e.s.; caviar
0372: Aquatic invertebrates, prepared or preserved, n.e.s.
0399: Intrastat: estimation of missing declarations of division 03
0411: Durus wheat, unmilled
0412: Other wheat (including spelt) and meslin, unmilled
0421: Rice in the husk (paddy or rough rice)
0422: Rice husked, not further prepared (cargo or brown)
0423: Rice, semi-milled or wholly milled
0430: Barley, unmilled
0441: Seed of maize
0449: Other maize, unmilled
0451: Rye, unmilled
0452: Oats, unmilled
0453: Grain sorghum, unmilled
0459: Buckwheat, millet and other cereals, unmilled, n.e.s.
0461: Flour of wheat or of meslin
0462: Groats, meal and pellets, of wheat
0471: Cereal flours (other than wheat or meslin)
0472: Cereal groats, meal and pellets (other than wheat)
0481: Cereal grains, worked or prepared, n.e.s.
0482: Malt, whether or not roasted
0483: Macaroni, spaghettis and similar products
0484: Bakers' ware; communion wafers, rice paper & similar
0485: Mixes & doughs for the preparation of bakers' ware
0497: Confidential trade of division 04
0499: Intrastat: estimation of missing declarations of division 04
0509: Intrastat: estimation of missing declarations of division 05
0541: Potatoes, fresh or chilled
0542: Leguminous vegetables, dried, shelled
0544: Tomatoes, fresh or chilled
0545: Other fresh or chilled vegetables
0546: Vegetables, frozen
0547: Vegetables provisionally preserved
0548: Vegetable products, roots & tubers, edible, n.e.s.
0561: Vegetables, dried, whole, cut, broken or in powder
0564: Flours, meals of potatoes, vegetables, fruits, n.e.s.
0566: Vegetables prepared & preserved (no vinegar), frozen
0567: Vegetables, prepared or preserved, n.e.s.
0571: Oranges, mandarines, citrus hybrids, fresh or drie
0572: Other citrus fruits, fresh or dried
0573: Bananas (including plantains), fresh or dried
0574: Apples, fresh
0575: Grapes, fresh or dried

0576: Figs, fresh or dried
0577: Edible nuts (no oil nuts), fresh or dried
0579: Fruit, fresh or dried, n.e.s.
0581: Jams, fruit jellies, fruit or nut paste, cooked prep.
0582: Fruits and nuts provisionnaly preserved; peel
0583: Fruits and nuts, frozen, whether or not sweetened
0589: Fruit, nuts, edible plants, otherwise prepared, n.e.s.
0591: Orange juice
0592: Grapefruit juice
0593: Juice of any other single citrus fruit
0597: Confidential trade of division 05
0599: Juice of any single fruit or vegetable; mixtures
0611: Sugars, beet or cane, raw, solid form, no added matter
0612: Other beet or cane sugar and pure sucrose, in solid
0615: Molasses resulting from extracted or refined sugar
0616: Natural honey
0619: Other sugars, solid form; pure sugar syrups; caramel
0621: Fruit, nuts, part of plants, preserved by sweetening
0622: Sugar confectionery (incl. white chocola.), no cocoa
0697: Confidential trade of division 06
0699: Intrastat: estimation of missing declarations of division 06
0711: Coffee, not roasted; coffee husks and skins
0712: Coffee, roasted
0713: Extracts, essences, concentr. of coffee; substitutes
0721: Cocoa beans, whole or broken, raw or roasted
0722: Cocoa powder without added sweetening matter
0723: Cocoa paste, wether or not defatted
0724: Cocoa butter, fat or oil
0725: Cocoa shells, husks, skins and other cocoa waste
0731: Cocoa powder containing added sweetening matter
0732: Other food preparations with cocoa, content > 2 kg
0733: Other food preparations with cocoa, in blocks, bars
0739: Food preparations containing cocoa, n.e.s.
0741: Tea
0743: Mate; extracts, concentrates of tea or mate, prepar.
0751: Pepper of the genus "piper", "capsicum", "pimenta"
0752: Spices (except pepper and pimento)
0799: Intrastat: estimation of missing declarations of division 07
0811: Hay and fodder, green or dry
0812: Bran & residues, derived from cereals, leguminous
0813: Oil-cakes, solid residues, from extraction of oil
0814: Flours, meals & pellets, of meat, fish, etc, non edible
0815: Residues of starch manufacture & similar, beet-pulp
0819: Food wastes and prepared animal feeds, n.e.s.
0897: Confidential trade of division 08
0899: Intrastat: estimation of missing declarations of division 08
0910: Margarine; preparations of animal or vegetable fat
0981: Homogenized food preparation
0984: Sauces; mixed condiments and seasonings; mustard
0985: Soups and broths and preparations therefor

0986: Yeasts; other single-cell micro-organisms
0989: Food preparations, n.e.s.
0999: Intrastat: estimation of missing declarations of division 09
1110: Non-alcoholic beverages, n.e.s.
1121: Wine of fresh grapes; grape must in fermentation
1122: Fermented beverages, n.e.s. (e.g., cider, perry, mead)
1123: Beer made from malt (incl. ale, stout and porter)
1124: Spirits (other than 51216) ; liqueurs
1199: Intrastat: estimation of missing declarations of division 11
1211: Tobacco, not stemmed/stripped
1212: Tobacco, wholly or partly stemmed/stripped
1213: Tobacco refuse
1221: Cigars, cheroots and cigarillos, containing tobacco
1222: Cigarettes containing tobacco
1223: Other manufactured tobacco; extracts and essences
1299: Intrastat: estimation of missing declarations of division 12
2097: Confidential trade of section 2
2111: Bovine or equine hides and skins (excluding 2112), raw
2112: Whole bovi. hides, dried<8kg, salted<10kg, other<14kg
2114: Goat & kid skins (excluding yemen, tibet, mongol., tibet.)
2116: Sheep skins (excluding astrakan & similar), with wool on
2117: Sheep & lamb skins without wool on, raw
2119: Hides and skins, n.e.s.; waste and used leather
2121: Mink skins, raw, whole
2122: Raw furskins, other than of mink, whole
2123: Heads, tails, paws and other pieces of cuttings
2197: Confidential trade of division 21
2221: Groundnuts, not roasted or otherwise cooked
2222: Soya beans
2223: Cotton seeds
2224: Sunflower seeds
2225: Sesame seeds
2226: Rape, colza and mustard seeds
2227: Safflower seeds
2231: Copra
2232: Palm nuts and palm kernels
2234: Linseed
2235: Castor oil seeds
2237: Oil seeds and oleaginous fruits, n.e.s.
2239: Flours & meal of oil seeds or oleaginous fruits
2311: Natural rubber latex, whether or not prevulcanized
2312: Natural rubber (other than latex)
2313: Balata, guayule, chicle and similar natural gums
2440: Cork, natural, raw and wastes (incl. blocks, sheets)
2450: Fuel wood (excluding wood waste) and charcoal
2461: Wood in chips or particles
2462: Sawdust & wood waste & scrap, agglomerated or not
2473: Wood in the rough or roughly squared, treated
2474: Wood, coniferous species, in the rough, not treated
2475: Wood, non-coniferous, in the rough, not treated

