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Foreign Direct Investment and the Catching-up Process in New EU Member States: Is There a Flying Geese Pattern?

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Abstract

The paper aims to verify the existence of the Flying Geese Model (FGM) in the case of inward FDI in Central European Countries (CECs) which are new EU member states; more precisely, to find out in what way and to what extent FDI has contributed to catching-up, i.e. to the restructuring process and to productivity growth in CEC manufacturing. The analysis shows that FDI is an important if not the main vehicle of manufacturing sector restructuring and productivity growth in the analysed CECs, along the lines of FGM. In terms of technological intensity, foreign investment enterprises show better structure and faster and more promising restructuring trends than domestic enterprises. Restructuring processes in domestic enterprises are slower. Productivity growth in CEC manufacturing is positively correlated with technological intensity and the level of foreign penetration; the higher the technological level and the higher the foreign penetration, the higher the productivity growth. However, high foreign penetration has a negative impact on productivity growth in high- and medium-high-technology industries. The latter is in line with the criticism of the FGM, maintaining that catching-up via FDI along the lines of FGM is going on mostly in industries at the lower end of the technological intensity spectrum (i.e. at earlier stages of host country development) and less so when it comes to industries at the upper end of the technological intensity spectrum (i.e. at later stages of host country development). The FGM seems to have problems in explaining the catching-up process at more advanced stages of host country development. Also, new EU member states could not rely to a major extent on FDI when attempting to catch up in technologically advanced industries and/or in more advanced stages of development. There, endogenous efforts are indispensable.

Keywords: foreign direct investment, flying geese model, catching-up process, new EU member states, restructuring of manufacturing industry, productivity growth, technological intensity

JEL classification: F210, F230, L600, O140

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1 Introduction

The catching-up process is the main issue governing the successful integration of the new member states in the European Union (EU). Foreign direct investment (FDI) has traditionally been treated as an important means for structural upgrading and increasing the productivity of transition economies and, thus, for their ability to catch up with the EU.[1] This paper applies the Flying Geese Growth Model (FGM) in order to explain the role of FDI in the industrial restructuring and productivity growth processes in those countries that recently joined the EU. The FGM argues that a lesser developed open economy is able to catch up through trade and pro-trade FDI, depending on the upgrading process in the lead country.

The aim of this paper is to verify the existence of the FGM in the case of inward FDI in the countries of Central Europe (CECs) that have recently become EU member states. More precisely, the aim is to establish the manner in which, and the extent to which, FDI has contributed to the catching-up process, i.e., to the restructuring process and productivity growth in CEC manufacturing.

A formal FGM has not been put forward to date. Different methodologies have been applied in the empirical literature. In assessing the role of FDI in the catching-up transformation of the CECs, we follow a multiple approach (for argumentation see Bellak, 2003). After presenting a brief overview of the relevant literature and formulating the research questions together with our hypothesis in section 2, we present the data set in section 3. In section 4 we analyse the descriptive statistics covering structural trends related to foreign investment and domestic enterprises in CEC manufacturing. We also allow for variations in technology intensity across industries. In section 5 we analyse the impact of FDI on manufacturing productivity growth in the CECs. First, we analyse labour productivity trends, allowing for differences between foreign investment and domestic enterprises, as well as between technology-defined groups of industries. We then follow a growth-accounting approach in order to assess the contribution of FDI to total factor productivity growth in CEC manufacturing, both overall and for individual groups of technology-intensive industries, as well as for individual countries. We present our conclusions in the final section.

[1] In the paper, the term 'catching-up' is not used in the strict sense of the word, i.e. as a process of bridging the gap between the new EU member states and the benchmark EU-15. It is used in the broader sense of positive structural change and productivity growth.

2 Overview of literature, research questions and hypothesis

The FGM aims to explain the catching-up process in the industrial sector in emergent open economies. The model argues that a lesser developed country is able to catch up, depending on the upgrading process in the lead country. The catching-up process is furthered via trade and FDI, the latter being pro-trade (i.e. trade-creating) in character (Bellak, 2003). According to Ozawa (1992, 2000), the FGM describes the links between the various stages of industrial upgrading and the related phases of FDI. As the lead country moves on up the technology ladder, it relocates via FDI industries at a lower level of technology to lesser developed countries. Based on the requirements of the differing stages of technology, multinational companies (MNCs) shift their manufacturing activities to various developing countries and/or transition economies.

The flying geese pattern encompasses three sub-patterns: (i) a sequence extending from import, through domestic production, to export; (ii) a sequence extending from the production of consumer goods to capital goods, as well as from the manufacture of crude and simple goods to complex and refined products; and (iii) the re-alignment of production from advanced nations to lesser developed nations according to their stages of growth (Bellak, 2003). In the FGM context, the restructuring process of a typical industry goes through five stages (Dowling and Cheang, 2000, pp. 446-447):

Stage 1: a new product is introduced via imports from lead country and some domestic production starts.

Stage 2: domestic production (starts to) substitutes for imports and foreign investors start to invest, albeit on a small scale.

Stage 3: domestic production increases, exports grow markedly and inward FDI becomes significant as the specific industry in the lead country loses its comparative advantage and starts relocating to follower countries.

Stage 4: domestic production slows down in the face of increasing costs and intensified competition from ‘late starter’ countries, exports slow down or decrease, while inward FDI drops as investors are attracted to ‘late starter’ countries.

Stage 5: loss of competitiveness and relocation of production to ‘late starter’ countries.

FDI-led growth was added to the FGM by Kojima and Ozawa (Kojima and Ozawa, 1985, Kojima, 2000). In the ‘Kojima II’ or pro-trade FDI model, a lead country starts relocating labour-intensive industries to low-wage countries: i.e., from a comparatively disadvantaged location to a comparatively advantaged location. This pro-trade FDI stimulates re-exports from the lesser developed host country, as well as capital and technology exports from the home country. This shift in comparative advantage across industries is the result of the catching-up process via this kind of defensive outward FDI (Bellak, 2003). ‘FDI thus augments comparative advantages in both countries, resulting in an expanded basis for trade and a reinforced productivity growth…. Moreover, FDI creates substantial spillover

effects' (Kojima, 2000, p. 383 quoted from Bellak, 2003). Thus, FDI can be seen to be highly favourable to the host country. In its modern version that has been developed almost exclusively by Ozawa, the FGM has been reformulated as follows: 'According to this paradigm, a group of economies advances together because of mutual interactions between countries through demonstration effects, learning and emulation, with the transmission mechanism being flows of people, trade in goods and services, flows of FDI, technology and other TNC-related assets. A characteristic feature of the "flying geese" pattern in Asia has been the increasing role of TNCs, initially through non-equity arrangements and joint ventures, more recently through FDI' (Kojima, 2000, p. 389 quoted from Bellak, 2003). The FGM has finally evolved into a general theory of development and FDI, developed by Ozawa (1992). This theory assumes a hierarchy of economies in terms of the stages of economic development. This hierarchy implies that on the one hand, the less advanced countries have the opportunity to learn from the advanced countries while on the other hand, the advanced countries need to transfer part of their value-added resources to less advanced countries. The pattern of FDI that a lesser developed country receives is bound to the structural transformations taking place in the home economy. With respect to the impact of FDI, the core of the theory is that it assumes a comparative-advantage-augmenting type of role; this means that in addition to gains from trade, 'countries gain even more from an expanded basis for trade when intangible assets are transplanted from the home countries' comparatively disadvantaged industries into the host countries' comparatively advantaged ones' (Ozawa, 1992, p. 42 quoted from Bellak, 2003).

The FGM was developed on the basis of experience in Japan and the countries of South-East Asia. Japan was the lead-goose heading the echelon of migrating geese with the other countries of South-East Asia in its train. As Japan, the lead economy, moved on up the technology ladder, it shifted lower level industries through FDI to other countries in South-East Asia that were at a lower stage of technological development. The FGM underwent various changes and extensions; it also survived widespread criticism. (For a comprehensive survey of theoretical developments and empirical evidence of FGM see Bellak, 2003.) One recurrent question was whether the FGM was also applicable to other countries or groups of counties. The opening-up and transformation of the CECs has given rise to the question whether a flying geese pattern might emerge in present-day Europe (Bellak, 2003, p. 5). The analogy with the EU-15 as the lead-goose with the CECs that recently joined the Union in its wake is obvious. All the more so since data show that: (i) most FDI in CEC manufacturing is pro-trade in character, thus making it conducive to a

catching-up process along the lines of FGM[2]; and (ii) the bulk of FDI in the CECs has come from EU countries[3].

On applying the FGM to the EU-15 and new EU member states, an important issue arises: the extent to which the FGM is applicable over and above its explaining the simple (initial) catching-up process as an outcome of the relocation of labour-intensive industries. In other words, what explanation does the FGM offer when it comes to the relocation of medium-high and high-tech industries? As developed in Ozawa's structural upgrading model, the FGM does not seem to take into account the fact that as the leader moves up the ladder, it becomes increasingly difficult to recycle comparative advantage, as the latter now differs from the early stages when it was based on low-cost unskilled labour (Ozawa, 2003). According to Bellak (2003, p. 20), 'the Schumpeterian and the internet-based industries involve created assets which are mobile, yet which are usually not transferred to host country firms, since they are the core of the firm-specific advantages. Also, contrary to cheap labour advantages, they can be recycled at home by the lead economy itself. Ozawa (2003) argues that each higher tier of industry offers to developing countries opportunities to participate in some low-end segments of production and service that are commensurate with their levels of technological sophistication and wages. Such reasoning assumes that as the lead economy moves to higher stages, also higher value-added part is left for the follower economy. Yet, if fragmentation in every stage means that only the labour-intensive stages are left for the follower economies, it is difficult to see how they are able to catch up.' In other words, the flying geese pattern of catching-up might mean that as a means of upgrading structures and enhancing productivity growth in host countries, FDI is a powerful factor in industries at the lower end of technology scale, but (much) less so in the industries at the upper end of that same scale.

The aim of our exercise is to confirm the existence of FGM in the case of inward FDI in the new EU member states. We shall endeavour to establish the manner in which, and the extent to which, FDI has contributed to both the restructuring process and productivity growth in CEC manufacturing. In that context, we shall attempt to answer the following questions:

(1) In terms of technology, which manufacturing industries have absorbed most of the inward FDI, and does the industrial structure of FDI in the CEC manufacturing sector differ from that of indigenous enterprises?

(2) In terms of technology intensity, which trends have emerged in the restructuring of CEC manufacturing, and what role does FDI play in that restructuring?

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[2] The exports-sales ratio in the manufacturing foreign investment enterprises in 2001 at 61.1% in the Czech Republic, 64.9% in Estonia, 63.3% in Hungary, 32.4% in Poland and 71.5% in Slovenia.

[3] At end-2001, the share of investors from EU countries in inward FDI stock was 84.5% in the Czech Republic, 80.1% in Estonia, 76.1% in Hungary, 81.8% in Poland, 60.3% in Romania, 81.1% in Slovakia and 85.6% in Slovenia (Hunya and Stankovsky 2003).

(3) What are the characteristics of FDI-related productivity growth in CEC manufacturing, and in which industries has FDI contributed most to productivity growth?

In keeping with the FGM we claim that FDI was a major factor in bringing about visible structural change and productivity growth in CEC manufacturing during the nineties. There were two reasons: (a) in part, foreign investment enterprises (FIEs) were on average directed more towards higher tiers of industry than domestic enterprises (DEs); and (b) in part, FIEs within the same industrial sector display higher rates of productivity growth. We also claim that in the catching-up process characterized by the FGM, the CECs gradually take over certain industries from the EU-15 via FDI. This has augmented the comparative advantages of the CECs, resulting in a broader basis for trade and stronger productivity growth. We further claim that, to the extent that it has been in medium-high and high-tech industries, FDI has made a relatively low contribution to the restructuring and productivity upgrading in the CECs, the reason being that FDI in the medium-high and high-tech industries in the CECs has been focused on the lower-end segments of those industries. In other words, in the new EU member states catching-up along the lines of the FGM occurs more frequently in industries at the lower (as distinct from the upper) end of the technology scale.

3 Data

The analysis in this paper is based on discrete financial data for both FIEs and DEs in six CECs over the period1993-2001. More precisely, we have used data at the sector level for the Czech Republic, Hungary, Poland and Slovakia over the period 1993-2001; for Estonia we have taken the period 1995-2001 and for Slovenia the period 1994-2001. Data are at the level of NACE Rev. 1, 2-digit manufacturing industries (codes 15-37). For the purposes of technology-intensity analysis, industries have been classified into four groups: high-tech industries; medium-high-tech industries; medium-low-tech industries; and low-tech industries[4]. The problem is that the manufacturing industries listed under code 24 and 35 fall into more than one classification. Industry 24.4 is in the high-tech group, whereas the rest of 24 are in the medium-high group; similarly, industry 35.3 is in the high-tech group, whereas 35.2 and 35.4 are in the medium-high group and 35.1 is in the medium-low group (see Table 1).[5] Since most activities in those two industries in the countries analysed fall within the medium-high group, we have for the purpose of this analysis placed all the

[4] The basic idea of FGM is more in line with a sole distinction being drawn between low-tech and other industries; however, in view of Ozawa's general theory on development and FDI (see Ozawa 1992), it is more appropriate to include the complete range of industries: low, medium-low, medium-high and high technology industries.

[5] A specific problem arose in the case of Estonia, where data for industries 23-24 and for industries 30-31-32-33 are grouped together. Industry 23 is in the medium-low technology cluster and 24 in the medium-high technology cluster. In our analysis we classified 23-24 under medium high technology industries. Industry 31 is in the medium-high technology cluster and industries 30-32-33 in the high technology cluster. In our analysis we classified 30-31-32-33 under the high technology cluster.

industries listed under 24 and 35 in that particular group. When testing the FGM pattern in both the EU and the CECs, one has to distinguish between FIEs with foreign parent companies in the EU and others. Available data do not permit this differentiation. The bulk of FDI in the CECs, however, comes from EU countries; this reduces the bias (see footnote 3).

