Technological Intensity and Patterns in Slovenian Merchandise Trade

Štefan Bojnec
Matjaž Novak

This paper analyses the technological intensity of industries classi-fied by technology levels (low-technology, medium-low-technology, medium-high-technology and high-technology) and patterns in Slove-nian merchandise trade developments between and within industries in the post-independence years since 1992. Merchandise trade flows by industries are rather homogeneous in the extent of a decline in the external trade integration measured by intra-industry trade in-dices and in the presence of relative trade advantages. More consid-erable differences are found in trade structures and trade quality us-ing the ratio of export to import unit values. In exports we confirm the climbing-up technological development approach, including the jump-up in the medium-high-technology industries in the non-EU-15 markets. Medium-low- and medium-high-technology industries expe-rienced greater price competitiveness in trade with the EU-15 countries. High-technology industries and to a lesser extent low-technology in-dustries experienced a greater competitiveness in the EU-15 internal and external trade. These similarities and differences imply implications for industries with different technological intensity, which are associated with trade and policy shifts before and after the accession of Slovenia to the EU.

Key Words: merchandise trade, trade structures, intra-industry trade, comparative trade advantages, price competitiveness
JEL *Classification:* F02, F14, F15

Introduction

One of the key issues in trade theory and trade analysis is the investiga-tion of patterns in trade specialization. Developed countries would spe-

cialize in more advanced medium-high-technology and high-technology industries, while emerging and developing countries in low-technology industries (e. g. Krugman 1986; Laursen 2000). Empirical studies reveal that there are some variances from these general patterns across countries in trade specialization (e. g. Dulleck et al. 2005; Wörz 2005).

Considering the literature on a dynamic view in economic development and trade patterns, Stehrer and Wörz (2003) distinguish three types of technological catching-up processes: the continuous-convergence approach equally rapid in all industries; the climbing-up-the-ladder approach with catching-up first in low-technology industries and then in medium-low-technology industries, and so on; and the jumping-up approach with catching-up first in high-technology or fast-growing industries when a higher learning potential in these fast growing sectors is available.

Different methodological concepts for measuring international trade specialization have been developed in the literature (e. g. Grubel and Lloyd 1975; Balassa 1965; 1989; Iaparde 2001). In different empirical merchandise trade analysis different classifications of products and activities are used. To evaluate the dynamics of trade specialization and technological convergence in trade patterns most recent empirical analyses of trade rely on grouping trade flows by technological intensities (e. g. Stehrer and Wörz 2003; Wörz 2005). Murn and Kmet (2002) analyze the structures of Slovenian exports by the UNCTAD product classification according to factors contents. They found a greater and increasing share of products by human capital and technological intensity, but a reduction in natural resource-based products and low-qualified labor intensive products. According to Rojec et al. (2004) these recorded favorable patterns seem to be less optimistic when these developments are compared with some previous EU-15 members, such as Finland and Ireland, and some new EU members, such as the Czech Republic and Hungary.

In this article we analyze four groups of trade indicators that are applied to the Slovenian merchandise trade in the post-independence period since 1991: trade (export/import) structures, the development of intra-industry trade (IIT) versus inter-industry trade, the development of comparative trade advantages, and international quality or international price competitiveness.[1] We employ the classification of the Organisation for Economic Cooperation and Development (OECD) that classifies merchandise trade by technology intensity levels of industries into four categories: low-technology, medium-low-technology,

medium-high-technology and high-technology industries (see Hatzi-chronoglou 1997). We compare our results concerning Slovenian merchandise trade structures with Stehrer and Wörz (2003) who analyze four groups of countries: the United States of America (USA), North OECD, South OECD, and East Asian countries. The comparison is possible due to the use of the same classification of industries by technological intensities. The patterns in Slovenian merchandise IIT versus inter-industry trade by technological intensity indicate a development in the degree of external integration. The results are compared with some other similar studies for Slovenia as well as for some other countries in the region (e. g. Aturupane et al. 1999; Fidrmuc et al. 1999; Rojec et al. 2004). Besides static indicators we calculate also dynamic or marginal IIT indicators (e. g. Brülhart 1994). Indicators of relative export advantage, relative import penetration and relative trade advantage (e. g. Balassa 1965; 1989) are used to establish associations of comparative relative advantages separately as well as simultaneously in exports and imports. Our results on international quality or international price competitiveness for Slovenian merchandise trade flows are also compared with some other studies (e. g. Aturupane et al. 1999; Fidrmuc et al. 1999). Finally, we derive a conclusion and policy implications for Slovenian merchandise trade developments focusing on characteristics in technological convergence and trade patterns.

Methodology and Data Used

Sectoral export (import) structures in total exports (imports) are defined as:

$$X_i\% = \frac{X_i}{\sum_i X_i} \cdot 100 \quad \text{or} \tag{1}$$

$$U_i\% = \frac{U_i}{\sum_i U_i} \cdot 100, \tag{2}$$

where $X_i\%$ is the i-activity export share, X_i is the i-activity export value, $\sum_i X_i$ is the total value of exports, $U_i\%$ is the i-activity import share, U_i is the i-activity import value and $\sum_i U_i$ is the total value of imports. The export and import shares are analyzed by activities and over time.