2481: Railway or tramway sleepers of wood
2482: Wood of coniferous species, sawn, sliced, thick> 6mm
2483: Wood of coniferous (incl. strips, parquet) shaped
2484: Non-coniferous wood, sawn lenghtwise, thickness>6mm
2485: Non-coniferous wood, continuous. shaped, edges, faces
2499: Intrastat: estimation of missing declarations of division 24
2613: Raw silk (not thrown)
2614: Silk worn cocoons and silk waste
2631: Cotton (excluding linters), not carded or combed
2632: Cotton linters
2633: Cotton waste (including yarn waste, garneted stock)
2634: Cotton, carded or combed
2641: Jute & other textile bast fibres, raw or retted
2649: Tow & waste of jute & other textile bast fibres
2651: Flax, raw or processed but not spun; waste
2652: True hemp, raw or processed, not spun; tow and waste
2654: Sisal, textile fibres of the genus agave; waste
2655: Abaca, raw or processed; tow and waste
2657: Coconut fibres and waste of these fibres
2658: Vegetable textiles fibres, n.e.s., not spun; waste
2681: Wool, greasy (incl. fleece-washed wool)
2682: Other wool, not carded or combed
2683: Fine animal hair, not carded or combed
2685: Horsehair, coarse animal hair, not carded or combed
2686: Waste of wool or of animal hair, excluding horsehair
2687: Wool or other animal hair, carded or combed
2911: Bones, horns, ivory, claws, coral, shells and similar
2919: Materials of animal origin, n.e.s.
2922: Lac; natural gums, resins, gum-resins, and balsams
2923: Vegetable materials used primarly for plaiting
2924: Plants & parts of plants for perf., pharm., insecti.
2925: Seeds, fruits & spores, n.e.s., for sowing
2926: Bulbs, tubers, rhyzomes of flowering; cuttings, slips
2927: Cut flowers and foliage
2929: Materials of vegetable origins, n.e.s.
2997: Confidential trade of division 29
2999: Intrastat: estimation of missing declarations of division 29
4099: Intrastat: estimation of missing declarations of division 40
4111: Fats & oils, of fish or marine mammals, not modified
4112: Lard; other pig & poultry fat, rendered
4113: Animal oils, fat and greases, n.e.s.
4211: Soya bean oil & its fractions
4212: Cotton seed oil and its fractions
4213: Groundnut (peanut) oil and its fractions
4214: Olive oil and other oil obtained from olives
4215: Sunflower seed or safflower oil & their fractions
4216: Maize (corn) oil and its fractions
4217: Rape, colza or mustard oil & their fractions
4218: Sesame oil and its fractions
4221: Linseed oil and its fractions

4222: Palm oil and its fractions
4223: Coconut (copra) and its fractions
4224: Palm kernel or babassu oil and their fractions
4225: Castor oil and its fractions
4229: Other fixed vegetable fats, crude, refined, fraction.
4311: Animal or veg. oils & fats, processed; mixtu., n.e.s.
4312: Animal or veg. fats & oils, hydrog., esterif., elaid.
4313: Fatty acids, acid oils & residues; degras
4314: Waxes of animal or vegetable origin
4397: Confidential trade of division 43
59211: Wheat starch
59212: Maize starch

Appendix 2 Bilateral revealed comparative advantage indices

Table A2.1 Bilateral revealed comparative advantages of Hungary by product groups (B)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	5.60	4.81	4.77	4.05	3.94	4.67	3.30
01: Meat and meat preparations	5.06	4.50	4.69	4.50	5.12	4.82	4.56
02: Dairy products and birds' eggs	0.33	0.29	0.16	0.12	0.15	0.09	0.23
03: Fish, crustaceans, molluscs and preparations thereof	0.14	0.09	0.14	0.14	0.15	0.07	0.08
04: Cereals and cereal preparations	0.58	0.39	0.76	1.02	0.55	0.74	1.60
05: Vegetables and fruits	2.92	2.15	2.33	1.96	2.03	1.96	2.08
06: Sugar, sugar preparations and honey	0.84	0.86	0.70	0.85	1.09	0.64	1.01
07: Coffee, tea, cocoa, spices, and manufactures thereof	1.44	0.87	0.92	0.94	0.73	0.66	0.62
08: Feedstuff for animals (excluding unmilled cereals)	1.39	0.86	0.74	0.95	1.16	0.74	0.89
09: Miscellaneous edible products and preparations	0.73	0.46	0.33	0.17	0.13	0.11	0.10
11: Beverages	0.43	0.37	0.38	0.40	0.43	0.50	0.53
12: Tobacco and tobacco manufactures	0.21	0.16	0.17	0.06	0.11	0.02	0.03
21: Hides, skins and furskins, raw	1.16	1.00	1.11	0.71	0.73	0.91	0.80
22: Oil seeds and oleaginous fruits	6.47	15.75	14.61	15.24	14.49	7.45	7.25
23: Crude rubber (including synthetic and reclaimed)	0.07	0.03	0.03	0.05	0.03	0.01	0.05
24: Cork and wood	4.40	3.26	2.85	2.96	3.07	3.14	3.61
26: Textiles fibres and their wastes	0.87	0.37	0.71	0.40	0.48	1.06	0.94
29: Crude animal and vegetable materials, n.e.s.	2.03	2.24	2.70	1.93	1.97	2.02	1.96
41: Animal oils and fats	7.33	5.92	4.09	2.39	3.18	1.90	1.29
42: Fixed vegetable oils and fats, crude, refined or fractionated	0.99	0.50	0.23	0.05	0.08	0.09	0.21
43: Processed Animal and vegetable oils and fats	0.11	0.10	0.20	0.22	0.13	0.21	0.33
59212: Wheat/Maize starch	0.71	0.17	0.36	0.12	0.00	0.03	0.00

Source: Author's calculation based on SITC code data at two-digit level.

Table A2.2 Bilateral revealed trade advantages of Hungary by product groups (RTA)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	4.97	4.31	4.20	3.61	3.44	4.13	2.77
01: Meat and meat preparations	4.79	3.81	3.43	3.72	4.72	4.39	4.09
02: Dairy products and birds' eggs	-0.38	-0.57	-0.58	-0.21	-0.15	-0.27	-0.06
03: Fish. crustaceans. molluscs and preparations thereof	-0.09	-0.22	-0.26	-0.12	-0.10	-0.12	-0.10
04: Cereals and cereal preparations	0.00	-0.59	-0.52	0.51	-0.15	0.29	1.18
05: Vegetables and fruits	2.28	1.33	1.43	1.16	1.31	1.45	1.65
06: Sugar. sugar preparations and honey	0.41	-1.76	-0.39	0.03	0.39	0.25	0.62
07: Coffee. tea. cocoa. spices. and manufactures thereof	-0.23	-1.50	-1.49	-1.15	-1.50	-0.58	-0.56
08: Feedstuff for animals (excluding unmilled cereals)	-1.72	-3.20	-2.87	-2.92	-3.04	-2.20	-2.00
09: Miscellaneous edible products and preparations	-1.70	-2.87	-2.96	-1.55	-1.24	-0.88	-0.86
11: Beverages	-0.26	-0.28	-0.24	-0.12	-0.04	0.24	0.32
12: Tobacco and tobacco manufactures	-1.45	-1.13	-1.86	-1.48	-2.02	-1.37	-1.07
21: Hides. skins and furskins. raw	-0.78	-1.64	-2.09	-1.80	-1.89	-0.72	-0.02
22: Oil seeds and oleaginous fruits	0.67	0.41	-0.01	-0.16	0.13	0.39	0.09
23: Crude rubber (including synthetic and reclaimed)	4.56	13.71	12.96	13.75	12.55	6.65	6.18
24: Cork and wood	-1.76	-2.36	-2.13	-2.21	-2.06	-1.19	-1.05
26: Textiles fibres and their wastes	2.77	1.07	0.89	1.05	0.94	1.68	2.46
29: Crude animal and vegetable materials. n.e.s.	-0.43	-1.64	-1.15	-1.09	-1.00	0.11	0.08
41: Animal oils and fats	0.99	1.19	1.81	1.37	1.43	1.55	1.77
42: Fixed vegetable oils and fats. crude. refined or fractionated	6.91	4.91	1.70	1.11	2.18	0.17	-0.49
43: Processed Animal and vegetable oils and fats	6.33	4.45	2.41	-0.42	0.00	-0.38	-0.88
59212: Wheat/Maize starch	0.71	-0.26	-0.17	-0.44	-0.83	-0.21	-0.03

Source: Author's calculation based on SITC code data at two-digit level.