Table 1

OECD classification of manufacturing industries based on technology using NACE Rev. 1 breakdown of activities

ACTIVITIES	NACE Rev. 1
High-tech industries	
Aircraft and spacecraft	35.3
Pharmaceuticals	24.4
Office, accounting and computing machinery	30
Radio, television and comm. equipment	32
Medical, precision and optical instruments	33
Medium-high-tech industries	
Electrical machinery and apparatus, n.e.c.	31
Motor vehicles, trailers and semi-trailers	34
Chemicals, excluding pharmaceuticals	24(excl. 24.4)
Railroad equipment and transport equipment n.e.c.	35.2+35.4
Machinery and equipment n.e.c.	29
Medium-low-tech industries	
Coke, refined petroleum products and nuclear fuel	23
Rubber and plastic products	25
Other non-metallic mineral products	26
Building and repairing of ships and boats	35.1
Basic metals	27
Fabricated metal products, except machinery and equipment	28
Low-tech industries	
Manufacturing n.e.c. and recycling	36+37
Wood, pulp, paper, paper products, printing and publishing	20+21+22
Food products, beverages and tobacco	15+16
Textiles, textile products, leather and footwear	17+18+19

4 FDI and the restructuring of CEC manufacturing

In this section we analyse the restructuring processes in the CEC manufacturing sector and the role of FDI in that sector over the period 1993-2001. We provide descriptive statistics relating to industrial distribution trends of both FIEs and DEs in terms of value-added, assets, employment and exports, as well as to the export propensity of FIEs and DEs and foreign penetration. In so doing, we distinguish between high, medium-high,

medium-low and low-tech manufacturing industries and address country differences. Finally, we attempt to define the FGM-related stages of the individual groups of technology-intensive industries in the CECs.

4.1 Trends in the industrial structure of FIEs and DEs in terms of technology intensity

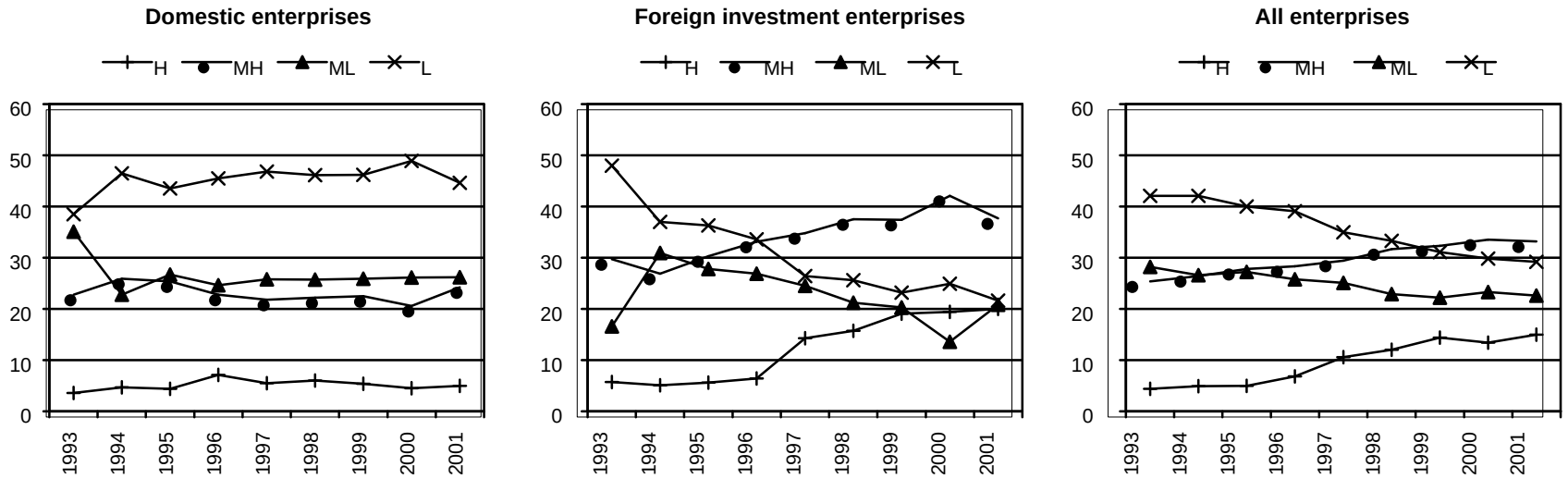
The data show positive trends in the restructuring of the CEC manufacturing sector as far as the technological intensity of industries is concerned. Most of these positive trends are due to FDI. This confirms the claim about the positive influence of FDI on restructuring processes in the CEC manufacturing sector. The restructuring processes in the DEs seem to be both slow and not necessarily in the right direction. Moreover, given the dual impact of foreign acquisitions (positive on FIE structure and negative on DE structure), the DE sector has had to implement structural changes simply in order to maintain current manufacturing structure. Therefore, extensive structural changes in the FIEs, to the extent that they were brought about via acquisitions, and the more or less unchanged structure of the DEs indicate the extent of structural change in the DE sector (for more, see final paragraph of section 4.1).

Figures 1, 2, 3 and 4 show the comparatively extensive and positive restructuring processes in CEC manufacturing in terms of value-added and exports, yet the surprisingly slow pace of restructuring, if any at all, in terms of employment. Restructuring in terms of assets is somewhere in between. Over the period 1993-2001, the share of low-tech industries in total manufacturing value-added dropped from 42.1% to only 29.2% and the share of medium-low-tech industries from 28.2% to 22.6%. On the other hand, the share of high-tech industries rose from only 4.4% to 15.0% and the share of medium-high-tech industries from 25.4% to 33.2%. A similar evolution can be observed in terms of exports, where the shares of high-tech and medium-high-tech industries can be seen to have increased palpably over the period: from 4.0% to 21.1% and from 39.3% to 45.7%, respectively. The structure of employment has remained virtually unchanged, while restructuring in terms of assets has been more intensive than that in terms of employment, yet less intensive than that in terms of value-added and exports (see Tables A.1, A.2, A.3 and A.4 in the Appendix).

Positive structural changes in CEC manufacturing have been overwhelmingly due to trends emerging in the FIEs. Most FIEs are among the medium-high-tech industries (except in terms of employment where the share of low technology industries is still highest), followed by low-tech and medium-low-tech industries. High-tech industries still have the lowest share, except in terms of exports, where their share shadowed that of medium-high-tech industries. In general, one can see a dynamic decrease in the share of

Figure 1

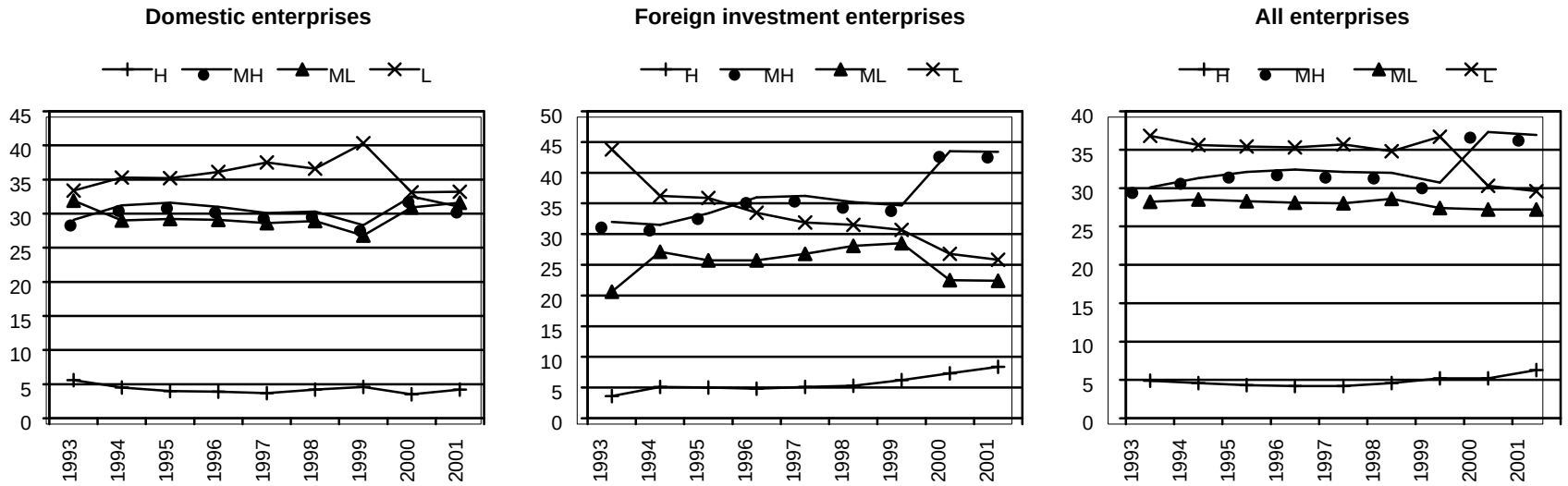
Distribution of value-added in the manufacturing sector, by technology-defined groups of industries for FIEs and DEs in six CECs, 1993-2001 (per cent)



See notes to Table A.1.

Figure 2

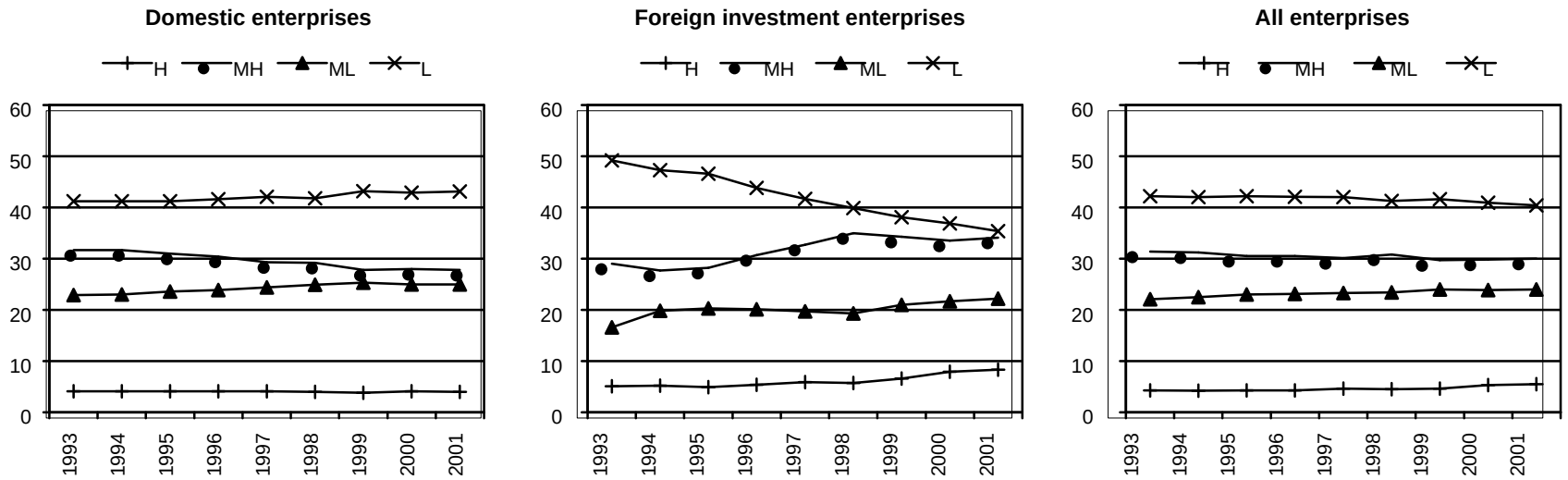
Distribution of assets in the manufacturing sector by technology-defined groups of industries for FIEs and DEs in four CECs[1], in 1993-2001 (per cent)



See notes to Table A.2.

Figure 3

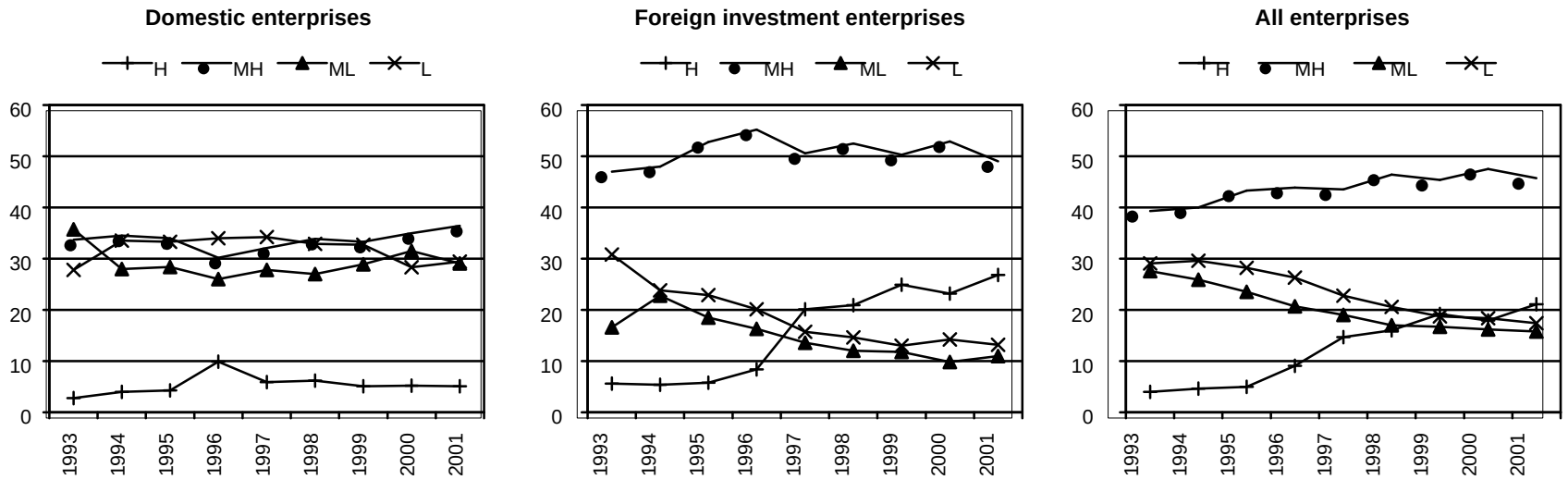
Distribution of employment in the manufacturing sector by technology-defined groups of industries for FIEs and DEs in six CECs, 1993-2001 (per cent)



See notes to Table A.3.

Figure 4

Distribution of exports in the manufacturing sector by technology-defined groups of industries for FIEs and DEs in four CECs[1)], 1993-2001 (per cent)



1) Estonia, Hungary, Poland and Slovenia. Export data for the Czech Republic and Slovakia are not available.