To obtain evidence on trade types, we employ the measure of intra-industry trade (IIT). More approaches and methods to calculate intra-industry trade are developed in the literature (e. g. Grubel and Lloyd 1975; Greenaway et al. 1995). The IIT component in trade flows is often measured by a percentage of IIT as an approximation of the degree of

integration of a certain activity into international trade (e. g. Greenaway et al. 1999). The most widely used formula for measuring the IIT is the Grubel-Lloyd (1975) IIT index (GLIIT), which measures the structure of trade flows by the proportion of IIT in total trade by product categories:

$$\text{GLIIT}_i = \left(1 - \frac{\sum_j |X_{ij} - M_{ij}|}{\sum_j (X_{ij} + M_{ij})}\right), \tag{3}$$

where X denotes the value of exports and the M value of imports, whereby i and j denote product groups. The degree of IIT at the aggregate level i is defined as a weighted average, where a share of value of a specific product j at the eight-digit level of Combined Nomenclature (CN) classification in the total trade value of product group i is used as a weight. The GLIIT index ranges between 0% and 100%. It is equal to 0% when all trade within a certain product group i is of inter-industry type (for example, if there are only exports or only imports). It is equal to 100% when all trade within a certain product group i is of IIT type (for example, if export is equal to import). Besides the static Grubel-Lloyd (1975), the LIIT index, we employ also the dynamic marginal IIT index that indicates dynamic changes in trade flows between two different time periods (years) (Brülhart 1994; Thom and McDowell 1999; Bojnec and Novak 2005a; 2005b). Similarly to GLIIT indices, also marginal IIT indices are calculated as aggregated indices using trade weights. The dynamic aggregated marginal IIT index measures the proportion of changes in total trade flows between two time periods, which pertain to IIT vis-à-vis the inter-industry trade. IIT can be horizontal or vertical (e. g. Greenaway et al. 1995; Thom and McDowell 1999). The inter-industry trade index is a residual between 100% and the value of GLIIT (or marginal GLIIT) index:

$$\text{IT}_i = 100 - \text{GIIT}_i. \tag{4}$$

The greater the value of inter-industry trade (IT), the greater the cost of restructuring, and adjustment in the economy is expected following the rapid trade liberalization.

One of the important questions in international trade and in economic growth is the question of competitiveness (e. g. Balassa 1989; Laursen 2000; Chen 2004; Funke and Ruhwedel 2005). Theories and concepts differ in measuring competitiveness and competition at global, regional, national, activity and micro economic levels. Our research focus in this article is limited only to theories, concepts and measures of

comparative trade advantages. In this specific research area different in-
dicators for measuring competitiveness on the basis of trade data are
developed. The advantage of using trade data in empirical analysis of
competitiveness lies in the fact that reactions in demands and supply
responses are considered simultaneously. Indicators of comparative ad-
vantages on the basis of trade data measure competitiveness by compar-
ing one sector to the others (e. g. Balassa 1965; 1989; Vollrath 1991). The
most widely used indicators on the basis of trade data are: the relative
export advantage (RXA) index, the relative import penetration (RMP)
index and the relative trade advantage (RTA) index:

$$\mathrm{RXA}_{ij} = \frac{X_{ij}}{\sum_{l,l \neq j} X_{il}} \cdot \frac{\sum_{k,k \neq i} \sum_{l,l \neq j} X_{kl}}{\sum_{k,k \neq i} X_{kj}}, \tag{5}$$

$$\mathrm{RMP}_{ij} = \frac{M_{ij}}{\sum_{l,l \neq j} M_{il}} \cdot \frac{\sum_{k,k \neq i} \sum_{l,l \neq j} M_{kl}}{\sum_{k,k \neq i} M_{kj}}, \tag{6}$$

where X denotes the value of export and M the value of import, i and k
denote product groups, whereby j and l denote countries. The numera-
tor is equal to export (import) of a country (for example for Slovenian
export or import with the EU-15) for a certain product group vis-à-vis
export (import) of this product from all countries, which are used as
a benchmark of comparison (for example the EU-15).[2] The enumerator
captures total exports (imports) of a certain country (Slovenia) as the
export (import) share in total export (import) of all countries, which are
used as the benchmark of comparison (for example the EU-15). An RXA
greater than 1 indicates that a country in this product group has a relative
comparative export advantage, and vice versa, an RXA lower than 1 indi-
cates a relative comparative export disadvantage. On the other hand, the
RMP indicates a relative comparative advantage (when the RMP is lower
than 1) or a disadvantage in the import penetration (when the RMP is
greater than 1) for a certain product or sector. The RTA is calculated as a
difference between the RXA and the RMP:

$$\mathrm{RTA}_{ij} = \mathrm{RXA}_{ij} - \mathrm{RMP}_{ij} \tag{7}$$

When RTA is positive, there is a relative comparative trade advantage,
and vice versa when RTA is negative, there is a relative comparative trade
disadvantage.