Table A2.3 Bilateral revealed trade advantages of Hungary by product groups (lnRXA)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	1.72	1.57	1.56	1.40	1.37	1.54	1.20
01: Meat and meat preparations	1.62	1.50	1.55	1.50	1.63	1.57	1.52
02: Dairy products and birds' eggs	-1.10	-1.25	-1.80	-2.08	-1.92	-2.39	-1.47
03: Fish. crustaceans. molluscs and preparations thereof	-1.95	-2.40	-1.96	-1.94	-1.87	-2.65	-2.53
04: Cereals and cereal preparations	-0.54	-0.94	-0.27	0.02	-0.59	-0.30	0.47
05: Vegetables and fruits	1.07	0.77	0.85	0.67	0.71	0.67	0.73
06: Sugar. sugar preparations and honey	-0.18	-0.15	-0.36	-0.17	0.08	-0.44	0.01
07: Coffee. tea. cocoa. spices. and manufactures thereof	0.37	-0.14	-0.08	-0.06	-0.32	-0.42	-0.48
08: Feedstuff for animals (excluding unmilled cereals)	0.33	-0.15	-0.30	-0.05	0.15	-0.31	-0.12
09: Miscellaneous edible products and preparations	-0.32	-0.78	-1.12	-1.79	-2.03	-2.19	-2.34
11: Beverages	-0.85	-1.00	-0.97	-0.92	-0.84	-0.70	-0.64
12: Tobacco and tobacco manufactures	-1.56	-1.81	-1.79	-2.76	-2.19	-4.19	-3.48
21: Hides. skins and furskins. raw	0.15	0.00	0.11	-0.34	-0.31	-0.09	-0.22
22: Oil seeds and oleaginous fruits	1.87	2.76	2.68	2.72	2.67	2.01	1.98
23: Crude rubber (including synthetic and reclaimed)	-2.71	-3.59	-3.61	-3.07	-3.67	-4.21	-3.02
24: Cork and wood	1.48	1.18	1.05	1.08	1.12	1.14	1.28
26: Textiles fibres and their wastes	-0.14	-1.00	-0.35	-0.91	-0.74	0.06	-0.06
29: Crude animal and vegetable materials. n.e.s.	0.71	0.81	0.99	0.66	0.68	0.70	0.67
41: Animal oils and fats	1.99	1.78	1.41	0.87	1.16	0.64	0.25
42: Fixed vegetable oils and fats. crude. refined or fractionated	-0.01	-0.69	-1.46	-2.91	-2.54	-2.38	-1.54
43: Processed Animal and vegetable oils and fats	-2.24	-2.28	-1.63	-1.51	-2.07	-1.54	-1.11
59212: Wheat/Maize starch	-0.35	-1.77	-1.03	-2.08	0.00	-3.48	-9.80

Source: Author’s calculation based on SITC code data at two-digit level.

Table A2.4 Bilateral revealed trade advantages of Hungary by product groups (RC)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	2.18	2.27	2.12	2.23	2.07	2.17	1.82
01: Meat and meat preparations	2.92	1.87	1.31	1.75	2.56	2.43	2.28
02: Dairy products and birds' eggs	-0.76	-1.10	-1.50	-0.99	-0.72	-1.37	-0.22
03: Fish. crustaceans. molluscs and preparations thereof	-0.50	-1.22	-1.04	-0.59	-0.50	-0.99	-0.79
04: Cereals and cereal preparations	-0.01	-0.92	-0.52	0.69	-0.24	0.50	1.33
05: Vegetables and fruits	1.52	0.96	0.95	0.90	1.04	1.34	1.58
06: Sugar. sugar preparations and honey	0.68	-1.12	-0.44	0.03	0.45	0.48	0.97
07: Coffee. tea. cocoa. spices. and manufactures thereof	-0.15	-1.00	-0.96	-0.80	-1.12	-0.63	-0.64
08: Feedstuff for animals (excluding unmilled cereals)	-0.81	-1.55	-1.58	-1.40	-1.29	-1.38	-1.18
09: Miscellaneous edible products and preparations	-1.21	-1.98	-2.31	-2.33	-2.34	-2.18	-2.30
11: Beverages	-0.47	-0.56	-0.48	-0.25	-0.08	0.65	0.94
12: Tobacco and tobacco manufactures	-2.07	-2.07	-2.49	-3.19	-2.95	-4.52	-3.58
21: Hides. skins and furskins. raw	-0.51	-0.97	-1.06	-1.26	-1.27	-0.58	-0.03
22: Oil seeds and oleaginous fruits	2.59	3.27	2.57	2.86	3.18	2.66	2.32
23: Crude rubber (including synthetic and reclaimed)	-3.36	-4.30	-4.11	-3.47	-4.33	-3.98	-3.09
24: Cork and wood	0.88	0.31	0.28	0.27	0.39	0.96	1.19
26: Textiles fibres and their wastes	-0.63	-1.79	-1.02	-1.55	-1.49	-0.31	-0.20
29: Crude animal and vegetable materials. n.e.s.	0.44	0.11	0.38	0.26	0.28	0.75	0.82
41: Animal oils and fats	1.96	1.73	1.52	1.45	1.77	1.40	1.90
42: Fixed vegetable oils and fats, crude, refined or fractionated	0.85	-0.70	-2.33	-3.16	-2.53	-2.93	-2.12
43: Processed Animal and vegetable oils and fats	-2.24	-2.67	-2.15	-2.54	-3.23	-2.37	-1.88
59212: Wheat/Maize starch	0.95	-1.50	-0.12	-1.38	0.10	-2.29	-8.37

Source: Author's calculation based on SITC code data at two-digit level.

Appendix 3 Regional revealed comparative advantage indices

Table A3.1 Regional revealed comparative advantages of Hungary by product groups (B)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	4.47	4.58	4.12	3.66	4.35	3.41	2.38
01: Meat and meat preparations	4.38	4.50	4.21	4.34	5.30	3.66	2.89
02: Dairy products and birds' eggs	0.51	0.53	0.36	0.38	0.52	0.39	0.46
03: Fish, crustaceans, molluscs and preparations thereof	0.12	0.10	0.15	0.14	0.17	0.06	0.07
04: Cereals and cereal preparations	4.05	1.06	1.78	4.65	1.29	2.28	2.43
05: Vegetables and fruits	2.88	3.15	3.42	2.93	3.06	1.95	1.53
06: Sugar, sugar preparations and honey	1.91	0.90	0.75	1.18	1.38	0.97	1.22
07: Coffee, tea, cocoa, spices, and manufactures thereof	1.20	1.11	1.22	1.10	1.24	0.75	0.57
08: Feedstuff for animals (excluding unmilled cereals)	1.51	1.12	0.77	0.97	1.48	0.78	0.79
09: Miscellaneous edible products and preparations	0.86	1.00	0.87	0.76	0.88	0.55	0.52
11: Beverages	0.96	1.61	1.32	1.74	1.56	0.79	0.65
12: Tobacco and tobacco manufactures	0.65	0.64	0.37	0.26	1.84	1.04	0.36
21: Hides, skins and furskins, raw	0.95	0.99	1.01	0.62	0.72	0.61	0.39
22: Oil seeds and oleaginous fruits	6.75	14.20	11.86	12.58	13.54	5.26	3.74
23: Crude rubber (including synthetic and reclaimed)	0.27	3.36	1.31	1.25	0.07	0.07	0.08
24: Cork and wood	3.02	2.62	2.16	2.29	2.32	1.60	1.56
26: Textiles fibres and their wastes	1.00	0.85	0.96	0.73	0.65	0.73	0.52
29: Crude animal and vegetable materials, n.e.s.	1.69	2.07	2.29	1.66	1.78	1.24	1.01
41: Animal oils and fats	5.29	5.10	3.79	1.93	3.04	1.44	0.90
42: Fixed vegetable oils and fats, crude, refined or fractionated	4.15	3.37	2.66	2.04	2.09	2.79	2.04
43: Processed Animal and vegetable oils and fats	0.08	0.09	0.15	0.15	0.10	0.12	0.14
59212: Wheat/Maize starch	0.79	0.41	0.45	0.26	0.35	0.36	0.05