See notes to Table A.4.

low-tech industries and an increase in that of both medium-high and high-tech industries. In terms of value-added, the FIEs displayed a remarkable increase in the share of high-tech (from 5.7% to 20.0%) and medium-high-tech (from 29.7% to 37.7%) industries, mainly by reducing the share of low-tech industries (from 48.0% to only 21.6%). In terms of assets, the most remarkable increase has been that of medium-high industries (from 32.0% to 43.4%) and the decrease in low-tech industries (from 43.8% to 25.8%). The share of high-tech industries has also increased: from only 3.6% to 8.4%. In terms of employment, restructuring trends in the FIEs have been slower to a certain extent, yet they are still moving in very much the same direction.

The share of employment in high-tech industries increased from 5.1% to 8.3% and in medium-high-tech industries from 29.0% to 34.1%, both on the account of the decreasing share of low-tech industries. These processes show that foreign investors in the CECs are investing to an increasing degree in high-tech and medium-high-tech industries, while the share of low-tech industries is gradually dropping. This pattern is most distinctly confirmed by structural changes in the FIEs in terms of exports. As far back as 1993 medium-high-tech industries accounted for 47.0%. By 2001, their share had increased to 49.0%, whereas the share of high-tech industries had risen from a mere 5.6% to as much as 26.8% over the same period. This increase is mirrored by the decrease in the share of medium-low-tech industries from 16.6% to 11.0% and, most particularly, by the decrease suffered by the low-tech industries, whose share dropped from 30.8% to only 13.2% (see Tables A.1, A.2, A.3 and A.4 in the Appendix).

Restructuring in the DEs has been much slower and scarcely positive. In terms of value-added, the shares of high-tech and medium-high-tech industries can be seen to have stagnated while the share of low-tech industries increased or stagnated. In terms of assets, the largest increase was in medium-high-tech industries, but this has been almost completely offset by the decrease in the share of high-tech industries. In terms of employment, the trends are even worse, characterized as they are by a gradual drop in the share of medium-high-tech industries and an increase in the share of low-tech industries; there has no increase whatsoever in the share of high -tech industries. In terms of exports, similar trends are to be observed: minor increases in the shares of high-tech (from 2.8% in 1993 to 5.1% in 2001) and medium-high-tech industries (from 33.7% to 36.4%), and a decrease in the share of medium-low-tech industries (from 35.7% to 29.1%). On the other hand, however, the share of low-tech industries further increased by 1.5 percentage points to a very high level: 29.4% (see Tables A.1, A.2, A.3 and A.4 in the Appendix). Owing to the negative structural impact of foreign acquisitions on the restructuring of the DEs, these figures in fact mask the extent of restructuring in the DE sector; the maintenance of current structure does in fact point to a measure of restructuring (for more, see the last paragraph of section 4.1).

Table 2 summarizes the structural changes in individual countries by showing the cumulative change in value-added shares by individual countries over the period 1993-2001. The table advances three main conclusions. The first is that in all countries, with the exception of Estonia, manufacturing activity has shifted away from low-tech industries towards either medium-low or medium-high-tech industries. In addition, in all countries, with the exception of Slovakia, the share of high-tech industries has increased. The second conclusion is that in all countries, the restructuring processes have been much more extensive in FIEs than in DEs. The third conclusion is that considerable differences exist between the countries analysed as far as the intensity of the restructuring sector is concerned, both in general and where FIEs are concerned. The most pronounced degree of technological restructuring is to be observed in Hungary.

Table 2

Changes in the distribution of manufacturing value-added [1)] by technology-defined groups of industries [2)] in individual CECs for all enterprises and FIEs, 1993-2001 [3)] (in percentage points)

	All enterprises						Foreign investment enterprises					
	CZ	**ES**	**HU**	**PL**	**SI**	**SK**	**CZ**	**ES**	**HU**	**PL**	**SI**	**SK**
H	1.1	2.7	11.8	1.7	0.7	-0.3	2.6	14.2	16.3	0.0	1.7	0.2
MH	2.7	-12.1	8.2	1.5	1.3	-1.2	3.1	-17.5	11.6	3.1	-12.7	0.6
ML	-0.9	8.0	-5.1	-3.1	3.4	8.0	1.5	3.3	-11.5	11.2	6.8	14.5
L	-2.9	1.5	-14.9	-0.1	-5.4	-6.5	-7.3	0.0	-16.4	-14.4	4.2	-15.2
Absolute change [4)]	7.6	24.2	40.0	6.3	10.9	15.9	14.5	35.0	55.8	28.8	25.3	30.5
Weighted change [5)]	2.6	-2.7	15.6	1.6	2.7	1.6	5.2	3.6	20.2	5.9	-4.5	5.4

Notes: 1) For Hungary and Poland sales data have been used. – 2) H = High technology, L = Low technology, MH = Medium-high technology, ML = Medium-low technology industries. – 3) Czech Republic, Hungary and Slovakia for 1993-2001, Estonia for 1995-2001, and Slovenia for 1994-2001. –

4) Sum of absolute changes: $|\Delta S| = \sum_i |(S_{it_1} - S_{it_0}|$ over i technology groups. –

5) Weighted change: $\Delta S * tech = \sum_i (S_{it_1} - S_{it_0}) * w_i$, where wH = 1, wMH = 0.67, wML = 0.33, and wL = 0.

Source: wiiw Database.

In Table 2 we provide two simple aggregate measures of industrial restructuring for each country. The firstmeasure is the sum of absolute changes of structural shares of individual technology groups (see note 1 to Table 2). The aim is to indicate the extent of restructuring in individual countries. The most turbulent restructuring process is to be observed in Hungary and Estonia, followed by Slovakia, whereas in Slovenia, the Czech Republic and Poland technological restructuring seems to have been slower. Absolute change, however, indicates only the extent of restructuring, but not its thrust. We have therefore calculated a weighted measure of restructuring, with greater weights being attached to higher-tech groups (see note 2 to Table 2). Weighted change indicates that once again the most

intensive shift in restructuring towards higher-tech groups occurred in Hungary which outperformed its closest counterpart by a factor of 5. Slovenia and the Czech Republic were also quite successful in their efforts to restructure towards higher-tech industries. The figures for Slovakia and Poland are more modest, while Estonia has taken a step back in terms of technology. The latter trend is attributable to the share of medium-high-tech industries in Estonia having decreased considerably.

Table 3

Distribution of FIEs [1] value-added [2] in the manufacturing sector by technology-defined groups of industries [3] in individual CECs, 2001 (per cent)

	CZ	ES	HU	PL	SI	SK
H	4.1	14.2	21.2	5.8	11.2	3.2
MH	40.2	18.2	37.9	30.4	37.7	31.1
ML	30.6	14.4	20.2	27.0	18.7	41.0
L	25.1	53.2	20.7	36.8	32.4	24.7
Total	100.0	100.0	100.0	100.0	100.0	100.0

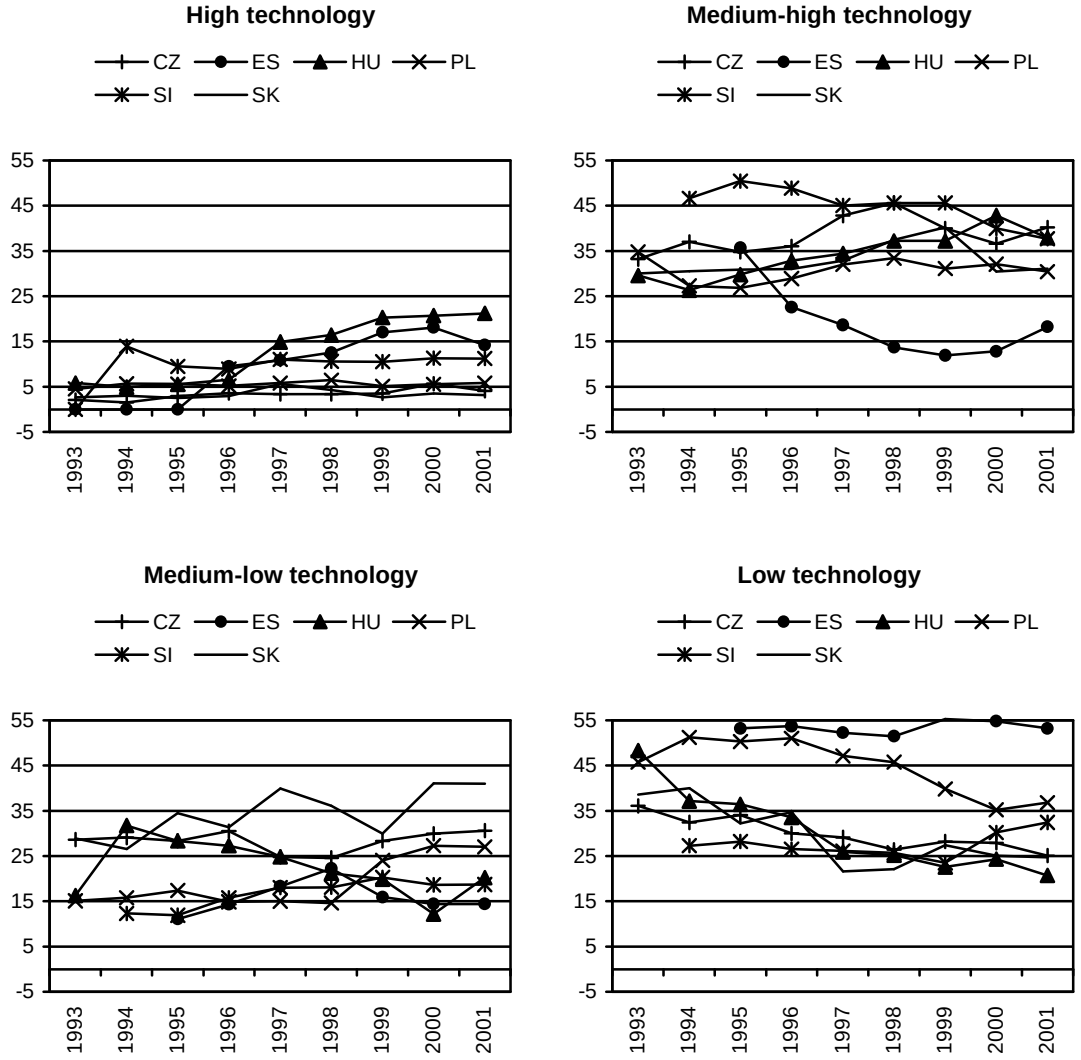
Notes: 1) FIEs = Foreign investment enterprises. – 2) For Hungary and Poland sales data have been used. – 3) H = High-tech, L = Low-tech, MH = Medium-high-tech, ML = Medium-low-tech industries.

Source: wiiw Database.

This positive technology change in Hungary is predominantly due to FDI, since the FIEs have increased their share in medium-high and high-tech industries by 28 percentage points. In other CECs technological restructuring was also significantly affected by the FIEs, which have gradually upgraded the technological intensity of their activities. However, in this context the differences between countries are really considerable. In the Czech Republic, the structural decrease in low-tech industries has for the most pat been accompanied by the structural increase in medium-high and high-tech industries. In Estonia, a huge increase in high-tech industries has been accompanied by an even larger decrease in medium-high-tech industries. In Poland and Slovakia, most of the decrease in low-tech industries has been far outweighed by the increase in medium-low-tech industries. Slovenia is the only CEC among those analysed where the weighted structural change of the FIEs in manufacturing has been negative: a major structural decrease in medium-high-tech industries has not been offset by a structural increase in medium-low and low-tech industries. In Slovenia, FDI can thus be seen to have moved away from medium-high to medium-low and low-tech industries. Hence, the overall positive technological restructuring in Slovene manufacturing seems to stem from restructuring among domestic firms.

Figure 5

Evolution in the distribution of FIE value-added in the manufacturing sector by technology-defined groups of industries in individual CECs, 1993-2001 (per cent)



See notes to Table 3.

The above differences in manufacturing structural changes brought about by FDI in individual CECs have resulted in considerable variations in the structure of FIEs in the manufacturing sectors of individual CECs (see Table 3). The most advanced structure seems to be that of the FIEs structure in Hungary, where in 2001 high and medium-high-tech industries accounted for 59.1% of total FIE value-added in that country's manufacturing sector. Hungary is the only one of the selected CECs to display a clear and steady trend towards an increasing share of high and medium-high-tech industries in the total value-added of FIE manufacturing (see Figure 5). Hungary is followed by Slovenia (48.9%) and Czech Republic (44.3%). In the high-tech industrial sector, Slovenia and the Czech Republic in particular have experienced significant structure lag compared to

Hungary. The share of high and medium-high-tech industries in FIE activities in Poland, Slovakia and Estonia is much lower. A somewhat puzzling factor is the large proportion of high-tech industries in Estonia[6], which otherwise accounts for the highest share of low-tech industries, as is the large proportion of low-tech industries in Slovenia.

When interpreting the data on structural trends in CEC manufacturing, account should be taken of the markedly different situation facing FIEs and DEs. The difference is due to foreign acquisitions, resulting in the transfer of ownership from domestic to foreign hands, in other words from DEs to FIEs. Every foreign acquisition has a dual effect. For instance, the foreign acquisition of an enterprise in high-tech sector simultaneously increases the share of high-tech industries in the FIE sector and reduces the share of high-tech industries in the DE sector. To the extent that foreign acquisitions have been an important component in FDI (as has been the case with all the CECs going through comprehensive privatization processes) and to the extent that FDI is increasingly directed towards medium-high and (in part) high-tech sectors away from low-tech industries (as is also the case), improvements in the sectoral structure of the FIEs also incurs an automatic deterioration in the sectoral structure of the DEs. Simply in order to offset the debilitating impact of foreign acquisitions on sectoral structure and uphold the current structure, the DE sector should undertake considerable restructuring efforts. The more intensive the positive restructuring process in the FIE sector and the more it is the consequence of acquisitions, the more intensive the restructuring efforts in the DE sector should be just to maintain the structural status quo. Under these circumstances, we should modify our conclusion that extensive restructuring is taking place in the FIE sector and to a lesser degree in the DE sector. The very fact that throughout the 1990s the DEs more or less retained a manufacturing structure based on technological intensity does in fact mean that the DE sector has undergone quite extensive restructuring.