Quality or price competitiveness in matched merchandise trade flows
is often measured by comparisons of export-to-import unit price val-
ues for a same product category (Greenaway et al. 1995; Aturupane et

al. 1999). The ratio of export-to-import unit values is used as a measure to indicate the quality of Slovenian merchandise exports vis-à-vis imports. In this article we use a comparison between Slovenian export and import unit values in merchandise trade with the EU-15 countries. The export unit value (UVX_{ij}) and the import unit value (UVM_{ij}) are derived on the basis of values and quantities of merchandise exports and imports at the eight-digit level of CN classification, where j is an individual product within the product group i. The ratio of Slovenian export-to-import unit values in merchandise trade with the EU-15 at the eight-digit CN classification level ($IATT_{ij}$) is defined as:

$$IARR_{ij} = \frac{UVX_{ij}}{UVM_{ij}}. \tag{8}$$

The results are presented as weighted at the group i level by activities of technological intensities of products. Value shares of individual product j in total value of product group i are used as weights (see also Bojnec and Novak 2005b). If the export unit value for Slovenian exports is greater than the import unit value for Slovenian imports from the EU-15, then this implies that higher quality products are exported rather than imported, and vice versa when the ratio is lower than one. Moreover, Slovenian export unit values for merchandise exports to the EU-15 are compared with similar unit values in internal EU-15 imports and external EU-15 imports, respectively.

The empirical analysis of four groups of trade indicators (export/import structures, IIT versus inter-industry trade, comparative trade advantages, and international price competitiveness) for Slovenian merchandise trade is conducted at the eight-digit CN classification on the basis of trade data obtained from the Statistical Office of the Republic of Slovenia (SORS) for total Slovenian trade, and on the basis of the Comext CD-ROM data obtained from the Statistical Office of the European Community (EUROSTAT) for trade between Slovenia and the EU-15 countries as well as for all internal and external EU-15 trade.

Merchandise Trade Structures by Technological Intensities

Medium-high technology products are the most important item in the Slovenian export trade structures (table 1). Their share is increasing, while the share of low-technology products is declining. This clearly suggests that induced quality improvements are consistent with the *jumping-up* approach from low-technology to medium-high-technology

TABLE 1   Slovenian total merchandise trade structures (%)

	1992	1996	1997	1998	1999	2000	2001	2002
Merchandise export structure								
High-technology	5.73	6.39	6.00	6.94	6.07	7.11	6.87	7.11
Medium-high	34.06	36.35	42.60	43.27	43.38	42.58	43.69	44.15
Medium-low	19.74	22.83	19.60	20.17	20.27	20.85	20.16	20.82
Low-technology	40.47	34.43	31.80	29.62	30.29	29.46	29.28	27.93
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Merchandise import structure								
High-technology	6.45	9.37	9.00	9.11	9.34	9.69	8.29	8.71
Medium-high	34.14	39.01	39.99	39.96	40.19	42.32	40.38	40.90
Medium-low	29.54	25.19	25.26	24.68	24.84	27.57	26.23	25.85
Low-technology	29.88	26.43	25.74	26.25	25.63	20.42	25.10	24.55
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Own calculations on the basis of data from SORS.

products. The share of medium-low-technology products is more stable at around one-fifth of merchandise exports. The share of high-technology exports is increasing, albeit it is still less than 7.2%.

Medium-high-technology industries are also the most important item in Slovenian import structures, but their increase is lower than that of export structures. Low-technology products are also less important in imports than in exports, but with an explored convergence tendency in export and import structures to around one-fourth of trade. High-technology products and medium-low-technology products are relatively more important in imports than in exports.

The Slovenian export share of low-technology industries is greater than that of the USA and East Asian countries, but lower than that of North and South OECD countries (table 2). With further increases in Slovenian real wages, their export shares are likely to decline further.

Slovenian medium-low technology industries are more important in merchandise trade structures than in the USA. In these industries, Slovenian import structures explore similar patterns as North OECD countries, while Slovenian export shares are lower than those of North OECD countries. South OECD countries and East Asian countries experience greater import and export shares in medium-low-technology industries than does Slovenia.

TABLE 2   Merchandise trade structures and patterns (%)

	USA		OECD North		OECD South		East Asia	
	1981	1997	1981	1997	1981	1997	1981	1997
Export structure								
High-technology	21.14	28.23	4.06	3.22	3.90	6.99*	15.72	29.38
Medium-high	49.73	46.08	28.55	34.97	27.15	12.88	17.86	24.91
Medium-low	13.71	11.88	34.27	29.66	35.19	41.00	32.70	23.94
Low-technology	15.42	13.81	33.12	32.15	33.76	46.12	33.72	21.77
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Import structure								
High-technology	12.37	23.74	6.47	4.34	10.35	12.55*	11.29	15.46
Medium-high	36.16	38.77	31.27	30.15	43.73	24.69	38.58	32.52
Medium-low	28.41	17.68	29.38	27.29	25.83	32.28	22.77	29.74
Low-technology	23.06	19.81	32.43	38.22	20.09	43.03	27.36	22.28
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

* Data for 1992. Note: USA – the United States of America. OECD North: Australia, Austria, Canada, Denmark, Finland, France, Germany-west, Italy, Japan, the Netherlands, New Zealand, Norway, Sweden, and the United Kingdom. OECD South: Greece, Portugal, Spain, and Iceland. East Asia: Hong Kong, Indonesia, the Republic of Korea, Malaysia, Singapore, and Thailand. Source: Stehrer and Wörz (2003).

Medium-high-technology industries play a crucial role in the Slovenian merchandise trade. Their roles in the USA exports are replacing high-technology industries. The Slovenian export share of medium-high-technology industries *is catching up on* North OECD countries, and is greater than that of South OECD countries and East Asian countries. Greater shares of medium-high-technology industries in Slovenia compared to North OECD countries, South OECD countries, and East Asian countries are found for imports.