Source: Author's calculation based on SITC code data at two-digit level.

Table A3.2 Regional revealed trade advantages of Hungary by product groups (RTA)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	4.09	4.37	3.86	3.44	4.09	3.07	2.04
01: Meat and meat preparations	4.22	4.22	3.64	3.94	5.10	3.39	2.59
02: Dairy products and birds' eggs	0.08	0.17	0.02	0.21	0.37	0.16	0.28
03: Fish. crustaceans. molluscs and preparations thereof	-0.02	-0.02	-0.03	0.00	0.04	-0.06	-0.04
04: Cereals and cereal preparations	3.69	0.66	1.20	4.38	0.94	1.99	2.15
05: Vegetables and fruits	2.50	2.81	3.01	2.52	2.70	1.62	1.25
06: Sugar. sugar preparations and honey	1.65	-0.19	0.25	0.76	1.03	0.72	0.97
07: Coffee. tea. cocoa. spices. and manufactures thereof	0.20	0.13	0.12	0.01	0.11	-0.04	-0.20
08: Feedstuff for animals (excluding unmilled cereals)	-0.38	-0.57	-0.90	-1.07	-0.67	-1.11	-1.11
09: Miscellaneous edible products and preparations	-0.60	-0.38	-0.64	-0.14	0.19	-0.08	-0.10
11: Beverages	0.55	1.34	1.04	1.47	1.32	0.63	0.51
12: Tobacco and tobacco manufactures	-0.35	0.11	-0.55	-0.55	0.75	0.15	-0.36
21: Hides. skins and furskins. raw	-0.21	-0.10	-0.46	-0.70	-0.61	-0.44	-0.15
22: Oil seeds and oleaginous fruits	6.45	13.95	11.34	12.13	13.24	4.93	3.28
23: Crude rubber (including synthetic and reclaimed)	-0.88	2.52	0.55	0.47	-0.92	-0.44	-0.62
24: Cork and wood	1.92	1.63	1.17	1.11	1.26	0.83	0.85
26: Textiles fibres and their wastes	0.02	-0.06	0.06	-0.26	-0.44	-0.20	-0.24
29: Crude animal and vegetable materials. n.e.s.	0.91	1.24	1.43	0.88	1.03	0.63	0.44
41: Animal oils and fats	4.66	4.66	3.39	1.63	2.77	1.14	0.78
42: Fixed vegetable oils and fats. crude. refined or fractionated	3.90	2.95	1.57	1.36	1.58	1.68	0.88
43: Processed Animal and vegetable oils and fats	-0.53	-0.51	-0.62	-1.32	-1.52	-1.34	-1.28
59212: Wheat/Maize starch	0.62	0.09	0.27	0.00	-0.11	0.16	-0.10

Source: Author's calculation based on SITC code data at two-digit level.

Table A3.3 Bilateral revealed trade advantages of Hungary by product groups (lnRXA)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	1.50	1.52	1.42	1.30	1.47	1.23	0.87
01: Meat and meat preparations	1.48	1.50	1.44	1.47	1.67	1.30	1.06
02: Dairy products and birds' eggs	-0.68	-0.64	-1.02	-0.97	-0.65	-0.94	-0.77
03: Fish. crustaceans. molluscs and preparations thereof	-2.11	-2.28	-1.89	-1.98	-1.76	-2.73	-2.62
04: Cereals and cereal preparations	1.40	0.06	0.58	1.54	0.26	0.82	0.89
05: Vegetables and fruits	1.06	1.15	1.23	1.08	1.12	0.67	0.43
06: Sugar. sugar preparations and honey	0.65	-0.11	-0.29	0.17	0.33	-0.03	0.20
07: Coffee. tea. cocoa. spices. and manufactures thereof	0.19	0.11	0.20	0.10	0.22	-0.29	-0.57
08: Feedstuff for animals (excluding unmilled cereals)	0.41	0.12	-0.26	-0.03	0.39	-0.25	-0.24
09: Miscellaneous edible products and preparations	-0.15	0.00	-0.14	-0.28	-0.12	-0.60	-0.65
11: Beverages	-0.04	0.47	0.28	0.55	0.44	-0.23	-0.43
12: Tobacco and tobacco manufactures	-0.43	-0.44	-0.99	-1.35	0.61	0.04	-1.03
21: Hides. skins and furskins. raw	-0.05	-0.01	0.01	-0.49	-0.32	-0.50	-0.95
22: Oil seeds and oleaginous fruits	1.91	2.65	2.47	2.53	2.61	1.66	1.32
23: Crude rubber (including synthetic and reclaimed)	-1.32	1.21	0.27	0.22	-2.69	-2.64	-2.48
24: Cork and wood	1.11	0.96	0.77	0.83	0.84	0.47	0.45
26: Textiles fibres and their wastes	0.00	-0.17	-0.04	-0.31	-0.44	-0.31	-0.66
29: Crude animal and vegetable materials. n.e.s.	0.53	0.73	0.83	0.51	0.58	0.21	0.01
41: Animal oils and fats	1.67	1.63	1.33	0.66	1.11	0.36	-0.10
42: Fixed vegetable oils and fats. crude. refined or fractionated	1.42	1.21	0.98	0.71	0.74	1.03	0.71
43: Processed Animal and vegetable oils and fats	-2.58	-2.36	-1.92	-1.89	-2.31	-2.11	-1.96
59212: Wheat/Maize starch	-0.24	-0.89	-0.80	-1.34	-1.06	-1.02	-2.93

Source: Author's calculation based on SITC code data at two-digit level.