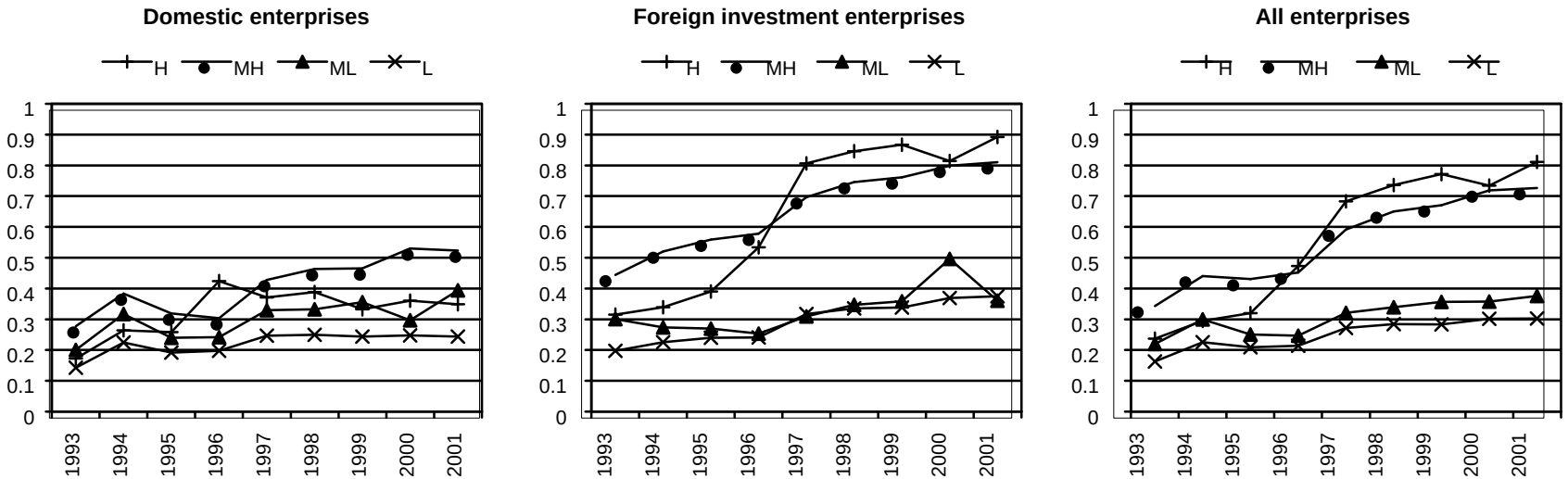
4.2 Export propensity of both the FIEs and DEs by technological intensity of industries

According to the FGM, the various stages of the restructuring process are defined not only by the trends in export volumes, but also by the export propensity (exports-sales ratio) of individual groups of technology-intensive industries. Exports and export propensity are the most striking features of the restructuring process in CEC manufacturing, predominantly due to FIEs. It is not only that medium-high and high-tech industries accounted for most of FIEs exports in 2001 (75.8% together), but over the period 1993-2001 FIE exports

[6] This may be the consequence of the data problem in the case of Estonia, where owing to data aggregation NACE 31 'Electrical machinery and apparatus' is classified under the high- (instead of medium-high) technology cluster (see footnote 5).

Figure 6

Evolution of export propensity in the manufacturing sector by technology-defined groups of industries for FIEs and DEs in four CECs [1], 1993-2001

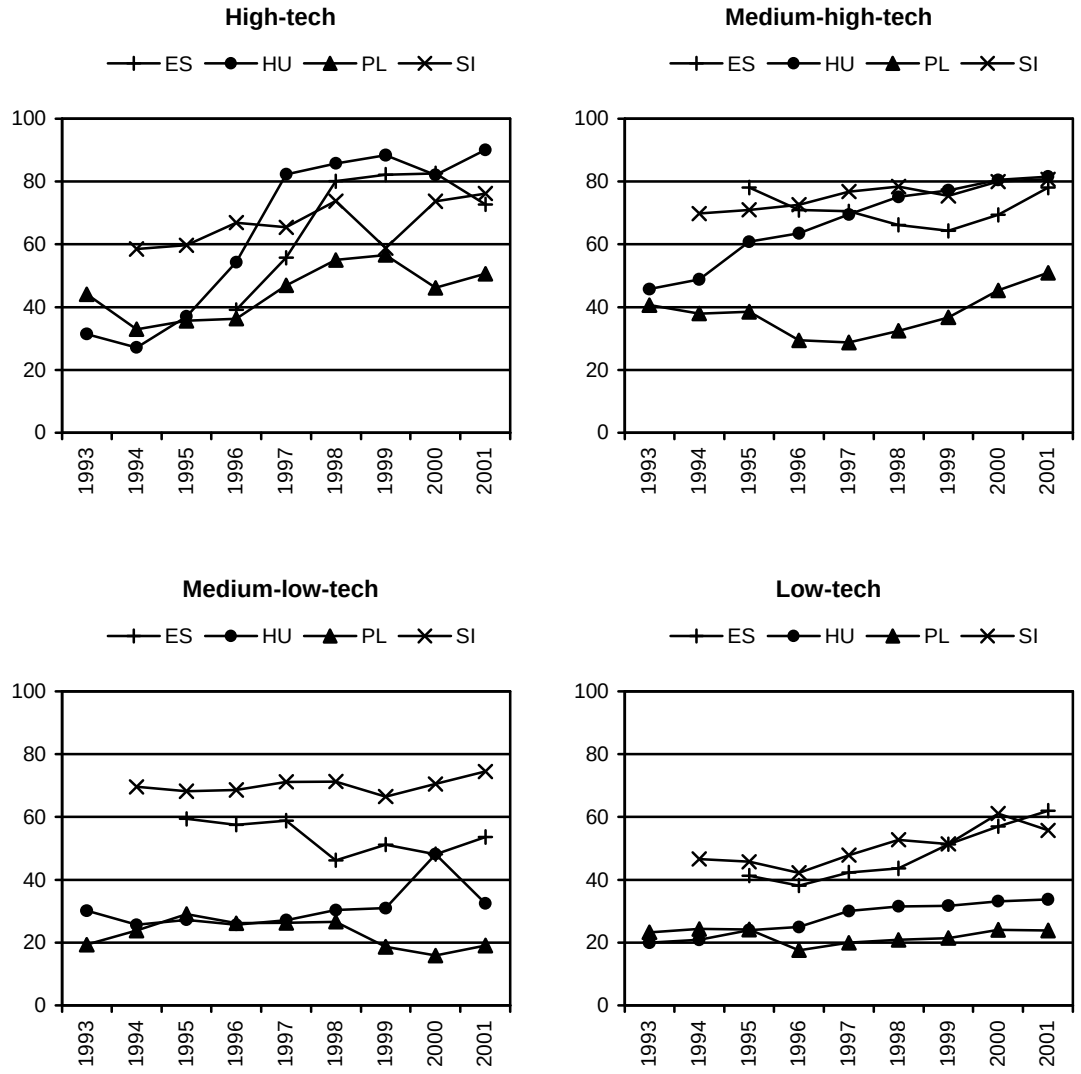


1) Estonia, Hungary, Poland and Slovenia. Export data for the Czech Republic and Slovakia are not available.

See notes to Table A.5.

Figure 7

Evolution of export propensity of FIEs in the manufacturing sector in four CECs, by country and technology-defined groups of industries, 1993-2001



See notes to Table A.6.

underwent extensive restructuring in favour of high-tech industries and shifted away from low and medium-low-tech industries. Even more striking was the growing export propensity of the FIEs over the same period in high-tech (from 31.5% to 89.2%) and medium-high-tech industries (from 44.4% to 81.0%), while the export propensity of low-tech (37.4% in 2001) and medium-low-tech industries (36.0%) remained much lower. Export propensity in the DEs in high-tech (34.9% in 2001) and medium-high-tech industries (52.3% in 2001) was much lower and also increased less over the period under analysis. The FIEs also

displayed greater export propensity in low-tech industries, while in the medium-low-tech group the export propensity of the DEs was higher than that of the FIEs. In all likelihood, the main contribution of the FIEs to economic restructuring and growth in the CECs thus stems from increased export volumes, thereby confirming the extraordinary pro-trade orientation of the FDI flowing into the CECs. The FIEs have helped the CECs in their technological restructuring efforts by increasing the export orientation of both the high and medium-high-tech industries (see Figure 6 above and Table A.5).

Figure 7 (and Table A.6) shows the export propensity of the FIEs by technology group for individual CECs.[7] It is evident that the size of a country may determine the export propensity of its FIEs, given that the FIEs in Estonia and Slovenia (the smallest of the CECs) register the highest level of export orientation, while those in Poland (the largest of the CECs) are the least export oriented in all technology groups. However, it is quite obvious that the FDI pattern and technological restructuring also play an important role in determining export orientation. Tables 2 and 3 above show that the high FDI penetration in Hungary has been accompanied by a considerable measure of technological restructuring – shifting away from low-tech and medium-low-tech industries towards medium-high and high-tech industries. At the same time, the export orientation of FIEs, both in general and in Hungary in particular, in high and medium-high-tech industries is much more pronounced than in medium-low and low-tech industries. Thus, the combination of restructuring towards medium-high and high-tech industries and the fact that these two industry groups are much more export-oriented than medium-low and low-tech industries explains the strong export performance of Hungarian FIEs. In 2001, Hungarian FIEs in high and medium-high-tech industries were the most export-oriented among the CECs analysed.

4.3 Foreign penetration by technological intensity of industries

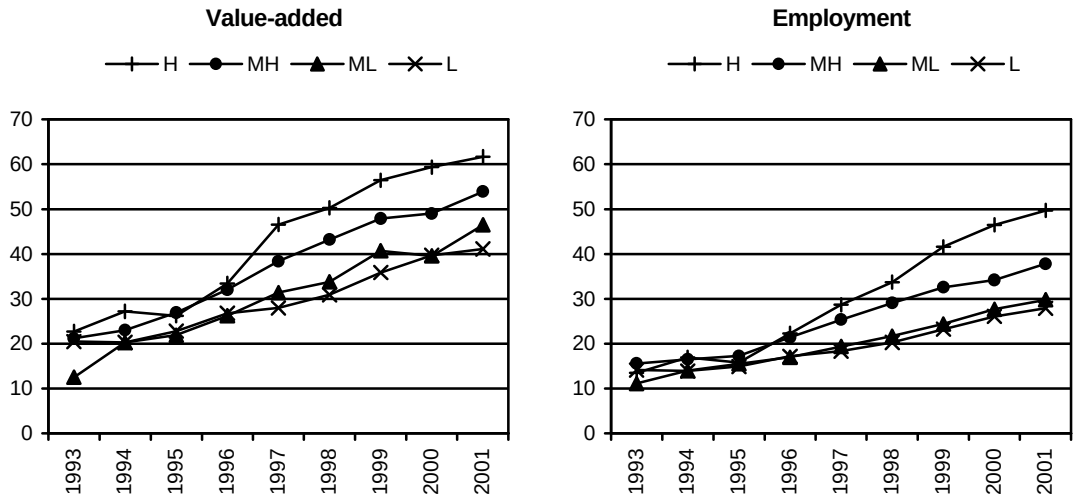
The significant and positive influence of FDI on the restructuring processes in CEC manufacturing is further confirmed by an increasing level of penetration on the part of FIEs – and especially by the pattern of that increase. The level of penetration is most pronounced in high-tech industries (in 2001, 62% in terms of value-added and 50% in terms of employment), followed by medium-high-tech industries (54% and 38%), medium-low 47% and 30%) and low-tech industries (41% and 28%). Over the period 1993-2001, the level of foreign penetration rose fastest in high-tech industries (by 39 percentage points in terms of value-added and 36 percentage points in terms of employment) and slowest in low-tech industries (21 and 14 percentage points). All in all, in recent years it has been the high-tech industries and the medium-high-tech industries that have exhibited the highest

[7] Note that export data for the Czech Republic and Slovakia are not available; hence, we only show figures for Estonia, Hungary, Poland and Slovenia.

level, and the most marked growth, of foreign penetration (see Figure 8 and Table A.7). Furthermore, the far greater foreign penetration ratios in terms of value-added than in terms of employment point to much higher productivity in FIEs compared to DEs.