More considerable differences across countries are recorded for merchandise trade patterns in high-technology industries. High-technology industries in Slovenia are still much less important in merchandise trade than in the USA and in East Asian countries. This makes also a considerable difference between the USA, East Asia and Europe, of which the latter is lagging behind. The Slovenian export share in high-technology products is greater than that of North OECD countries and similar to that of South OECD countries. The latter experience higher import shares than Slovenia, while import shares of North OECD countries are lower.

Slovenian Merchandise Trade Structures with the EU-15 Markets

After the Slovenian independence, the EU-15 markets have been the most important destination for Slovenian merchandise exports and the origin of Slovenian merchandise imports with around two-thirds of Slovenian merchandise exports flowing to the EU-15 markets, and even somewhat greater imports from those EU countries to the Slovenian markets. As presented in table 3, medium-high-technology industries are the most important item in the Slovenian merchandise exports to the EU-15 markets, but with a slight decline in the export share, which has been observed since 1994. This declining tendency in Slovenian merchandise export shares to the EU-15 markets differs from the general Slovenian merchandise export patterns, suggesting that Slovenia has been facing more considerable competitive pressures in these products on the EU-15 markets than in other markets. Initial Slovenian advantages on the EU-15 markets have deteriorated over time. The declining tendency in Slovenian merchandise export shares to the EU-15 markets is also observed for low-technology industries, which seems to be caused by increasing Slovenian wages, reducing cost competitiveness, and increasing competitive pressures in the EU-15 markets from emerging regional and world market competitors. The tendency towards continued technological catch-up is confirmed for high-technology industries, albeit at a relatively lower level, and for medium-low-technology industries. These two merchandise export shifts from low-technology industries to medium-low-technology industries and from medium-high-technology to high-technology industries could be referred as the *climbing up approach* in the Slovenian exports to the EU-15 markets.

In Slovenian merchandise import structures from the EU-15 markets, there is a continuous decline in low-technology industry imports, but a slight increase in medium-low-technology industries and high-technology industries, and particularly a considerable increase in medium-high-technology imports.

Intra-Industry Trade

The GLIIT index for the Slovenian merchandise trade with the EU, calculated by Wyzan (1999), increased from 0.58 in 1992 to 0.696 in 1998.[3] Aturupane et al. (1999) present the results of the GLIIT index as a percentage of the Slovenian IIT with individual EU-9 countries. The GLIITS varied between 35% and 40% in the years 1993–1995. The percentage of the horizontal IIT increased slightly, but the vertical IIT remained the

TABLE 3   Slovenian merchandise trade structures with the EU-15 (%)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Merchandise export structure										
High-technology	7.6	7.6	9.1	9.0	8.6	9.2	11.2	11.9	11.6	12.9
Medium-high	48.4	48.4	46.6	45.2	44.7	45.1	44.9	43.0	44.4	43.5
Medium-low	16.9	17.9	18.4	20.3	22.4	23.1	22.8	24.4	23.3	23.1
Low-technology	27.2	26.2	25.9	25.5	24.3	22.6	21.1	20.7	20.8	20.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Merchandise import structure										
High-technology	5.3	5.4	5.1	8.4	4.7	4.9	5.3	6.9	5.7	7.1
Medium-high	34.7	37.6	39.4	39.9	42.0	46.3	45.4	45.0	46.1	48.1
Medium-low	18.1	19.2	20.6	19.5	20.7	19.6	20.4	21.2	22.0	21.0
Low-technology	42.0	37.8	34.9	32.2	32.6	29.1	28.8	26.9	26.2	23.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Own calculations on the basis of data from Eurostat Comext CD-ROM (2004).

TABLE 4   GLIIT index for total Slovenian merchandise trade (%)

	1992	1996	1997	1998	1999	2000	2001	2002
High-technology	70.3	64.0	91.2	68.1	92.2	82.2	78.0	76.8
Medium-high	92.6	74.2	68.8	72.1	67.9	97.8	65.7	64.0
Medium-low	87.4	82.9	83.8	83.6	81.0	83.7	81.5	77.4
Low-technology	77.7	94.5	62.3	92.9	63.9	84.3	62.4	61.8

Source: Own calculations on the basis of data from SORS.

most important component of IIT. The Slovenian merchandise trade with the EU is also compared by Fidrmuc et al. (1999). They find that in 1996 the GLIIT index in merchandise trade between Austria and Slovenia was 61.4%, between Italy and Slovenia 58.5% and between Germany and Slovenia 52.7%. Such differences in the results of these studies indicate a mixed finding regarding the prevalence of IIT or inter-industry trade in Slovenian merchandise trade with selected EU countries.

Our results of GLIIT indices are presented separately for total Slovenian merchandise trade with all trading partners and separately for Slovenian merchandise trade with the EU-15. GLIIT indices for total Slovenian merchandise trade indicate some prevailing IIT characteristics in total Slovenian merchandise trade (table 4). While an increase in IIT over time is expected with the economic growth and trade liberaliza-

tion, this tendency is not clearly confirmed by our results for Slovenia. The evidence indicates some instabilities and even a declining tendency in GLIIT indices for total Slovenian merchandise trade, suggesting a persistence of some bottlenecks reducing the degree of external trade integration. However, the majority of total Slovenian merchandise trade flows remain of IIT type.