Table A3.4 Regional revealed trade advantages of Hungary by product groups (RC)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	2.46	3.10	2.75	2.78	2.84	2.30	1.93
01: Meat and meat preparations	3.30	2.76	1.99	2.37	3.28	2.61	2.26
02: Dairy products and birds' eggs	0.18	0.40	0.06	0.78	1.24	0.53	0.92
03: Fish. crustaceans. molluscs and preparations thereof	-0.15	-0.22	-0.18	0.03	0.30	-0.62	-0.45
04: Cereals and cereal preparations	2.44	0.97	1.11	2.87	1.29	2.08	2.18
05: Vegetables and fruits	2.02	2.23	2.13	1.96	2.14	1.79	1.71
06: Sugar. sugar preparations and honey	2.01	-0.19	0.41	1.02	1.37	1.34	1.59
07: Coffee. tea. cocoa. spices. and manufactures thereof	0.18	0.13	0.10	0.01	0.09	-0.05	-0.30
08: Feedstuff for animals (excluding unmilled cereals)	-0.22	-0.41	-0.77	-0.74	-0.38	-0.88	-0.88
09: Miscellaneous edible products and preparations	-0.53	-0.32	-0.55	-0.17	0.24	-0.14	-0.18
11: Beverages	0.85	1.79	1.55	1.87	1.88	1.57	1.58
12: Tobacco and tobacco manufactures	-0.43	0.18	-0.91	-1.13	0.53	0.15	-0.70
21: Hides. skins and furskins. raw	-0.20	-0.10	-0.38	-0.76	-0.61	-0.54	-0.33
22: Oil seeds and oleaginous fruits	3.14	4.05	3.14	3.32	3.79	2.76	2.08
23: Crude rubber (including synthetic and reclaimed)	-1.45	1.38	0.54	0.47	-2.67	-1.96	-2.13
24: Cork and wood	1.01	0.97	0.78	0.66	0.78	0.73	0.78
26: Textiles fibres and their wastes	0.02	-0.07	0.06	-0.31	-0.52	-0.24	-0.38
29: Crude animal and vegetable materials. n.e.s.	0.77	0.91	0.99	0.75	0.86	0.71	0.58
41: Animal oils and fats	2.14	2.46	2.23	1.88	2.41	1.56	1.97
42: Fixed vegetable oils and fats, crude, refined or fractionated	2.79	2.09	0.89	1.11	1.42	0.92	0.56
43: Processed Animal and vegetable oils and fats	-2.08	-1.87	-1.66	-2.28	-2.79	-2.49	-2.31
59212: Wheat/Maize starch	1.56	0.26	0.89	0.01	-0.29	0.61	-1.07

Source: Author's calculation based on SITC code data at two-digit level.

Appendix 4 Global revealed comparative advantage indices

Table A4.1 Global revealed comparative advantages of Hungary by product groups (B)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	5.80	6.06	5.77	4.99	5.96	4.37	3.04
01: Meat and meat preparations	6.25	6.70	6.12	6.05	7.12	6.28	1.63
02: Dairy products and birds' eggs	1.00	1.11	0.74	0.77	1.01	0.77	0.90
03: Fish, crustaceans, molluscs and preparations thereof	0.06	0.05	0.08	0.07	0.09	0.04	0.04
04: Cereals and cereal preparations	3.75	1.05	1.62	4.01	1.06	1.94	2.04
05: Vegetables and fruits	2.68	2.86	2.81	2.48	2.49	1.80	1.41
06: Sugar, sugar preparations and honey	1.91	0.95	0.72	1.12	1.13	0.88	1.11
07: Coffee, tea, cocoa, spices, and manufactures thereof	1.00	0.97	0.98	0.90	1.02	0.58	0.43
08: Feedstuff for animals (excluding unmilled cereals)	1.30	1.02	0.72	0.92	1.22	0.67	0.72
09: Miscellaneous edible products and preparations	1.48	1.74	1.46	1.30	1.51	0.93	0.87
11: Beverages	1.77	3.13	2.49	3.16	2.82	1.50	1.18
12: Tobacco and tobacco manufactures	0.50	0.48	0.25	0.17	1.31	0.87	0.29
21: Hides, skins and furskins, raw	0.93	0.98	1.01	0.57	0.73	0.59	0.37
22: Oil seeds and oleaginous fruits	2.48	3.77	3.23	3.10	3.12	1.42	1.21
23: Crude rubber (including synthetic and reclaimed)	0.01	0.13	0.05	0.05	0.00	0.00	0.01
24: Cork and wood	1.72	1.37	1.29	1.43	1.31	0.95	1.01
26: Textiles fibres and their wastes	0.32	0.31	0.35	0.26	0.21	0.25	0.17
29: Crude animal and vegetable materials, n.e.s.	2.27	3.00	3.33	2.34	2.56	1.79	1.49
41: Animal oils and fats	5.29	4.87	3.72	1.78	2.97	1.50	0.91
42: Fixed vegetable oils and fats, crude, refined or fractionated	3.36	2.80	1.94	1.52	1.73	2.17	1.48
43: Processed Animal and vegetable oils and fats	0.07	0.09	0.13	0.12	0.09	0.12	0.14

Source: Author's calculation based on SITC code data at two-digit level.

Table A4.2 Global revealed trade advantages of Hungary by product groups (RTA)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	5.31	5.79	5.41	4.71	5.64	3.93	2.60
01: Meat and meat preparations	6.04	6.31	5.35	5.51	6.86	5.93	1.25
02: Dairy products and birds' eggs	0.33	0.50	0.15	0.47	0.75	0.37	0.59
03: Fish. crustaceans. molluscs and preparations thereof	-0.06	-0.06	-0.08	-0.05	-0.03	-0.08	-0.07
04: Cereals and cereal preparations	3.51	0.75	1.20	3.82	1.00	1.74	1.86
05: Vegetables and fruits	2.22	2.43	2.30	2.00	2.06	1.40	1.08
06: Sugar. sugar preparations and honey	1.68	-0.09	0.31	0.77	0.84	0.66	0.91
07: Coffee. tea. cocoa. spices. and manufactures thereof	-0.18	-0.32	-0.54	-0.70	-0.50	-0.55	-0.55
08: Feedstuff for animals (excluding unmilled cereals)	-1.19	-1.43	-1.74	-1.90	-1.55	-1.73	-1.60
09: Miscellaneous edible products and preparations	-0.34	-0.11	-0.49	0.16	0.64	0.18	0.14
11: Beverages	1.29	2.81	2.14	2.83	2.52	1.29	1.01
12: Tobacco and tobacco manufactures	-0.40	-0.02	-0.70	-0.63	0.27	0.00	-0.42
21: Hides. skins and furskins. raw	0.47	-0.17	-0.71	-0.87	-0.73	-0.60	-0.27
22: Oil seeds and oleaginous fruits	2.12	3.45	2.54	2.50	2.75	1.04	0.67
23: Crude rubber (including synthetic and reclaimed)	-0.57	-0.32	-0.38	-0.38	-0.51	-0.28	-0.39
24: Cork and wood	0.77	0.62	0.44	0.40	0.45	0.29	0.34
26: Textiles fibres and their wastes	-0.59	-0.54	-0.54	-0.66	-0.76	-0.66	-0.56
29: Crude animal and vegetable materials. n.e.s.	1.21	1.85	2.11	1.25	1.52	0.92	0.69
41: Animal oils and fats	4.51	4.31	3.18	1.42	2.64	1.13	0.78
42: Fixed vegetable oils and fats. crude. refined or fractionated	3.16	2.43	1.02	1.01	1.29	1.23	0.55
43: Processed Animal and vegetable oils and fats	-0.60	-0.60	-0.80	-1.50	-1.97	-1.79	-1.65

Source: Author's calculation based on SITC code data at two-digit level.