Figure 8

Foreign penetration in the manufacturing sector in six CECs in terms of value-added and employment, by technology-defined groups of industries, 1993-2001 (per cent)

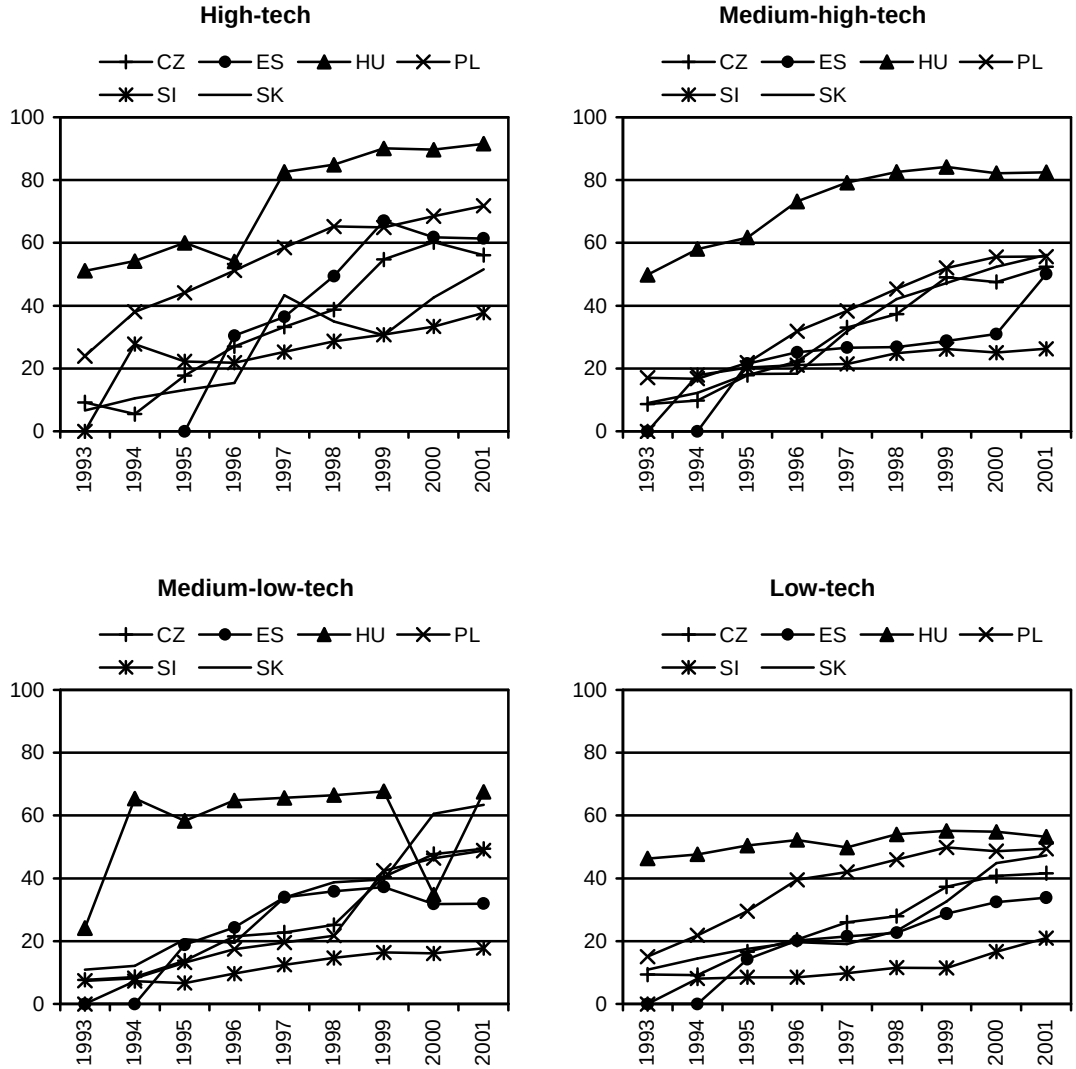


See notes to Table A.7.

Individual countries included in the analysis display the same pattern of foreign penetration, the highest level of penetration being in high and medium-high-tech industries. In terms of value-added, the level of foreign penetration is by far the most pronounced in Hungary (91.6% high and 82.5% in medium-high-tech industries), followed by Poland (71.9% in high and 55.6% in medium-high-tech groups). The lowest penetration ratios in all technology groups are to be observed in Slovenia – less than 40% in high-tech, less than 30% in medium-high-tech, less than 20% in medium-low-tech and around 20% in low-tech industries. In the Czech Republic, Slovakia and Estonia the penetration ratios range between these two limits: between 50% and 60% in high-tech and medium-high-tech industries. Foreign penetration in medium-low and low-tech industries is far greater in Slovakia (63.4% and 47.3% respectively) than in the Czech Republic (49.4% and 41.7%) and Estonia (32.0% and 33.9%) (see Figure 9 and Table A.8 in the Appendix).

Figure 9

Foreign penetration in the manufacturing sector in six CECs in terms of value-added, by country and technology-defined groups of industries, 1993-2001



See notes to Table A.8.

4.4 FGM stages of the individual groups of technology-intensive industries in the CECs

The available data allow us to try and detect FGM-stages 2, 3 and 4 in the individual groups of technology-intensive industries, as defined by Dowling and Cheang (2000, pp. 446-447). According to Dowling and Cheang, those three stages display the following features: (i) stage 2: domestic production (starts to) substitutes for imports and foreign investors start to invest albeit on a small scale; (ii) stage 3: domestic production increases, exports grow markedly and inward FDI becomes significant; and (iii) stage 4: domestic

production slows down in the face of rising costs and intensified competition from ‘late starter’ countries, exports slow down or decrease, while inward FDI drops as investors are attracted to ‘late starter’ countries.

Table 4 establishes a scheme for classifying the individual groups of technology-defined industries into FGM-stages 2, 3 or 4. We use four indicators to classify the industry groups into the three stages: industrial distribution in terms of value-added; industrial distribution in terms of exports; export propensity; and foreign penetration. Roughly speaking, low levels in terms of value-added, share of exports, export propensity and foreign penetration indicate that an industry group is at stage 2; increasing and levels of the same indicators mean that the group has reached stage 3, while high and stagnating or falling levels means that it is at stage 4. Table 4 is based on Tables A.1, A.4, A.5 and A.7 and Figures 1, 4, 6 and 8. Short time series are probably the main shortcoming of this exercise. The pattern established by Table 4 is presented below.

The situation and trends in high-tech industries place them somewhere towards the end of the second stage or at the beginning of the third stage. The share of high-tech industries in the manufacturing sector in terms of value-added is relatively low, but increasing. In terms of exports, the share has already reached the medium level and is rapidly increasing. FDI in these industries is the lowest of all industry groups, the highest by far being in Hungary, followed by Estonia and Slovakia, while the other three CECs lag far behind. Foreign penetration in high-tech industries in the CECs, however, is high; this is mostly on account of the DEs being rarely engaged in those industries. Export propensity is also high and rapidly increasing; this might be due to the FIEs being engaged in the lower-end segments of those industries, producing inputs for their parent companies’ integrated international production.

The share of medium-high-tech industries is high (the highest of all groups and in all the CECs analysed, except Estonia and Slovakia) and increasing, in terms of both value-added and exports. Export propensity and foreign penetration are also high and rapidly increasing. These features place medium-high-tech industries in the third stage. Medium-low-tech industries have a medium, but falling share in the manufacturing sector, in terms of both value-added and exports, medium but slowly increasing export propensity, and high and ever-increasing foreign penetration. These traits put medium-low-tech industries somewhere at the end of the third stage or at the beginning of the fourth stage. It is important to note that it is Slovakia, Czech Republic and Poland where the FIEs generate really large shares of their value-added in medium-low-tech industries.

There is no doubt that low-tech industries are at the fourth stage or close to it. Their share in the manufacturing sector in terms of value-added and exports is falling, their export

Table 4

FGM stages of individual groups of technology-intensive industries in CECs

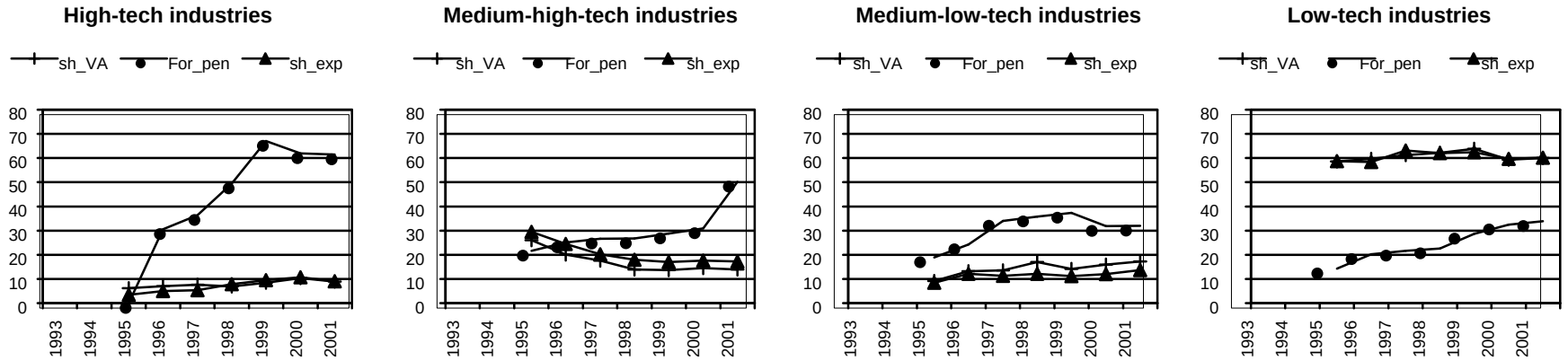
	Industrial distribution Share of individual industry group in total manufacturing **(In terms of value-added)**	**Industrial distribution** Share of individual industry group in total manufacturing **(In terms of exports)**	**Export propensity** Exports-sales ratio of individual industry group in relation to export propensity in manufacturing total	**Foreign penetration** Share of FIEs in all enterprises in individual industry group **(In terms of value-added)**	**OVERALL**
Stylized characteristics of FGM stages					
Stage 2	low	low	low	low	
Stage 3	increasing/high	increasing/high	increasing/high	increasing/high	
Stage 4	high/stagnating/falling	high/stagnating/falling	high/stagnating/falling	high/stagnating/falling	
FGM stages of individual groups of technology-intensive industries					
H	**Stage 1-2** (low to medium-increasing)	**Stage 2** (medium-increasing)	**Stage 3** (high-increasing)	**Stage 3** (high-increasing)	**Stage 2-3**
MH	**Stage 3** (high-increasing)	**Stage 3** (high-increasing)	**Stage 3** (high-increasing)	**Stage 3** (high-increasing)	**Stage 3**
ML	**Stage 3-4** (medium-falling)	**Stage 4** (medium-falling)	**Stage 3-4** (medium-slowly increasing)	**Stage 3** (high-increasing)	**Stage 3-4**
L	**Stage 4** (high-falling)	**Stage 4** (medium-falling)	**Stage 3-4** (medium-slowly increasing)	**Stage 3-4** (high-slowly increasing)	**Stage 4**

Source: Tables A.1, A.4, A.5 and A.7 and Figures 1, 4, 6 and 8.

Figure 10

Flying geese pattern in Estonia, Hungary, Poland and Slovenia: shares in value-added and exports and foreign penetration in individual groups of technology-intensive industries, 1993-2001

ESTONIA



HUNGARY

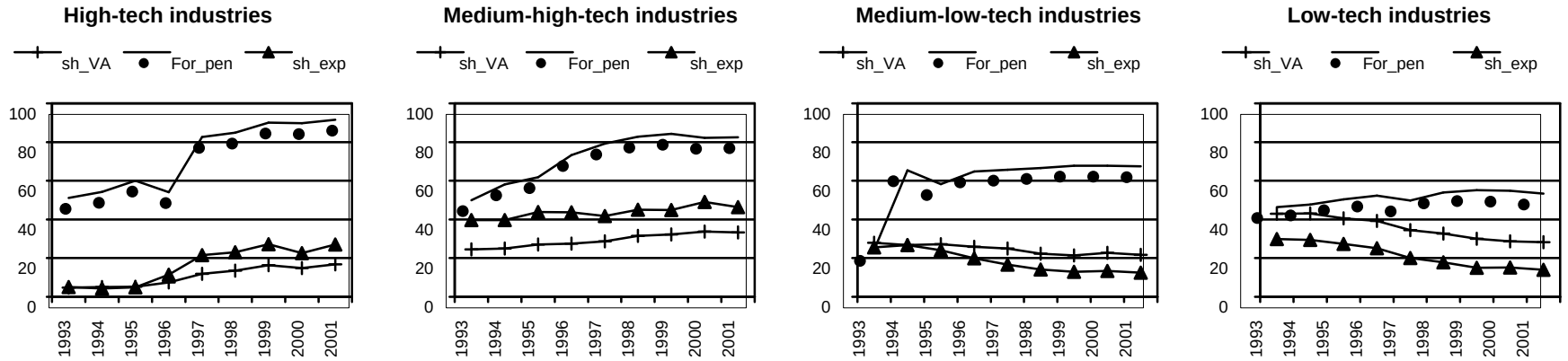
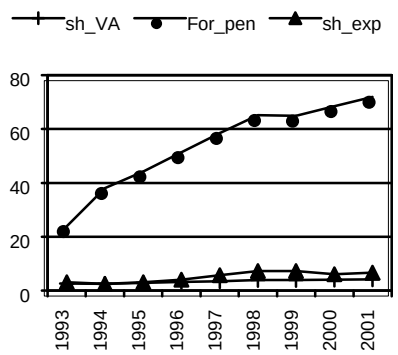


Figure 10 (cont.)

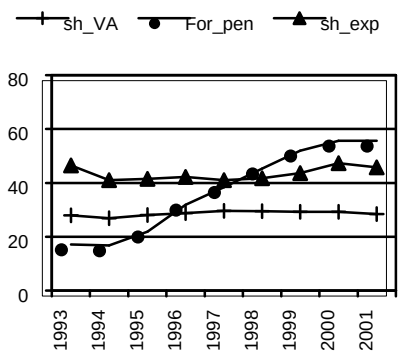
Flying geese pattern in Estonia, Hungary, Poland and Slovenia: shares in value-added and exports and foreign penetration in individual groups of technology-intensive industries (cont.) 1993-2001

POLAND

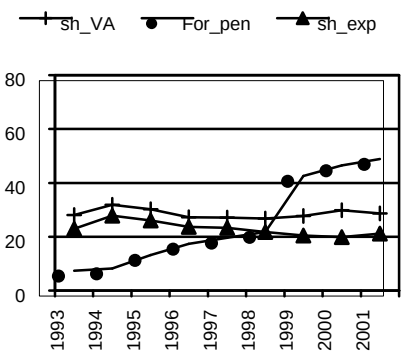
High-tech industries



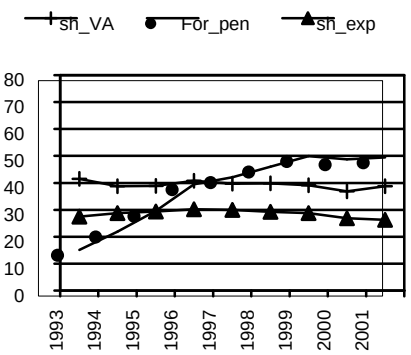
Medium-high-tech industries



Medium-low-tech industries

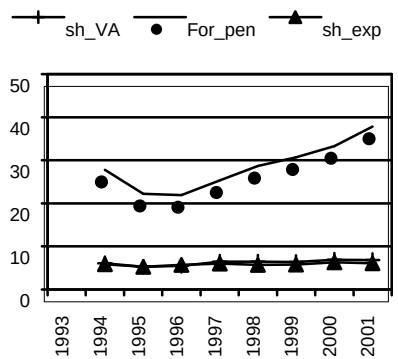


Low-tech industries

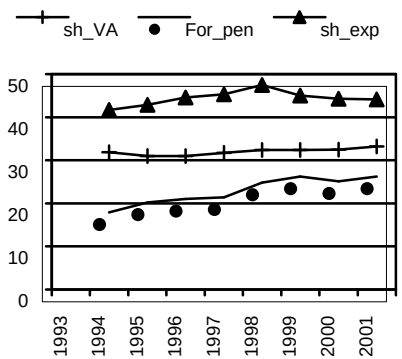


SLOVENIA

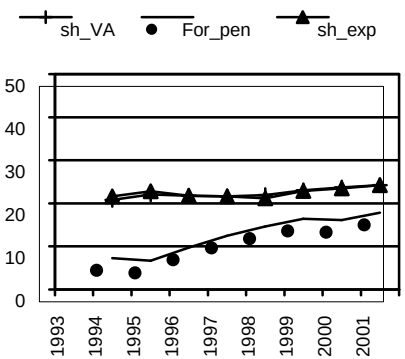
High-tech industries



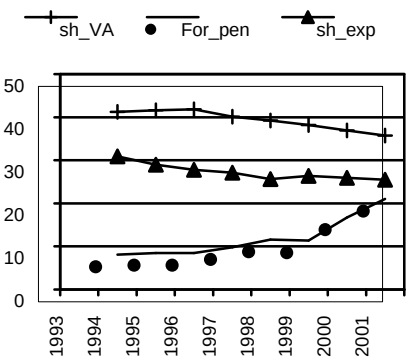
Medium-high-tech industries



Medium-low-tech industries



Low-tech industries



See notes to Table A.10.

propensity and foreign penetration are high, yet are increasing only slowly. Since 1998, the levels of both export propensity and foreign penetration have almost stagnated. Foreign investor interest in investing in low-tech industries in the CECs seems to be gradually on the wane. It is Estonia, Poland and (surprisingly) Slovenia where the FIEs generate the highest shares of their value-added in low-tech industries.