Our results for the Slovenian IIT are somewhat more consistent with theory in the case of Slovenian merchandise trade with the EU-15 (table 5). In 1993, at least 80% of Slovenian merchandise trade flows were characterized by the IIT type, suggesting that similar products were exported and imported at the same time. Since then, two diverging patterns have been observed. First, there was an increasing tendency in the degree of IIT for low-technology industries and for medium-high-technology industries particularly between 1993 and 1997. These industries were heavily integrated with the EU-15. Second, there has been a declining tendency in the degree of IIT for medium-low-technology industries and high-technology industries, which is inconsistent with Slovenian efforts to achive a greater integration with the EU-15 markets. More likely, it has resulted from the prevalence of export in the case of medium-low-technology industries and the prevalence of import in the case of high-technology industries.

For comparison we also present our results for GLIIT indices for the internal EU-15 merchandise trade and the external EU-15 merchandise trade. The internal merchandise trade between the EU-15 countries is exclusively of IIT type. This finding is consistent with previous studies on this subject (e. g. Chen 2004). The IIT component contains more than 95% of merchandise trade flows. This holds for main technological groups and for individual analyzed years, suggesting that the borderless single EU market leads to exporting and importing of similar merchandise products at the same time. The external EU-15 merchandise trade with the rest of the world indicates an increasing tendency in the already relatively high degree of IIT for low-technology, medium-low-technology, and high-technology industries. In the case of the medium-low-technology industry, IIT is also prevailing but at a lower degree (around 70%). Thus, the evidence for the EU-15 merchandise trade suggests that the prevalence and a further increase in the IIT are consistent with theoretical expectations that economic growth and trade liberalization are pushing up the degree of IIT.

The marginal IIT (MIIT) index measures the degree of IIT in trade

TABLE 5   GLIIT index for Slovenian merchandise trade with the EU-15 (%)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Slovenian merchandise trade with the EU-15										
High-technology	80.0	81.4	65.2	64.0	59.4	60.2	55.3	62.8	56.2	61.6
Medium-high	81.8	85.5	84.4	86.1	84.0	90.4	89.3	90.5	90.5	94.3
Medium-low	98.5	98.5	98.4	90.4	83.0	81.2	83.4	81.4	85.9	84.7
Low-technology	80.4	83.9	92.5	96.0	98.4	98.3	95.7	98.5	99.8	96.7
Merchandise trade between the EU-15 countries										
High-technology	98.7	98.3	97.2	97.2	95.7	97.4	95.9	95.9	95.1	95.2
Medium-high	99.6	98.8	99.7	99.8	99.9	99.8	99.5	99.8	99.9	99.4
Medium-low	95.9	97.2	97.0	97.2	97.0	97.7	96.3	96.8	95.7	95.6
Low-technology	96.0	96.2	96.6	96.5	96.6	97.1	96.8	96.5	96.6	96.4
EU-15 *merchandise trade with the rest of the world*										
High-technology	92.1	92.5	94.5	95.3	96.4	94.6	92.3	91.3	96.1	97.1
Medium-high	70.4	70.5	69.0	66.6	68.8	73.6	77.6	78.1	74.8	72.0
Medium-low	93.4	94.9	96.1	90.9	91.2	96.3	96.6	99.7	99.6	97.8
Low-technology	92.2	92.9	99.8	99.0	99.6	97.2	94.3	93.9	93.8	94.5

Source: Own calculations on the basis of data from Eurostat Comext CD-ROM (2004).

TABLE 6   Marginal IIT index for total Slovenian manufacturing trade (%)

	MIIT$_i$	MIIT$_i$	MIIT$_i$
	1996–1992	2002–1992	2002–1996
High-technology	64.9	99.6	69.0
Medium-high	84.3	81.8	64.5
Medium-low	98.4	81.1	77.4
Low-technology	81.9	95.5	72.1

Source: Own calculations on the basis of data from SORS.

changes over a certain period of time. The prevalence of IIT in total Slovenian merchandise trade, which differs across technological product groups and periods is confirmed again (table 6). For low-technology, medium-low-technology, and medium-high-technology industries, the degree of IIT was higher in the first period 1992–1996 than in the second period 1996–2002, and vice versa for high-technology industries. The MIIT for the whole period 1992–2002 was higher than that for the two sub-periods in the case of low-technology industries and high-technology industries. This could be explained by the fact that some

TABLE 7   Relative export advantage for Slovenian merchandise trade
in the EU-15 markets

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Benchmark: Internal EU-15 merchandise trade										
High-technology	0.5	0.4	0.6	0.6	0.6	0.4	0.6	0.6	0.6	0.6
Medium-high	1.7	1.6	1.8	1.9	2.2	1.5	1.9	1.9	2.0	1.8
Medium-low	1.0	1.1	1.2	1.6	2.0	1.7	2.1	2.1	2.0	2.1
Low-technology	1.2	1.2	1.4	1.6	1.7	1.2	1.4	1.4	1.4	1.4
Benchmark: External EU-15 merchandise trade										
High-technology	0.4	0.4	0.5	0.5	0.4	0.4	0.5	0.6	0.5	0.6
Medium-high	1.5	1.5	1.6	1.5	1.8	1.8	2.1	2.2	2.0	1.7
Medium-low	1.1	1.2	1.5	1.7	2.2	2.3	2.6	2.9	2.7	2.4
Low-technology	1.8	1.7	1.8	1.9	2.0	1.9	2.0	2.2	2.0	1.9

Source: Own calculations on the basis of data from Eurostat Comext CD-ROM (2004).

shifts in trade flows occurred in the mid-1990s, which biases the empirical results.