Table A4.3 Global revealed trade advantages of Hungary by product groups (lnRXA)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	1.76	1.80	1.75	1.61	1.79	1.47	1.11
01: Meat and meat preparations	1.83	1.90	1.81	1.80	1.96	1.84	0.49
02: Dairy products and birds' eggs	0.00	0.10	-0.30	-0.26	0.01	-0.26	-0.10
03: Fish. crustaceans. molluscs and preparations thereof	-2.79	-2.97	-2.57	-2.65	-2.38	-3.35	-3.20
04: Cereals and cereal preparations	1.32	0.05	0.48	1.39	0.06	0.66	0.71
05: Vegetables and fruits	0.98	1.05	1.03	0.91	0.91	0.59	0.34
06: Sugar. sugar preparations and honey	0.65	-0.05	-0.33	0.12	0.13	-0.13	0.11
07: Coffee. tea. cocoa. spices. and manufactures thereof	0.00	-0.03	-0.02	-0.11	0.02	-0.55	-0.85
08: Feedstuff for animals (excluding unmilled cereals)	0.26	0.02	-0.33	-0.08	0.20	-0.41	-0.32
09: Miscellaneous edible products and preparations	0.39	0.56	0.38	0.26	0.41	-0.08	-0.14
11: Beverages	0.57	1.14	0.91	1.15	1.04	0.41	0.17
12: Tobacco and tobacco manufactures	-0.69	-0.73	-1.40	-1.74	0.27	-0.14	-1.22
21: Hides. skins and furskins. raw	-0.07	-0.02	0.01	-0.57	-0.31	-0.52	-0.99
22: Oil seeds and oleaginous fruits	0.91	1.33	1.17	1.13	1.14	0.35	0.19
23: Crude rubber (including synthetic and reclaimed)	-4.66	-2.04	-3.09	-3.03	-5.93	-5.59	-5.17
24: Cork and wood	0.54	0.31	0.26	0.36	0.27	-0.05	0.01
26: Textiles fibres and their wastes	-1.14	-1.16	-1.06	-1.35	-1.54	-1.40	-1.77
29: Crude animal and vegetable materials. n.e.s.	0.82	1.10	1.20	0.85	0.94	0.58	0.40
41: Animal oils and fats	1.67	1.58	1.31	0.58	1.09	0.41	-0.10
42: Fixed vegetable oils and fats. crude. refined or fractionated	1.21	1.03	0.66	0.42	0.55	0.78	0.39
43: Processed Animal and vegetable oils and fats	-2.61	-2.36	-2.03	-2.12	-2.38	-2.10	-1.94

Source: Author's calculation based on SITC code data at two-digit level.

Table A4.4 Global revealed trade advantages of Hungary by product groups (RC)

SITC	1992	1993	1994	1995	1996	1997	1998
00: Live animals other than animals of division 03	2.47	3.11	2.78	2.88	2.92	2.31	1.94
01: Meat and meat preparations	3.37	2.85	2.08	2.43	3.30	2.87	1.45
02: Dairy products and birds' eggs	0.40	0.60	0.22	0.93	1.37	0.66	1.06
03: Fish. crustaceans. molluscs and preparations thereof	-0.70	-0.77	-0.72	-0.51	-0.24	-1.17	-1.04
04: Cereals and cereal preparations	2.77	1.24	1.34	3.06	2.88	2.29	2.41
05: Vegetables and fruits	1.76	1.90	1.71	1.64	1.77	1.50	1.45
06: Sugar. sugar preparations and honey	2.11	-0.09	0.56	1.16	1.35	1.38	1.69
07: Coffee. tea. cocoa. spices. and manufactures thereof	-0.17	-0.28	-0.44	-0.58	-0.40	-0.67	-0.83
08: Feedstuff for animals (excluding unmilled cereals)	-0.65	-0.88	-1.23	-1.12	-0.82	-1.28	-1.16
09: Miscellaneous edible products and preparations	-0.21	-0.06	-0.29	0.13	0.55	0.21	0.17
11: Beverages	1.31	2.27	1.98	2.27	2.25	1.95	1.94
12: Tobacco and tobacco manufactures	-0.58	-0.04	-1.35	-1.53	0.23	0.00	-0.89
21: Hides. skins and furskins. raw	0.70	-0.16	-0.54	-0.93	-0.69	-0.70	-0.54
22: Oil seeds and oleaginous fruits	1.94	2.47	1.54	1.64	2.14	1.30	0.80
23: Crude rubber (including synthetic and reclaimed)	-4.11	-1.23	-2.24	-2.19	-5.26	-4.32	-4.24
24: Cork and wood	0.60	0.60	0.41	0.33	0.42	0.36	0.41
26: Textiles fibres and their wastes	-1.04	-1.01	-0.94	-1.26	-1.51	-1.30	-1.45
29: Crude animal and vegetable materials. n.e.s.	0.76	0.96	1.01	0.77	0.90	0.72	0.62
41: Animal oils and fats	1.91	2.15	1.93	1.61	2.21	1.40	1.96
42: Fixed vegetable oils and fats, crude, refined or fractionated	2.84	2.01	0.74	1.08	1.37	0.84	0.47
43: Processed Animal and vegetable oils and fats	-2.22	-2.00	-1.96	-2.60	-3.10	-2.74	-2.53

Source: Author's calculation based on SITC code data at two-digit level.

Appendix 5 Horizontal, vertical and total vertical intra-industry trade in agri-food products between Hungary and the EU, 1992-98

		1992	1993	1994	1995	1996	1997	1998
Austria	Horizontal	0.04	0.03	0.10	0.10	0.13	0.11	0.14
	Vertical	0.20	0.23	0.19	0.21	0.12	0.18	0.14
	Total	0.24	0.26	0.29	0.31	0.25	0.29	0.28
Belgium	Horizontal	0.00	0.00	0.01	0.00	0.07	0.02	0.11
	Vertical	0.28	0.32	0.33	0.19	0.09	0.09	0.19
	Total	0.28	0.32	0.33	0.19	0.16	0.11	0.30
Denmark	Horizontal	0.05	0.00	0.00	0.02	0.01	0.04	0.09
	Vertical	0.22	0.25	0.15	0.11	0.13	0.33	0.12
	Total	0.27	0.25	0.15	0.13	0.14	0.36	0.21
Finland	Horizontal	0.02	0.27	0.00	0.08	0.07	0.19	0.00
	Vertical	0.34	0.44	0.44	0.14	0.10	0.00	0.52
	Total	0.36	0.71	0.44	0.22	0.17	0.20	0.52
France	Horizontal	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	Vertical	0.08	0.15	0.15	0.20	0.15	0.17	0.23
	Total	0.09	0.16	0.16	0.21	0.16	0.18	0.24
Germany	Horizontal	0.02	0.02	0.01	0.01	0.02	0.01	0.01
	Vertical	0.11	0.17	0.17	0.20	0.21	0.14	0.16
	Total	0.13	0.19	0.18	0.21	0.23	0.15	0.17
Greece	Horizontal	0.13	0.00	0.00	0.00	0.00	0.00	0.01
	Vertical	0.04	0.21	0.20	0.09	0.08	0.05	0.02
	Total	0.17	0.21	0.20	0.09	0.08	0.05	0.03
Ireland	Horizontal	0.20	0.00	0.00	0.00	0.00	0.00	0.03
	Vertical	0.00	0.34	0.00	0.11	0.03	0.17	0.19
	Total	0.20	0.34	0.00	0.12	0.03	0.17	0.22
Italy	Horizontal	0.01	0.05	0.01	0.01	0.01	0.01	0.02
	Vertical	0.15	0.09	0.16	0.09	0.09	0.12	0.15
	Total	0.16	0.14	0.17	0.10	0.10	0.14	0.17
Netherlands	Horizontal	0.01	0.04	0.02	0.01	0.01	0.00	0.02
	Vertical	0.23	0.22	0.19	0.20	0.24	0.31	0.29
	Total	0.23	0.26	0.22	0.20	0.25	0.32	0.32
Portugal	Horizontal	0.00	0.80	0.00	0.00	0.00	0.03	0.28
	Vertical	0.00	0.00	0.00	0.20	0.95	0.34	0.16
	Total	0.00	0.80	0.00	0.20	0.95	0.37	0.43
Spain	Horizontal	0.09	0.05	0.00	0.12	0.02	0.00	0.00
	Vertical	0.32	0.18	0.05	0.14	0.13	0.05	0.08
	Total	0.41	0.23	0.05	0.27	0.15	0.05	0.09
Sweden	Horizontal	0.00	0.01	0.00	0.00	0.02	0.00	0.03
	Vertical	0.07	0.08	0.14	0.19	0.27	0.50	0.21
	Total	0.07	0.09	0.15	0.19	0.29	0.50	0.23
UK	Horizontal	0.00	0.02	0.01	0.01	0.00	0.02	0.01

	Vertical	0.12	0.07	0.12	0.08	0.10	0.18	0.21
	Total	0.13	0.09	0.13	0.08	0.10	0.20	0.22
EU15	Horizontal	0.03	0.02	0.03	0.03	0.02	0.06	0.06
	Vertical	0.16	0.21	0.23	0.19	0.20	0.17	0.19
	Total	0.18	0.23	0.27	0.22	0.22	0.23	0.26

Source: Author's calculation based on SITC code data at four-digit level.