All the above would suggest that in the course of catching up the CECs go through the various stages rather than skip them. Hungary, Slovenia and Czech Republic are a step ahead of Poland, Slovakia and Estonia in this process. The role of FDI in all these trends and processes is crucial. Figure 10 and Table A.10 shed some additional light on the flying geese pattern in Estonia, Hungary, Poland and Slovenia[8]:

(a) The structure of the Estonian manufacturing sector in terms of value-added is characterized by an extremely high share of low-tech industries – by far the highest of the four countries – with the restructuring process moving away from medium-high and towards medium-low-tech industries. Estonia is the only country of the four, in which the structure of value-added and exports is very balanced for all groups of technology-intensive industries. In all other countries, the export shares of low-tech industries are lower than their value-added shares: i.e., the export propensity of low-tech industries is below average. Estonia seems to be the only country that still continues to base its exports heavily on low-tech industries. Foreign penetration is highest and increasing at the fastest rate in high and medium-high-tech industries. The level of foreign penetration in medium-low and low-tech industries has been stagnating as of late: foreign investment opportunities in these two industry groups in Estonia seem to have more or less reached saturation point. The overall conclusion is that FDI has gradually begun to restructure the Estonian manufacturing sector towards medium-high-tech industries, while domestic enterprises are still very much to be found in the low and medium-low-tech industries.

(b) Of the four countries, Hungary displays by far the highest share of high-tech (and medium-high as well) industries in the value-added structure of the manufacturing sector. Over the period 1993-2001, it set in train an extensive process of manufacturing restructuring away from low and medium-low-tech industries towards high and medium-high-tech industries. Comparison of exports and value-added shares of the individual groups of technology-defined industries shows export propensity to be above average in high and medium-high-tech industries and below average in medium-low and low-tech industries. Hungary is the only country where the share of high-tech industries in exports outstrips that in value-added. Hungary is basing its exports more and more on medium-high (46.4% of total manufacturing exports in 2001) and high-tech industries (27.1%). FDI plays the major role throughout; foreign penetration is highest in high and medium-high-

[8] Only countries with export data available are taken into account in Figure 10 and Table A.10.

tech industries, and considerably lower in medium-low and, especially, low-tech industries. Hungary has obviously reached the stage where medium-high-tech industries constitute the main engine of development, while high-tech industries are also gaining in importance. However, one should not forget that medium-low and low-tech industries still produce half of the value-added generated by the Hungarian manufacturing sector.

(c) The restructuring process in the Polish manufacturing sector over the period 1993-2001 has been rather slow. Shifts in the structural shares of the four groups of technology-intensive industries in terms of value-added have been very small, with low-tech industries retaining their prominent position, followed by medium-low and medium-high-tech industries which rank almost equal in importance. Medium-high-tech industries seem to be the main export force in Polish manufacturing; their share in total manufacturing exports is much higher than the share in value-added, indicating an above-average export propensity. Quite the opposite picture prevails in low and medium-low-tech industries. Foreign penetration in all four industry groups has been increasing rather rapidly. None the less, in recent years (since 1998) foreign penetration in low-tech industries can be seen to have stagnated. All in all, not much has been going on in the restructuring of the Polish manufacturing sector, except the stagnation of foreign penetration in the low-tech industries; the latter may well indicate a forthcoming shift away from those industries. The low export propensity of both low and medium-low-tech industries may be indicative of the same trend.

(d) Of all the countries, Slovenia displays the lowest level of foreign penetration. That notwithstanding, foreign penetration has been gradually increasing in all industry groups, without any clear differentiation between them. In Slovene manufacturing, low-tech industries are still the most important, followed by medium-high and medium-low-tech industries. The main structural trend over the period 1994-2001 was a very modest shift away from low-tech industries (-5.5 and -5.4 percentage points in terms of value-added and exports, respectively). Structural gains in the medium-high and high-tech industries, however, were even more modest; during the period 1994-2001 together they both gained only 2 and 2.6 percentage points in terms of value-added and exports, respectively. Low and medium-low-tech industries still account for almost 60% of the Slovene manufacturing sector in terms of value-added. Nevertheless, comparison of the structural shares of the individual groups of technology-intensive industries in terms of value-added and exports would seem to put a slightly different spin on things. In low-tech industries the share of exports is much lower than that of value-added share, whereas in medium-low-tech industries both shares are almost balanced, while in medium-high-tech industries the share of exports is much higher than that of value-added. This would indicate that the export propensity of low-tech industries is below average, while that of medium-high-tech industries is above average. There is no doubt that Slovenia bases its manufacturing exports on medium-high-tech industries; in 2001 the latter's share in total manufacturing

sector exports amounted to 44.1%. In view of the fact that Slovenia is the most developed of the four countries and given that it has by far the highest wage levels, the significant trend towards increasing the value-added share of medium-low-tech industries is surprising and not sustainable. Furthermore, the trend towards increasing the value-added share of medium-high and high-tech industries is too slow, given that higher labour productivity in technologically more advanced industries might more easily offset the high wage levels compared to low-tech industries. In conclusion, compared to Hungary, structural changes in Slovene manufacturing have been less extensive and less favourable. The reasons are of a policy nature: a gradualist reform process in Slovenia (see Rojec et al., 2004) and a hesitant attitude towards FDI resulting in a low level of foreign investment. Several other factors, however, may speed up the restructuring processes and bring about a shift towards medium-high-tech industries away from low-tech industries in the future. First, by joining the ERM 2[9] in 2004, Slovenia has changed its exchange rate policy and now pegs the national currency to the euro; this will put an end to the favourable treatment shown to marginal exporters[10] located mainly in low-tech industries. Secondly, upon accession to the EU, structural reforms will speed up, one indication of the latter being the recently adopted government policy aimed at actively promoting FDI and exports.

Cross-country comparison of Estonia, Hungary, Poland and Slovenia once again shows that in terms of the flying geese pattern, Hungary is to the fore, followed by Slovenia, Poland and Estonia. FDI is an important component in FGM-shaped restructuring. The main underlying features are:

(i) The structural shares of high-tech industries are increasing in all the countries, while those of low-tech industries are decreasing. The situation in medium-high and medium-low-tech industries differs by country. The share of medium-high-tech industries is decreasing in Estonia, stagnating in Poland and increasing in Hungary and Slovenia. The share of medium-low-tech industries is decreasing in Hungary, stagnating in Poland and increasing in Estonia and Slovenia;

(ii) In all the countries, except Estonia, medium-high-tech industries are the driving force behind manufacturing exports. They show the highest ratio of structural shares of exports to value-added (above 1 in all the countries); this in fact indicates export propensity. The ratio of structural shares of exports to value-added is lowest (much below 1) in low-tech industries; this holds true for all the countries except Estonia, where it is approximately 1. The ratio is also below 1 in medium-low-tech industries, with the exception of Slovenia where it is approximately 1. In high-tech industries the ratio is close to 1, except in Hungary where it exceeds 1; and

[9] European exchange rate mechanism.

[10] Enterprises whose export competitiveness has depended on an accommodating exchange rate policy.

(iii) Foreign penetration is increasing in all countries and in all industry groups. Foreign penetration is much higher in high and medium-high-tech industries than in medium-low and low-tech industries (see Figure 10 and Table A.10).

5 Impact of FDI on productivity growth in the CECs

The catching-up process described by FGM should be reflected in the productivity growth in FDI recipient countries. Based on the classification of the individual industry groups into FGM-stages, it becomes a question of establishing at which stage FDI can be expected to have the optimal effect on productivity growth in CEC manufacturing. Low--tech industries seem to be at a stage where they no longer possess the competitive advantages that would qualify them for successful export-oriented production. In other words, low-tech industries in the CECs have more or less lost their potential for productivity growth and can no longer attract FDI seeking factor cost advantages. High-tech industries face a similar situation, albeit the obverse. For the most part, the requisite elements and appropriate environment for competitive involvement in high-tech industries are mostly at a very incipient stage in the CECs. Even more importantly, one can hardly expect those industries to catch up via FDI, because according to economic theory FDI would be mostly directed towards low-end segments of high-tech industries. Hence, one cannot expect major productivity breakthroughs in those industries, nor can foreign investors be expected to express significant interest in those industries. At the present juncture, productivity growth and international competitiveness in the CECs seem to be mostly based on medium-high and medium-low-tech industries. They are also the industries that have attracted the interest of foreign investors seeking factor cost advantages; moreover they are the industries, in which one can expect an FDI-assisted catching-up processes in keeping with the FGM.

We will analyse the impact of FDI on productivity growth in the CECs and endeavour to confirm the above propositions: first, by looking at labour productivity trends in CEC manufacturing; and secondly, by looking at the contribution of FDI to total factor productivity growth in CEC manufacturing.

5.1 Trends in labour productivity growth

In this section the focus is on productivity growth in CEC manufacturing as reflected in the trends related to value-added per employee. Our specific interest is in the role of FDI in productivity growth and in the differences between the different groups of technology-intensive industries. Table 5 shows that the productivity growth in CEC manufacturing during the 1990s was largely attributable to FDI. Productivity growth of the FIEs in terms of value-added per employee was on average much higher than in the DEs; that has become

a general pattern. FIEs outperformed DEs in all groups of technology-defined industries and in all the CECs, except the Czech Republic. In the latter country, FIE productivity in all groups of technology-defined industries except medium-low-tech industries was found to grow at a slower rate than in DEs[11].

The highest productivity growth was recorded by FIEs in high-tech industries. On average they grew some 40% more rapidly than medium-low and low-tech industries, while productivity growth in medium-high-tech industries was lower. FIEs outperformed DEs to the greatest degree in high-tech (by a factor of 1.87) and medium-low-tech industries (by a factor of 1.86), followed by low-tech (by a factor of 1.54) and medium-high-tech industries (by a factor of 1.12). In relative terms, the marked growth in labour productivity in the FIEs in high-tech industries was to a great extent influenced by Hungary's outlying situation. If one excludes Hungary from the calculation, FIEs would outperform DEs in high-tech industries only by a factor of 1.35: a figure lower than that in medium-low and low-tech industries.

Table 5

Cumulative changes in labour productivity (value-added per employee)[1)] by groups of technology-defined industries [2)] in FIEs and DEs [3)] in six CECs, 1995-2001 (per cent)

	H		MH		ML		L	
	FIEs	**DEs**	**FIEs**	**DEs**	**FIEs**	**DEs**	**FIEs**	**DEs**
CZ	46	99	77	92	95	64	97	106
ES		166	95	118	239	133	341	141
HU	422	60	136	103	147	63	125	140
PL	270	180	174	141	374	126	240	138
SI	330	141	130	147	125	127	177	121
SK	120	122	173	102	138	86	167	97
Average	**238**	**128**	**131**	**117**	**186**	**100**	**191**	**124**

Notes: 1) Average cumulative growth rates of individual sectors within respective technology sectors. In the case of Hungary and Poland, sales data have been used instead of value-added data. – 2) H = High-tech, L = Low-tech, MH = Medium-High-tech, ML = Medium-Low-tech industries. – 3) FIEs = Foreign Investment Enterprises, DEs = Domestic Enterprises.

Source: wiiw Database.

In conclusion, although medium-high-tech industries in the CECs have attracted the highest share of FDI and seem to have reached the most 'competitive' third stage of FGM, their productivity growth has been lower than that of the FIEs in medium-low-tech industries. Furthermore, productivity growth in low-tech industries, which we assessed to

[11] This is in line with Damijan et al. (2003) who found the same pattern of slower total factor productivity growth among FIEs in the Czech Republic using firm-level data. As one can see from Table 5, there have been instances of FIES recording slower labour-productivity growth than DEs in other countries as well, i.e. in high-tech industries in Slovakia, in medium-high-tech industries in Estonia and Slovenia, in medium-low-tech industries in Slovenia, and in low-tech industries in Hungary.

be at the fourth stage of the FGM, has obviously not yet been fully exhausted, while high-tech industries, which we assessed to be at the early second stage of the FGM, have been increasing their productivity growth rather rapidly. The latter trend might be attributed to those industries in the CECs still being at an early stage, thus offering greater scope for improvement.

5.2 Contribution of FDI to total factor productivity growth in manufacturing

In this section, we account for the contribution of both FIEs and DEs to overall manufacturing total factor productivity (TFP) growth in the CECs. Consider the following production function:

$$Y = AF(h_D K_{D,} h_F K_{F,} q_D L_D, q_F L_{F,}) \quad (1)$$

where Y is domestic output, L_D is labour force engaged in domestically-owned firms, L_F is labour force engaged in domestically-owned firms, K_D is domestically-owned stock of capital, K_F is foreign-owned stock of capital, h_D, h_F, q_D, and q_F capture the embodied technical change in inputs, and A is technology available at a given time; it incorporates disembodied technical change, i.e. unobserved productivity shocks due to foreign ownership (F).