The majority of Slovenian merchandise MIIT is of a vertical type. This tendency towards diversity rather than similarity is consistent with structural changes which have occurred in the Slovenian economy, causing supply side changes, and changes in demand by consumers towards a diversity of products in the markets.

Comparative Trade Advantages

According to the relative export advantage in the EU-15 markets, Slovenian merchandise exports in the internal EU-15 merchandise exports would enjoy comparative advantages (ratio greater than 1) in the case of low-technology, medium-low-technology, and medium-high-technology industries, but not in the case of high-technology industries (measure lower than 1; see table 7). Although there exist some differences in the absolute size of the measure of relative export advantages, a similar conclusion is derived on the basis of comparisons of Slovenian merchandise exports to the EU-15 countries vis-à-vis the EU-15 external merchandise exports.

Relative import penetration indices suggest that Slovenia was more successful in merchandise import substitution from the EU-15 in comparison with the EU-15 internal merchandise imports for high-technology industries and to a lesser extent for medium-high technology in-

TABLE 8   Relative import penetration for Slovenian merchandise trade with the EU-15

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Benchmark: Internal EU-15 merchandise trade										
High-technology	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Medium-high	0.9	1.0	0.8	0.9	0.8	0.9	0.9	0.9	1.0	1.1
Medium-low	1.1	1.1	1.0	1.0	1.0	1.0	1.1	1.1	1.2	1.2
Low-technology	2.3	2.0	1.5	1.5	1.3	1.2	1.3	1.2	1.2	1.1
Benchmark: External EU-15 merchandise trade										
High-technology	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2
Medium-high	1.7	1.9	1.8	1.9	1.7	1.8	1.6	1.6	1.8	2.1
Medium-low	1.2	1.3	1.3	1.4	1.3	1.2	1.3	1.2	1.3	1.3
Low-technology	2.4	2.0	1.8	1.7	1.5	1.4	1.3	1.3	1.2	1.1

Source: Own calculations on the basis of data from Eurostat Comext CD-ROM (2004).

TABLE 9   Relative trade advantage for Slovenian merchandise trade with the EU-15

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Benchmark: Internal EU-15 merchandise trade										
High-technology	0.2	0.1	0.4	0.4	0.4	0.3	0.4	0.4	0.4	0.4
Medium-high	0.8	0.6	1.0	1.1	1.4	0.5	1.0	0.9	1.0	0.7
Medium-low	−0.1	−0.1	0.2	0.5	1.0	0.7	1.0	1.1	0.8	0.8
Low-technology	−1.1	−0.8	−0.1	0.1	0.3	0.0	0.1	0.2	0.2	0.3
Benchmark: External EU-15 merchandise trade										
High-technology	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.5	0.4	0.4
Medium-high	−0.2	−0.4	−0.2	−0.4	0.1	0.0	0.4	0.5	0.2	−0.4
Medium-low	−0.1	−0.1	0.2	0.3	0.9	1.2	1.3	1.7	1.4	1.1
Low-technology	−0.6	−0.4	0.0	0.2	0.5	0.5	0.7	0.9	0.8	0.7

Source: Own calculations on the basis of data from Eurostat Comext CD-ROM (2004).

dustries, when the measure is lower than 1, but less so in the case of low-technology industries, where the measure is greater than 1. In the latter case, some improvements have been recorded recently (table 8). The picture is less clear for medium-low-technology industries, where the measure around 1 or slightly greater than 1 suggests more indifferent decisions between domestic Slovenian merchandise production and import substitution by merchandise products from the EU-15 countries.

When Slovenian merchandise imports from the EU-15 countries are

compared with the EU-15 external merchandise imports, the relative import penetration index is not substantially different in the case of low-technology industries and high-technology industries. A disadvantage in import penetration is more clearly recorded for medium-low-technology industries. Even more evident is the disadvantage in import penetration for medium-high-technology industries. Before the Slovenian accession to the EU, the EU-15 external markets had been more relevant for a comparison. With Slovenia's EU membership, the internal EU market has become more relevant. However, some other countries joined the EU at the same time. So the internal EU market has slightly changed when some other countries from the Central European region joined the EU.

According to our results, Slovenia enjoys a relative trade advantage in merchandise trade in the EU-15 markets in high-technology industries due to an advantage in import penetration rather than in export (table 9). For other industries by technological intensities the results are mixed, but the trade advantage is more evident than the trade disadvantage.

International Price Competitiveness

The ratio of export to import prices greater than one, which is achieved by Slovenia in merchandise trade with the EU-15 countries, indicates that Slovenia exported better quality products and thus more expensive ones to the EU-15 countries (the upper part of table 10). However, the unit price ratio has declined over time. This deterioration in the unit price ratio towards close to one, and thus towards a greater similarity in the quality of exported and imported products is more considerable for low-technology and for high-technology industries. The declining tendency in the unit price ratio is also confirmed for medium-high-technology industries, but the ratio remains greater than one. The unit price ratio for medium-low-technology industries at around 1.4 suggests a more stable quality and thus price advantages of Slovenian merchandise exports vis-à-vis Slovenian merchandise imports from the EU-15 in these products.