Note: Calculation based on the Greenaway et. al. (1994) method

Appendix 6 Product coverage of horizontal, vertical and total vertical intra-industry trade in agri-food products between Hungary and the EU, 1992-98

		1992	1993	1994	1995	1996	1997	1998
Austria	Horizontal	13	8	16	14	14	15	11
	Vertical	82	84	75	69	70	62	59
	Total	95	92	91	83	84	77	70
Belgium	Horizontal	1	1	2	1	5	3	6
	Vertical	26	27	25	27	21	24	18
	Total	27	28	27	28	26	27	24
Denmark	Horizontal	2	2	1	1	2	3	2
	Vertical	10	16	15	10	8	8	10
	Total	12	18	16	11	10	11	12
Finland	Horizontal	1	1	0	1	1	2	0
	Vertical	8	1	5	3	5	1	3
	Total	9	2	5	4	6	3	3
France	Horizontal	3	4	3	2	4	5	4
	Vertical	19	25	34	30	30	28	33
	Total	22	29	37	32	34	33	37
Germany	Horizontal	11	9	11	9	9	9	10
	Vertical	85	88	82	87	74	79	74
	Total	96	97	93	96	83	88	84
Greece	Horizontal	2	0	0	0	0	0	1
	Vertical	3	3	5	6	8	6	4
	Total	5	3	5	6	8	6	5
Ireland	Horizontal	1	0	0	1	0	0	2
	Vertical	0	2	0	2	1	5	4
	Total	1	2	0	3	1	5	6
Italy	Horizontal	2	3	2	6	5	6	5
	Vertical	42	38	51	51	49	54	47
	Total	44	41	53	57	54	60	52
Netherlands	Horizontal	3	7	7	2	2	2	6
	Vertical	50	44	51	62	48	59	50
	Total	53	51	58	64	50	61	56
Portugal	Horizontal	0	1	0	0	0	1	2
	Vertical	0	0	0	2	1	2	2
	Total	0	1	0	2	1	3	4
Spain	Horizontal	2	2	0	3	2	1	2
	Vertical	8	8	9	4	12	13	14
	Total	10	10	9	7	14	14	16
Sweden	Horizontal	2	1	1	0	3	0	2
	Vertical	11	12	15	12	10	7	8
	Total	13	13	16	12	13	7	10
UK	Horizontal	2	2	3	3	2	4	2
	Vertical	19	14	19	19	23	22	20

	Total	21	16	22	22	25	26	22
EU15	Horizontal	17	19	23	19	19	20	25
	Vertical	127	121	118	128	124	124	121
	Total	144	140	141	147	143	144	146

Source: Author's calculation based on SITC code data at four-digit level.

Note: Data relate to Appendix 5.

Appendix 7 Share of trade types in agri-food trade between Hungary and the EU, 1992-98

		1992	1993	1994	1995	1996	1997	1998
Austria	One way trade	0.54	0.54	0.57	0.51	0.60	0.46	0.61
	HTWT	0.05	0.07	0.14	0.11	0.16	0.16	0.16
	VTWT	0.42	0.39	0.29	0.38	0.23	0.38	0.21
	TTWT	0.46	0.46	0.43	0.49	0.40	0.54	0.38
Belgium	One way trade	0.48	0.52	0.25	0.65	0.77	0.78	0.40
	HTWT	0.00	0.01	0.01	0.01	0.12	0.05	0.12
	VTWT	0.52	0.48	0.75	0.34	0.12	0.17	0.48
	TTWT	0.52	0.48	0.75	0.35	0.23	0.22	0.60
Denmark	One way trade	0.55	0.16	0.89	0.94	0.87	0.30	0.49
	HTWT	0.09	0.00	0.00	0.00	0.00	0.11	0.18
	VTWT	0.36	0.84	0.11	0.06	0.13	0.58	0.33
	TTWT	0.45	0.84	0.11	0.06	0.13	0.70	0.51
Finland	One way trade	0.47	0.00	0.13	0.40	0.70	0.73	0.00
	HTWT	0.00	0.46	0.00	0.28	0.21	0.27	0.00
	VTWT	0.53	0.54	0.87	0.32	0.10	0.00	1.00
	TTWT	0.53	1.00	0.87	0.60	0.30	0.27	1.00
France	One way trade	0.85	0.79	0.73	0.53	0.73	0.71	0.68
	HTWT	0.02	0.02	0.02	0.03	0.01	0.00	0.00
	VTWT	0.13	0.19	0.24	0.45	0.26	0.29	0.32
	TTWT	0.15	0.21	0.26	0.47	0.27	0.29	0.32
Germany	one way trade	0.78	0.57	0.59	0.60	0.48	0.65	0.70
	HTWT	0.03	0.04	0.01	0.01	0.04	0.03	0.01
	VTWT	0.19	0.38	0.40	0.39	0.48	0.32	0.29
	TTWT	0.22	0.42	0.41	0.40	0.52	0.35	0.30
Greece	One way trade	0.67	0.79	0.49	0.93	0.94	0.95	0.97
	HTWT	0.17	0.00	0.00	0.00	0.00	0.00	0.00
	VTWT	0.16	0.21	0.51	0.07	0.06	0.05	0.03
	TTWT	0.33	0.21	0.51	0.07	0.06	0.05	0.03
Ireland	One way trade	0.00	0.00	0.00	0.98	1.00	0.64	0.65
	HTWT	1.00	0.00	0.00	0.01	0.00	0.00	0.06
	VTWT	0.00	1.00	0.00	0.01	0.00	0.36	0.28
	TTWT	1.00	1.00	0.00	0.02	0.00	0.36	0.35
Italy	One way trade	0.73	0.75	0.68	0.81	0.86	0.83	0.78
	HTWT	0.02	0.09	0.02	0.02	0.01	0.02	0.04
	VTWT	0.26	0.16	0.31	0.17	0.13	0.15	0.18
	TTWT	0.27	0.25	0.32	0.19	0.14	0.17	0.22
Netherlands	One way trade	0.56	0.59	0.64	0.66	0.53	0.46	0.34
	HTWT	0.01	0.00	0.04	0.00	0.01	0.00	0.03
	VTWT	0.43	0.40	0.33	0.34	0.46	0.53	0.63
	TTWT	0.44	0.41	0.36	0.34	0.47	0.54	0.66
Portugal	One way trade	0.00	0.00	0.00	0.94	0.00	0.00	0.22