The above model is based on endogenous growth theory where FDI can improve both short-term and long-term rates of growth in the host economy through knowledge and technology slipovers related to R&D and job training activities performed by the FIEs. In the short run, Y expands as the foreign owned stock of capital increases (K_F>0). In the long run, FDI exerts an indirect effect on Y through the changes induced in the other inputs (h_D, h_F, q_D, and q_F) and in the technological parameter A (see OECD 2002).

We estimate a slightly modified growth model, where we account directly for changes in total factor productivity, by regressing labour productivity growth on changes in the capital-labour ratio and the share of foreign penetration in individual sectors. The basic advantage of this approach is that after checking for the impact of the capital-labour ratio on labour productivity, we obtain direct estimates of the TFP growth (see Griliches and Mairesse, 1990). We estimate the following regression model:

$$d\ln\left(VA/L\right)_{ijt} = a + b_1 i\ln\left(VA/L\right)_{ij} + b_2 d\ln\left(K/L\right)_{ijt} + b_3 F_{ij} + b_4 Tech_{ik} + b_5 F_{ij} * Tech_k + dT + l\sum S_j + e_{ijt} \quad (2)$$

where $d\ln(VA/L)_{ijt}$ is the change in labour productivity in country's i sector j in period t; $i\ln(VA/L)_{ij}$ is the initial (starting year in our sample) labour productivity, $d\ln(K/L)_{ijt}$ is the change in capital-labour ratio. F_{ij} (F_{ij} = 1,...,3) indicate penetration of foreign capital in

sector *j* in terms value-added, and $Tech_k$ ($Tech_k$ = 1,...,4) is the technology level of individual sectors. Including those two terms in (2) enables us to infer whether TFP-growth by sectors (after controlling for changes in the capital-labour ratio) is higher in sectors dominated by foreign capital and in more technology-intensive sectors. The interaction term F_{ij} *$Tech_k$ allows the inference whether FDI induces productivity growth in technologically more advanced sectors. We also include time and sectoral dummies in order to control for common policy shocks as well specific sectoral shocks over the observed period. Note, that we estimate (2) in first-differences, which enables us to account for TFP growth (not levels) as well as to exclude any sector-specific effects remaining t the individual country level that normally arise in a panel data framework.

First, we present the results for a pooled panel of all six CECs (see Table 6). The results of estimating (2) for the period 1993-2001 are presented in four models. Models 1 and 2 take the industry group with low foreign penetration (less than 20% in terms of value-added) as a comparison group; Model 1 looks at annual changes in productivity (first differences) and Model 2 at cumulative changes (cumulative differences). Models 3 and 4 take the low technology industry group with low foreign penetration (less than 20% in terms of value-added) as a comparison group; Model 3 looks at annual changes in productivity (first differences) and Model 4 at cumulative changes (cumulative differences). Table 6 offers two main insights.

The first insight from Table 6 is that faster TFP-growth in the manufacturing sector in the CECs is, in general, related to high FDI-penetration. The higher the share of FIEs in an industry, the faster the productivity growth in that industry. The productivity gap between sectors with high and low foreign penetration increased over the period1993-2001. This holds true for both annual changes in productivity (first differences) and cumulative productivity growth over the whole period (cumulative differences). In all six CECs, those sectors where foreign penetration exceeded 40-60% grew on average some 2-7 percentage points faster per year compared to sectors with foreign penetration below 20% (see Model 1); in cumulative terms, productivity growth in sectors where foreign penetration exceeded 40- 60% was 28-75% higher (see Model 2). The figures are similar for the comparison group comprising a group of low-tech industries group with foreign penetration less than 20%[12]. Compared to low-tech industries with low foreign penetration, productivity growth in sectors with high foreign penetration (over 40% and 60%) was some 3 to 6 percentage points faster per year (see Model 3), while in cumulative terms over the period 1993-2001 as a whole, productivity growth in sectors with high foreign penetration (over 40% and 60%) was by 40-90% higher (see Model 4).

[12] In a changed specification of the model (2) we also included export propensity by sector. Results, however, do not confirm faster TFP-growth in the more export-oriented sectors. This might be due to the correlation between foreign penetration and export orientation by sector, i.e. sectors with a higher proportion of FIEs are more export-oriented.

Table 6

Impact of technological intensity and FDI penetration on productivity growth in six CECs [1], pooled OLS-regressions on differenced data, period 1993–2001

	Model 1 [2] First diff. Coef.	t	**Model 2** [2] Cum. diff. Coef.	t	**Model 3** [3] First diff. Coef.	t	**Model 4** [3] Cum. diff. Coef.	t
i*ln*VA/L	****-0.009**	(-2.8)	-0.029	(-1.3)	****-0.008**	**(-2.5)**	-0.034	(-1.4)
K/L	*****0.122**	(5.4)	*****0.427**	(4.9)	*****0.128**	**(5.6)**	*****0.482**	(5.2)
F>0.2 [4]	0.015	(1.1)	0.110	(0.8)	0.003	(0.2)	0.159	(0.8)
F>0.4 [4]	0.023	(1.6)	***0.277**	(1.9)	***0.035**	(**1.7**)	****0.412**	(2.1)
F>0.6 [4]	*****0.069**	(**3.5**)	*****0.754**	(4.5)	***0.064**	(**1.8**)	*****0.882**	(2.9)
ML tech [5]	0.013	(0.4)	0.324	(1.3)	-0.009	(-0.2)	0.377	(1.0)
MH tech [5]	0.047	(1.3)	0.524	(1.0)	0.011	(0.3)	0.788	(1.1)
H tech [5]	***0.063**	(**1.8**)	0.386	(1.4)	0.059	(1.4)	****1.123**	(2.1)
ML*F>0.2					0.040	(1.2)	0.010	(0.0)
ML*F>0.4					0.018	(0.5)	0.106	(0.3)
ML*F>0.6					-0.013	(-0.3)	-1.192	(-1.4)
MH*F>0.2					0.023	(0.6)	-0.123	(-0.3)
MH*F>0.4					-0.018	(-0.4)	-0.259	(-0.6)
MH*F>0.6					*****-0.133**	**(-2.9**)	***-1.210**	(-1.8)
H*F>0.2					0.043	(0.9)	0.019	(0.0)
H*F>0.4					-0.004	(-0.1)	-0.125	(-0.3)
H*F>0.6					-0.083	(-1.4)	***-0.964**	(-1.9)
Const.	****0.064**	**(2.1)**	0.280	(1.3)	****0.063**	**2.1)**	0.178	(0.7)
Time dum.	Yes		-		Yes		-	
Sectoral dum.	Yes		Yes		Yes		Yes	
N	870		122		833		122	
adj. R [2]	0.146		0.386		0.131		0.367	

Notes: Dependent variable: value-added per employee (In the case of Hungary and Poland sales data have been used instead of value-added data); model is estimated in first differences and cumulative differences over the period 1993-2001. - 1) CECs (Czech Republic, Estonia, Hungary, Poland, Slovakia and Slovenia). - 2) Comparison group are industries with foreign penetration less than 20% in terms of value-added. - 3) Comparison group are low-tech industries with foreign penetration less than 20% in terms of value-added. – 4) F denotes extent of foreign penetration, i.e. share of value-added produced by FIEs, that exceeds 20%, 40% or 60% of total sector value-added. - 5) ML – medium-low-tech, MH – medium-high-tech, H – high-tech; reference group are L – low-tech industries.

t- statistics in parentheses; ***, ** and * denote statistical significance of regression coefficients at 1%, 5% and 10% level.

The second main insight of Table 6 relates to the issue of productivity growth and the technology-intensity of industries. Table 5 suggested higher cumulative productivity growth in high-tech industries in some CECs, and Models 1 and 4 from Table 6 gave some indication of supporting this. Productivity in high-tech industries was seen to grow 6 percentage points per year faster than in low-tech industries (see Model 1), while in cumulative terms productivity growth in high-tech industries was by about 110% higher than in low-tech industries with low foreign penetration (Model 4). It is important, however, to note that faster TFP growth in high and medium-high-tech sectors is significant only for

industries with prevalent domestic ownership. Furthermore, interaction between technology groups with foreign penetration demonstrates that on average in all six CECs, the marked presence of FDI (more than 60%) in the two upper tiers of industry (high and medium-high tech) displays a significant negative correlation with TFP-growth. Compared to low-tech industries with low foreign penetration, cumulative productivity growth over the period 1993-2001 in industries with highest foreign penetration (more than 60%) was 120% lower in medium-high-tech industries and some 100% lower in high-tech industries (see Model 4).

Table 7

Impact of technological intensity and FDI penetration on productivity growth by individual CEC, data in first differences, period 1993-2001

	CZ		**EST**		**HU**		**PL**		**SLO**		**SK**	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t
i*ln*DV/L	0.123	0.8	-0.048	-0.3	-0.010	-0.2	-0.030	-1.1	-0.031	-0.9	-0.057	-0.9
K/L	****0.245**	2.3	-0.011	-0.1	0.040	0.9	*****0.520**	6.1	*****0.505**	5.7	*****0.260**	4.3
F>0.2 [1)]	***-0.148**	-1.9	-0.032	-0.3	*****-0.604**	-3.3	-0.014	-0.3	0.026	0.4	0.068	1.2
F>0.4 [1)]	-0.298	-1.3	-0.115	-0.6	*****-0.573**	-3.0	0.013	0.2	0.159	1.6	0.114	1.4
F>0.6 [1)]	-0.127	-0.6	0.150	0.6	****-0.526**	-2.7	-0.074	-1.0	0.086	0.6	****0.223**	2.0
ML tech [2)]	-0.138	-0.8	0.091	0.4	****-0.560**	-2.5	-0.044	-0.6	-0.023	-0.5	0.058	0.3
MH tech [2)]	-0.038	-0.2	-0.084	-0.7	-0.002	0.0	-0.014	-0.2	0.037	0.8	0.039	0.4
H tech [2)]	0.252	0.9			0.207	0.9	0.213	1.4	0.009	0.1	0.037	0.5
ML*F>0.2	****0.301**	2.1			****0.654**	2.6	0.081	1.0	0.041	0.5	-0.061	-0.7
ML*F>0.4	0.026	0.2	0.123	0.8	0.089	0.6	0.015	0.2	-0.009	-0.1	-0.068	-0.7
ML*F>0.6	0.041	0.3					0.000	0.0	0.022	0.2	-0.097	-0.9
MH*F>0.2	0.336	1.4	0.077	0.3	****0.675**	2.7	0.077	0.8			-0.094	-0.6
MH*F>0.4	0.167	0.6					0.039	0.4			-0.093	-0.7
MH*F>0.6	0.046	0.2			-0.232	-1.1	-0.136	-1.4	-0.164	-1.0	-0.237	-1.5
H*F>0.2	0.072	0.2	-0.162	-0.5	****0.572**	2.2	****0.243**	2.5			-0.068	-0.4
H*F>0.4	-0.089	-0.3			0.047	0.4	0.137	1.2			-0.253	-1.5
H*F>0.6	***-0.460**	-1.7			-0.163	-0.9	-0.046	-0.3			-0.183	-1.1
Const.	0.146	0.8	-0.137	-0.3	***0.734	3.2	-0.039	-0.5	**0.100	2.0	-0.070	-0.5
Year dum.	Yes		Yes		Yes		Yes		Yes		Yes	
Sector dum.	Yes		Yes		Yes		Yes		Yes		Yes	
N	115		45		184		184		161		181	
adj. R^2	0.172		0.144		0.146		0.108		0.352		0.163	

Notes: Dependent variable is value-added per employee (In the case of Hungary and Poland sales data have been used instead of value-added data); model is estimated in first differences. Comparison group is low technology sector with foreign penetration less than 20% in terms of value-added. – 1) F denotes extent of foreign penetration, i.e. share of value-added produced by enterprises with foreign capital that exceeds 20%, 40% or 60% of total sector value-added. – 2) ML – medium-low-tech, MH – medium-high-tech, H – high-tech; reference group are L – low-tech industries.

t- statistics in parentheses,; ***, ** and * denote statistical significance of regression coefficients at 1%, 5% and 10% level.

This pattern, however, is not necessarily a general feature of all six CECs. Table 7, showing regression results using data in first differences[13], only shows significantly lower TFP-growth rates in high-tech sectors with high foreign penetration (more than 60%) for the Czech Republic, while the figures for Poland, Slovakia and Slovenia, though negative, are not significantly different from zero at 10% confidence level[14]. On the other hand, the results for Hungary show a completely different picture. It is evident that in Hungary, sectors with foreign penetration exceeding 20% grow more rapidly in terms of TFP than sectors with prevalent domestic ownership. This holds true for all technology sectors.[15]

These results suggest that in the past eight years all the CECs included in the sample experienced significant shifts towards more rapid productivity growth in higher-tech industries. However, TFP-growth in the technologically most advanced industries is not necessarily related to FDI, although FDI enhances productivity growth in general. The only exception to this pattern seems to be Hungary, where FDI has had a positive and significant impact on productivity growth in high-tech industries. As already indicated by structural shifts in the FIEs analysed in section 4, the current stage of development in the CECs seems to attract FDI in medium-low and medium-high-tech industries in particular since the catching-up process brought about by FDI is far more pronounced in the medium-low-tech industries than in the medium-high-tech industries[16]. The reasons for weaker productivity growth in high and medium-high-tech FIEs might be as follows. First, and in accordance with the FGM, at the present juncture CECs still lack the requisite elements and appropriate environment for competitive involvement in high-tech industries. Secondly and most importantly, in keeping with the criticism levelled at the FGM (see, in particular, Bellak, 2003, p. 40), the nature of the catching-up process in industries at the upper-end of the technological intensity scale undergoes a change and foreign investors are reluctant to transfer the benefits of ownership.[17] Consequently, foreign investors in high and medium-high-tech industries tend to transfer relatively standardized technologies and/or engage in somewhat less sophisticated phases of production. For these two reasons, the scope for productivity growth in those industries is reduced and the catching-up process via FDI in more advanced stages as posited in the FGM becomes

[13] Note that for want of adequate observations, model (2) cannot be estimated using data in cumulative differences.