The ratio of Slovenian merchandise export prices achieved on the EU-15 markets vis-à-vis the internal EU-15 merchandise import prices indicates Slovenian price competitiveness for high-technology industries with an additional improvement over time, and for low-technology industries with some deteriorations (the middle part of table 10). The evidence suggests a lack of Slovenian merchandise price competitiveness on the EU-15 internal markets for medium-low-technology industries as

TABLE 10   Slovenian export to EU-15 import price ratio in merchandise trade

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Slovenian export to import unit values with the EU-15										
High-technology	1.13	1.12	1.22	1.11	1.09	1.13	1.09	1.12	1.08	0.98
Medium-high	1.57	1.55	1.47	1.38	1.44	1.38	1.38	1.25	1.24	1.31
Medium-low	1.47	1.67	1.43	1.32	1.42	1.56	1.41	1.27	1.32	1.44
Low-technology	1.23	1.19	1.14	1.18	1.17	1.07	1.09	1.06	1.01	1.02
Benchmark: Internal EU-15 import price										
High-technology	1.39	1.37	1.29	1.24	–	1.43	1.39	1.49	1.59	1.58
Medium-high	–	0.88	0.85	1.04	0.89	0.97	0.87	0.89	0.93	1.08
Medium-low	0.42	0.23	0.28	0.28	0.25	0.39	0.46	0.19	0.17	0.72
Low-technology	1.29	1.19	1.19	1.19	1.06	1.15	1.19	1.18	1.19	1.09
Benchmark: External EU-15 import price										
High-technology	1.25	1.53	1.49	1.78	1.49	1.39	1.39	1.45	1.31	1.25
Medium-high	1.12	0.76	0.76	0.73	0.89	0.94	0.89	0.84	0.93	1.07
Medium-low	0.38	0.29	0.28	0.19	0.36	0.39	0.38	–	0.17	1.26
Low-technology	1.52	1.61	1.68	1.62	1.77	1.64	–	1.19	1.13	–

Source: Own calculations on the basis of data from Eurostat Comext CD-ROM (2004).

well as for medium-high-technology industries. In the latter case, recent improvements in price competitiveness have been recorded.

The ratio of Slovenian merchandise export prices on the EU-15 markets vis-à-vis the external EU-15 merchandise import prices also indicates Slovenian price competitiveness for high-technology industries, but with more stable tendencies over time, and low-technology industries with some deteriorations (the bottom part of table 10). The evidence suggests a general lack of price competitiveness for medium-low- technology industries. The exception is the year 2002. To a lesser extent, this is also true for medium-high-technology industries.

Conclusions

Slovenian merchandise trade structures explore three significant patterns with two considerable shifts. First, we have confirmed that there is the shift from low-technology industries, where Slovenia is losing its comparative advantage, towards medium-low-technology, medium-high-technology and high-technology industries. This shift is most consistent with the climbing-up technological development approach. As more

low-technology industries, which are largely low-skill labour-intensive, are lost at the EU-15 and other markets to the catching-up countries from the region and the rest of the world, Slovenian low-technology industries are shrinking. Thus the demand for low-skilled workers is declining. Second, Slovenia particularly gains comparative advantage by the jump-up in medium-high-technology industries in the non-EU-15 markets. At these markets Slovenia has been losing its initial comparative advantage caused by the EU-15 trade liberalization towards other Central and East European countries and the rest of the world. Finally, Slovenian merchandise trade patterns in medium-low-technology and high-technology industries indicate more mixed trade patterns with the continuous convergence and the climbing up the ladder approaches. The Slovenian merchandise trade by technological intensities seems to be more similar to trade patterns observed in the North OECD countries. However, the mixture of the continuous convergence, climbing-up and jumping-up technological approaches have also some elements which are observed in rapidly growing East Asian countries. However, the technological jump-up in Slovenia as well as in most European countries has been much less remarkable in the case of high-technology industries, which are one of the key features in the jumping-up trade and in high-technology-based export-led growth in some East Asian countries.

The role of education, internal organization of production, firms' foreign investment strategies and transfer of technologies, research and development activities are among those crucial factors in these technological development shifts. However, there is also an important role of government policies in reducing market failures and providing a proper incentive mechanism for trade and developments. The indicators of IIT for Slovenia do not reveal that trade liberalization and economic growth have led to an increase in IIT in merchandise trade. These trade patterns are observed in Slovenian manufacturing trade with the EU-15 countries for low-technology industries and for medium-high-technology industries. Except for high-technology industries, Slovenia has enjoyed a relative export advantage in the EU-15 markets. On the other hand, Slovenia has been more successful in the import penetration from the EU-15 countries for high-technology industries. As a result of the combined effects of export advantage and import penetration, high-technology industries have a trade advantage in the EU-15 markets. To a lesser extent and with considerable differences by individual years this holds also for medium-high-, medium-low- and low-technology industries. Slovenia was com-

petitive in quality and prices in trade with the EU-15 in medium-high- and medium-low-technology industries, but less for low-technology and high-technology industries. Slovenian high-technology industries perform better when merchandise export prices at the EU-15 markets are compared with internal and external EU-15 merchandise import prices. Slovenian low-technology industries perform better when export prices at the EU-15 markets are compared with external EU-15 import prices. Slovenian industries, which perform better in comparison to the EU-15 external than to the EU-15 internal trade conditions, are facing greater difficulties upon the accession of Slovenia in the enlarged borderless EU markets.