	HTWT	0.00	1.00	0.00	0.00	0.00	0.08	0.58
	VTWT	0.00	0.00	0.00	0.06	1.00	0.92	0.20
	TTWT	0.00	1.00	0.00	0.06	1.00	1.00	0.78
Spain	One way trade	0.00	0.65	0.92	0.32	0.81	0.91	0.91
	HTWT	0.29	0.15	0.00	0.23	0.03	0.00	0.00
	VTWT	0.71	0.19	0.08	0.45	0.16	0.09	0.09
	TTWT	1.00	0.35	0.08	0.68	0.19	0.09	0.10
Sweden	One way trade	0.94	0.95	0.56	0.57	0.46	0.51	0.75
	HTWT	0.00	0.00	0.00	0.00	0.01	0.00	0.00
	VTWT	0.05	0.05	0.43	0.43	0.53	0.49	0.25
	TTWT	0.06	0.05	0.44	0.43	0.54	0.49	0.25
UK	One way trade	0.68	0.78	0.81	0.87	0.78	0.63	0.72
	HTWT	0.00	0.00	0.00	0.01	0.00	0.02	0.00
	VTWT	0.21	0.21	0.19	0.14	0.22	0.35	0.28
	TTWT	0.22	0.22	0.19	0.15	0.22	0.37	0.28
EU15	One way trade	0.70	0.56	0.58	0.56	0.58	0.53	0.61
	HTWT	0.05	0.04	0.05	0.10	0.05	0.08	0.10
	VTWT	0.25	0.40	0.37	0.34	0.38	0.39	0.29
	TTWT	0.29	0.44	0.42	0.44	0.42	0.47	0.39

Source: Author's calculation based on SITC code data at four-digit level.

Note: HTWT: horizontal two-way trade

VTWT: vertical two-way trade

TTWT: total two-way trade

Appendix 8 Nilsson's measure of horizontal, vertical and total vertical intra-industry trade in agri-food trade between Hungary and the EU, 1992-98

		1992	1993	1994	1995	1996	1997	1998
Austria	Horizontal	2425077	719500	2735750	3065714	3518286	2310667	3901455
	Vertical	1536415	1621095	170216	1860841	984314	1429452	1209390
	Total	1658021	1542696	712637	2064072	1406643	1601117	1632429
Belgium	Horizontal	18000	16000	87000	58000	1069600	1534000	577667
	Vertical	432462	718308	1051200	760692	707905	757083	1336778
	Total	417852	703185	1035926	734667	863000	843407	1158083
Denmark	Horizontal	236000	15000	38000	242000	82000	285333	1508000
	Vertical	758600	560250	601600	682000	1125250	486500	235600
	Total	671500	499667	569625	878909	954200	531636	447667
Finland	Horizontal	42000	114000	0	76000	148000	681000	0
	Vertical	178000	182000	856800	45333	146800	26000	472000
	Total	215556	191000	856800	150500	147000	462667	472000
France	Horizontal	976000	714500	984667	951000	1358000	881200	184000
	Vertical	549579	1471200	2413471	1341533	990400	1331786	1649212
	Total	607727	1366828	2297622	1317125	1033647	1263515	1490811
Germany	Horizontal	4450000	1845111	3398545	705333	2292000	1999556	893200
	Vertical	1537600	1958409	2826707	1888598	2169703	2174456	2265270
	Total	1915125	2167010	2894344	1777667	2182964	2162795	2101929
Greece	Horizontal	211000	0	0	0	0	0	80000
	Vertical	36667	110667	91600	428667	53583	66333	86000
	Total	106400	110667	91600	428667	53583	66333	1174400
Ireland	Horizontal	28000	0	0	32000	0	0	17000
	Vertical	0	32000	0	603000	20000	54800	124500
	Total	28000	32000	0	465333	20000	54800	88667
Italy	Horizontal	332000	1036000	709000	1703000	526800	539667	688400
	Vertical	349381	427842	956745	544078	1157143	1025370	1014809
	Total	348591	472341	947396	699930	1226259	976800	1142549
Netherlands	Horizontal	128000	1172571	2614857	412000	433000	166000	821000
	Vertical	1322120	1260818	1881255	1925581	1683792	1461322	1887400
	Total	1254528	1248706	1969793	1952000	1645960	1425246	1817071
Portugal	Horizontal	0	114000	0	0	0	30000	189000
	Vertical	0	0	0	113000	396000	267000	90000
	Total	0	114000	0	113000	396000	226000	156000
Spain	Horizontal	197000	434000	0	124667	51000	76000	141000
	Vertical	301000	132250	311333	385500	470667	631385	654714
	Total	280200	231000	311333	273714	424714	648857	660125
Sweden	Horizontal	67000	210000	64000	0	160000	0	0
	Vertical	113091	352000	431867	278833	848000	794000	99,250
	Total	106000	341077	410500	278833	689231	794000	79,400
UK	Horizontal	89000	201000	209333	49333	31000	194000	78000
	Vertical	455263	255143	741579	348526	359304	683182	863200
	Total	650667	489625	669000	307727	333040	607923	858000

Source: Author's calculation based on SITC code data at four-digit level.

Note: Nilsson's measure: the level of IIT/number of products

Appendix 9 Descriptive statistics of variables in regressions

Table A9.1 Dependent variables for total IIT

	GL	TIIT	TTWT	IIT/P	TIIT/P
Mean	0.10	0.22	0.38	247355.90	845096.60
Median	0.08	0.20	0.35	194091.00	664562.50
Maximum	0.28	0.95	1.00	1016114.00	2917189.00
Minimum	0.00	0.00	0.00	0.00	0.00
Std. Dev.	0.07	0.15	0.27	229167.20	698765.80
Skewness	0.60	2.15	0.83	1.34	0.91
Kurtosis	2.37	9.99	3.11	4.16	3.08
Jarque-Bera	7.42	274.94	11.44	34.66	13.41
Probability	0.02	0.00	0.00	0.00	0.00
Observations	98	98	98	98	98

Table A9.2 Dependent variables for horizontal IIT

	HIIT	HTWT	HIIT/P
Mean	0.04	0.07	627518.30
Median	0.01	0.01	175000.00
Maximum	0.80	1.00	4450000.00
Minimum	0.00	0.00	0.00
Std. Dev.	0.09	0.17	969961.80
Skewness	5.70	4.10	2.04
Kurtosis	43.22	21.64	6.63
Jarque-Bera	7136.97	1692.46	121.65
Probability	0.00	0.00	0.00
Observations	98	98	98

Table A9.3 Dependent variables for vertical IIT

	VIIT	VTWT	VIITP
Mean	0.18	0.31	760024.20
Median	0.16	0.28	580925.00
Maximum	0.95	1.00	2826707.00
Minimum	0.00	0.00	0.00
Std. Dev.	0.13	0.24	674723.80
Skewness	2.45	1.06	0.90
Kurtosis	13.94	3.99	2.96
Jarque-Bera	587.45	22.20	13.13
Probability	0.00	0.00	0.00
Observations	98	98	98

Table A9.4 Independent variables

	DGDPC	DGDP	AVGDP	DIS
Mean	16248	516,000,000,000	301,000,000,000	1295
Median	18101	186,000,000,000	137,000,000,000	1216
Maximum	30459	237,000,000,0000	1,230,000,000,000	2486
Minimum	2415	4,860,000,000	39,300,000,000	233
Std. Dev.	6450	619,000,000,000	310,000,000,000	551
Skewness	-0.36	1.36	1.36	0.32
Kurtosis	2.38	3.77	3.78	3.02
Jarque-Bera	3.66	32.47	32.55	1.63
Probability	0.16	0.00	0.00	0.44
Observations	98	98	98	98