Notes

1. For more detailed results on Slovenian merchandise trade at more dis-aggregated trade data levels see Bojnec and Novak (2004, 2005a, 2005b, and 2005c).

2. As a benchmark of comparison for Slovenia are relevant EU countries. The trade for EU countries is recorded separately for intra-EU trade between its member countries and for extra-EU trade with the rest of the world. Before Slovenia's accession to the EU, around two-thirds of Slovenian merchandise trade was with the EU-15.

3. According to Wyzan (1999, 327), the GLIIT index for Slovenian merchandise trade increased by more than 10 percentage points between 1992 and 1998 suggesting the increased degree of integration of Slovenian merchandise industries with the EU markets.

References

Aturupane, C., S. Djankov, and B. Hoekman. 1999. Horizontal and vertical intra-industry trade between Eastern Europe and the European Union. *Weltwirtschaftliches Archiv* 135 (1): 62–81.

Balassa, B. 1965. Trade liberalisation and 'revealed' comparative advantage. *Manchester School of Economic and Social Studies* 33 (1): 99–123.

———. 1989. *Comparative advantage, trade policy and economic development.* New York: New York University Press.

Bojnec, Š., and M. Novak. 2004. Kakšna je slovenska blagovna menjava po tehnološki intenzivnosti? *IB-revija* 38 (3): 37–56.

———. 2005a. Ali znotrajpanožna trgovina prevladuje v slovenski blagovni menjavi? *IB-revija* 39 (3): 22–41.

———. 2005b. Metodologija za ugotavljanje konkurenčnih prednosti in pozicioniranje sektorjev slovenskega gospodarstva po konkurenčnosti blagovne menjave. *IB-revija* 39 (1–2): 4–25.

———. 2005c. Primerjalne prednosti slovenske blagovne menjave na tržiščih Evropske unije. *Naše gospodarstvo* 51 (3–4): 64–74.

Brülhart, M. 1994. Marginal intra-industry trade: Measurement and the relevance for the pattern of industrial adjustment. *Weltwirtschaftliches Archiv* 130 (3): 600–13.

Chen, N. 2004. Intra-national versus international trade in the European Union: Why do national borders matter? *Journal of International Economics* 63 (1): 93–118.

Dulleck, U., N. Foster, R. Stehrer, and J. Woerz. 2005. Dimensions of quality upgrading: Evidence from ceecs. *The Economics of Transition* 13 (1): 51–76.

Fidrmuc, J., D. Grozea-Helmenstein, and A. Wörgötter. 1999. East-West intra-industry trade dynamics. *Weltwirtschaftliches Archiv* 135 (2): 332–46.

Funke, M., and R. Ruhwedel. 2005. Export variety and economic growth in East European transition economies. *The Economics of Transition* 13 (1): 25–50.

Greenaway, D., R. Hine, and C. Milner. 1995. Vertical and horizontal intra-industry trade: A cross industry analysis for the United Kingdom. *Economic Journal* 105:1505–18.

Greenaway, D., C. Milner, and J. R. Elliot. 1999. uk intra-industry trade with eu North and South. *Oxford Bulletin of Economics and Statistics* 61 (3): 365–84.

Grubel, H. G., and P. J. Lloyd. 1975. *Intra-industry trade: The theory and measurement of international trade in differentiated products.* London: Macmillan.

Hatzichronoglou, T. 1997. Revision of the high-technology sector and product classification. sti Working Paper oecd/gd(97)/216.

Iaparde, L. P. 2001. Measuring of international specialization. *International Applied Economic Review* 7:173–83.

Krugman, P. 1986. A 'technology gap' model of international trade. In *Structural adjustment in developed open economies,* ed. K. Jungenfeldt and D. Hague. London: Macmillan.

Laursen, K. 2000. *Trade specialization, technology and economic growth: Theory and evidence from advanced countries.* Cheltenham: Edward Elgar.

Murn, A., and R. Kmet, ed. 2002. *Development report.* Ljubljana: Institute of Macroeconomic Analysis and Development.

Rojec, M., J. Šušteršič, B. Vasle, M. Bednaš, and S. Jurančič. 2004. Accession to the eu: The end of gradualism in Slovenia? Paper presented at the 57th International Atlantic Economic Conference, Lisbon, 10–14 March.

Stehrer, R., and J. Wörz. 2003. Technological convergence and trade patterns. *Review of World Economics* 139 (2): 191–219.

Thom, R., and M. McDowell. 1999. Measuring marginal intra-industry trade. *Weltwirtschaftliches Archiv* 135 (1): 48–61.

Vollrath, T. L. 1991. A theoretical evaluation of alternative trade intensity measures of revealed comparative advantage. *Weltwirtschaftliches Archiv* 127 (2): 265–80.

Wörz, J. 2005. Dynamics of trade specialization in developed and less developed countries. *Emerging Markets Finance and Trade* 41 (3): 92–111.

Wyzan, M. L. 1999. Macedonian and Slovenian trade: Contrasting patterns and focus on the European Union. *Post-Soviet Geography and Economics* 40 (5): 309–34.