[14] Figures for medium-high-tech industries with more than 60% foreign penetration in the Czech Republic, Poland and Slovenia are also negative, but do not differ significantly from zero at 10% confidence level.

[15] Note that in order to obtain a true parameter for an individual technology sector with different foreign penetration, one should sum up corresponding coefficients on foreign penetration and technology group as well as the term of interaction between the two. For example, a coefficient for high technology sector with foreign penetration exceeding 20% for Hungary is equal to 0.175 (= -0.604+0.207+0.572).

[16] This is also confirmed by other analyses, which use different databases (questionnaires) (see for instance, Majcen, Radoševic and Rojec, 2003) and claim that productivity growth is higher in FIEs in low- and medium-low-tech industries.

[17] According to Bellak (2003), the idea of large-scale technology transfer via FDI contradicts the ownership benefit hypothesis, where it is in the interest of the investing firm not to disseminate its competitive advantage to host country firms. For the most part, the technology transferred to host-country firms is more mature technology.

questionable. In other words, it would seem that catching-up via FDI along the lines of the FGM occurs mostly in industries at the lower end of the technological intensity scale (i.e. at the earlier stages of development in the host country) – and less so when it comes to industries at the upper end of the technology scale (i.e. at later stages of development in the host country).

Conclusions

The FGM claims that as the leader country (in our case the 'old' EU member states) moves on up the technology ladder, it transfers lower-tech industries via FDI to lesser developed countries (in our case new EU member states). The analysis shows that in keeping with the FGM, FDI is an important, if not the main vehicle for restructuring the manufacturing sector and enhancing productivity growth in the CECs analysed. In other words, for the new EU member states FDI is an important element in the catching-up process.

In terms of technological intensity, FIEs display better structures, as well as more rapid and more promising restructuring trends than DEs. The restructuring processes in DEs are slower. Most of the manufacturing-related FDI in the CECs analysed is concentrated in medium-high-tech industries which appear to have reached the third stage in the FGM: the stage where domestic production increases, exports are strong and inward FDI becomes significant as the particular industry in the lead-country has lost its comparative advantage and started to relocate to follow-up countries. Medium-low-tech industries range somewhere between the end of stage three and the beginning of stage four of the FGM, while low-tech industries are at stage four and for the most part would seem to have lost their competitive advantage as well as attractiveness for inward FDI. On the opposite side, high-tech industries only range somewhere between the end of stage two and the beginning of stage four of the FGM; they have not yet reached a level where they could compete on a larger scale on international markets and attract inward FDI. This suggests that when catching up the CECs go through all stages, rather than skip them.

Productivity growth in CEC manufacturing is positively correlated with technological intensity and the level of foreign penetration; the higher the technological level and the higher the foreign penetration, the higher the productivity growth. However, high foreign penetration has a negative impact on productivity growth in high and medium-high-tech industries; the only exception seems to be Hungary. The current stage of development in the CECs analysed, would thus seem to attract FDI predominantly in medium-low to medium-high-tech industries, the catching-up process through FDI being most obvious in medium-low-tech industries. Applying the terminology used in the FGM, medium-low and, to some extent, medium-high-tech industries are those which are transferred to CECs and where the catching-up is ongoing. Obviously the CECs still lack the requisite elements and appropriate environment for competitive involvement in high-tech industries. However even

when it comes to FDI in high-tech industries, foreign investors are mostly engaged in lower-end segments and transfer technologies that are less than up-to-date, thus reducing the impact on productivity growth. The latter is in keeping with the criticism levelled at the FGM to the effect that catching-up via FDI along the lines of the FGM occurs mostly in industries at the lower end of the technology scale (i.e. at earlier stages of host-country development) and less so when it comes to industries at the upper end of the technology scale (i.e. at later stages of host-country development). This has two important implications: one for FGM theory and the other for host-country economic policy. The first implication is that in terms of the FGM, it is difficult to explain the catching-up process at more advanced stages of host-country development. The second implication is that new EU member states cannot rely to any great extent on FDI when attempting to catch up in technologically advanced industries and/or at more advanced stages of development. In that context, endogenous efforts are indispensable.

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Appendix

Table A.1

Distribution of value-added [1] in the manufacturing sector by technology-defined groups of industries [2] for FIEs and DEs[3] in six CECs, 1993-2001 [4]

(per cent, change in percentage points)

	DEs				FIEs				All enterprises			
	H	MH	ML	L	H	MH	ML	L	H	MH	ML	L
1993	3.6	22.8	35.1	38.5	5.7	29.7	16.6	48.0	4.4	25.4	28.2	42.1
1994	4.7	25.9	22.8	46.5	5.1	26.9	30.9	37.0	4.9	26.4	26.6	42.1
1995	4.4	25.4	26.7	43.5	5.6	30.3	27.8	36.3	5.0	27.8	27.2	40.0
1996	7.1	22.8	24.6	45.5	6.4	33.1	26.9	33.6	6.8	28.3	25.8	39.1
1997	5.5	21.8	25.8	46.8	14.3	34.8	24.5	26.4	10.6	29.4	25.1	35.0
1998	6.0	22.2	25.7	46.1	15.7	37.5	21.2	25.6	12.0	31.7	22.9	33.3
1999	5.4	22.5	25.9	46.2	19.1	37.4	20.3	23.2	14.4	32.3	22.2	31.1
2000	4.5	20.6	26.1	48.9	19.4	42.1	13.6	24.9	13.4	33.5	23.3	29.8
2001	5.0	24.2	26.2	44.6	20.0	37.7	20.8	21.6	15.0	33.2	22.6	29.2
Change	1.3	1.5	-8.9	6.1	14.3	7.9	4.2	-26.4	10.6	7.8	-5.6	-12.9

Notes: 1) For Hungary and Poland sales data have been used. - 2) H = high-tech, L = low-tech, MH = medium-high-tech, ML = medium-low-tech industries. They sum up to 100%. - 3) FIEs = Foreign Investment Enterprises, DEs = Domestic Enterprises. - 4) Czech Republic, Hungary, Poland and Slovakia for 1993-2001, Estonia for 1995-2001, and Slovenia for 1994-2001.

Source: wiiw Database.

Table A.2

Distribution of assets in the manufacturing sector by technology-defined groups of industries [1] for FIEs and DEs [2] in six CECs, 1993-2001 [3]

(per cent, change in percentage points)

	DEs				FIEs				All enterprises			
	H	MH	ML	L	H	MH	ML	L	H	MH	ML	L
1993	5.6	29.1	31.9	33.4	3.6	32.0	20.6	43.8	4.9	30.1	28.2	36.8
1994	4.5	31.2	29.0	35.3	5.1	31.5	27.1	36.2	4.6	31.3	28.5	35.6
1995	4.0	31.6	29.2	35.2	5.0	33.4	25.7	35.9	4.3	32.1	28.3	35.4
1996	3.9	31.0	29.1	36.1	4.8	36.0	25.7	33.5	4.2	32.4	28.1	35.3
1997	3.7	30.1	28.6	37.5	5.1	36.2	26.8	31.9	4.2	32.1	28.0	35.7
1998	4.2	30.3	28.9	36.6	5.3	35.2	28.1	31.5	4.6	32.0	28.6	34.8
1999	4.6	28.3	26.8	40.3	6.2	34.7	28.5	30.7	5.2	30.7	27.4	36.7
2000	3.5	32.5	30.9	33.1	7.3	43.5	22.5	26.8	5.2	37.3	27.2	30.3
2001	4.2	31.0	31.6	33.2	8.4	43.4	22.4	25.8	6.3	36.9	27.2	29.6
Change	-1.4	1.9	-0.3	-0.2	4.8	11.4	1.8	-18.0	1.4	6.8	-1.0	-7.2

Notes: 1) H = high-tech, L = low-tech, MH = medium-high-tech, ML = medium-low-tech industries. They sum up to 100%. - 2) FIEs = Foreign Investment Enterprises, DEs = Domestic Enterprises. - 3) Czech Republic, Hungary, Poland and Slovakia for 1993-2001, Estonia for 1995-2001, and Slovenia for 1994-2001.

Source: wiiw Database.

Table A.3

Distribution of employment in the manufacturing sector by technology defined groups of industries [1] for FIEs and DEs [2] in six CECs, 1993-2001 [3]

(per cent, change in percentage points)

	DEs				FIEs				All enterprises			
	H	MH	ML	L	H	MH	ML	L	H	MH	ML	L
1993	4.1	31.7	22.9	41.2	5.1	29.0	16.6	49.2	4.3	31.4	22.1	42.2
1994	4.1	31.7	23.0	41.2	5.2	27.7	19.8	47.3	4.2	31.2	22.5	42.0
1995	4.1	31.0	23.6	41.2	4.9	28.2	20.3	46.6	4.3	30.5	23.0	42.2
1996	4.1	30.4	23.9	41.6	5.4	30.7	20.1	43.8	4.3	30.5	23.1	42.1
1997	4.1	29.3	24.4	42.1	5.9	32.7	19.7	41.7	4.6	30.1	23.3	42.0
1998	4.0	29.2	24.9	41.8	5.7	35.0	19.3	39.9	4.5	30.8	23.4	41.3
1999	3.8	27.8	25.3	43.2	6.6	34.3	21.0	38.1	4.6	29.7	24.0	41.6
2000	4.1	28.0	25.0	42.9	7.9	33.5	21.7	36.9	5.3	29.8	23.9	40.9
2001	4.0	27.8	25.0	43.1	8.3	34.1	22.2	35.4	5.5	30.0	24.0	40.4
Change	-0.1	-3.9	2.1	1.9	3.2	5.1	5.6	-13.9	1.3	-1.4	1.9	-1.8

Notes: 1) H = high-tech, L = low-tech, MH = medium-high-tech, ML = medium-low-tech industries. They sum up to 100%. - 2) FIEs = Foreign Investment Enterprises, DEs = Domestic Enterprises. - 3) Czech Republic, Hungary, Poland and Slovakia for 1993-2001, Estonia for 1995-2001, and Slovenia for 1994-2001.

Source: wiiw Database.

Table A.4

Distribution of exports in the manufacturing sector by technology-defined groups of industries [1] for FIEs and DEs [2] in four CECs, 1993-2001 [3]

(per cent, change in percentage points)

	DEs				FIEs				All enterprises			
	H	MH	ML	L	H	MH	ML	L	H	MH	ML	L
1993	2.8	33.7	35.7	27.8	5.6	47.0	16.6	30.8	4.0	39.3	27.6	29.1
1994	4.0	34.5	28.0	33.5	5.4	48.0	22.8	23.8	4.6	40.0	25.9	29.6
1995	4.3	34.0	28.4	33.3	5.8	52.8	18.5	22.9	5.0	43.3	23.5	28.2
1996	9.9	30.2	26.0	34.0	8.4	55.2	16.3	20.1	9.1	43.9	20.7	26.3
1997	5.9	32.1	27.8	34.2	20.1	50.6	13.6	15.7	14.7	43.5	19.0	22.8
1998	6.2	33.9	27.0	32.9	20.9	52.5	12.0	14.6	16.0	46.4	17.0	20.6
1999	5.1	33.3	28.9	32.7	24.9	50.3	11.8	13.0	19.2	45.4	16.7	18.7
2000	5.2	35.0	31.5	28.3	23.2	52.9	9.8	14.2	17.9	47.5	16.2	18.4
2001	5.1	36.4	29.1	29.4	26.8	49.0	11.0	13.2	21.1	45.7	15.8	17.4
Change	2.4	2.7	-6.6	1.5	21.2	2.0	-5.6	-17.6	17.1	6.3	-11.8	-11.7

Notes: 1) H = high-tech, L = low-tech, MH = medium-high-tech, ML = medium-low-tech industries. They sum up to 100%. - 2) FIEs = Foreign Investment Enterprises, DEs = Domestic Enterprises. - 3) Hungary and Poland for 1993-2001, Estonia for 1995-2001, and Slovenia for 1994-2001. Export data for Czech Republic and Slovakia are not available.

Source: wiiw Database.

Table A.5

Export propensity (exports-sales ratio) in the manufacturing sector by technology-defined groups of industries [1)] for FIEs and DEs [2)] in four CECs, 1993-2001 [3)]

(per cent, change in percentage points)

	DEs				FIEs				All enterprises			
	H	MH	ML	L	H	MH	ML	L	H	MH	ML	L
1993	17.3	27.8	20.0	14.2	31.5	44.4	30.1	19.7	23.7	34.3	21.9	16.3
1994	26.4	38.3	31.7	22.5	33.9	52.1	27.4	22.6	29.5	44.0	30.0	22.5
1995	25.8	31.8	24.0	19.2	39.0	55.8	27.0	24.0	32.0	43.0	25.0	20.9
1996	42.4	30.3	24.2	19.8	53.4	57.8	25.4	24.1	47.3	45.1	24.7	21.4
1997	37.1	42.8	33.0	24.6	80.7	69.7	30.9	31.7	68.3	59.2	32.1	27.2
1998	38.8	46.4	33.2	25.0	84.6	74.6	34.7	33.5	73.6	65.0	33.9	28.4
1999	33.2	46.5	35.5	24.4	86.7	76.1	35.9	33.9	77.1	67.0	35.7	28.3
2000	36.0	53.0	29.7	24.8	81.4	79.8	49.7	36.9	73.4	71.8	35.8	30.2
2001	34.9	52.3	39.4	24.3	89.2	81.0	36.0	37.4	81.1	72.7	37.6	30.2
Change	17.6	24.5	19.3	10.1	57.7	36.6	5.9	17.7	57.4	38.4	15.6	14.0

Notes: 1) H = high-tech, L = low-tech, MH = medium-high-tech, ML = medium-low-tech industries. They sum up to 100%. - 2) FIEs = Foreign Investment Enterprises. DEs = Domestic Enterprises. - 3) Hungary and Poland for 1993-2001. Estonia for 1995-2001. and Slovenia for 1994-2001.

Source: wiiw Database.

Table A.6

Export propensity (exports-sales ratio) of FIEs [1] in the manufacturing sector in four CECs [2], by country and technology-defined groups of industries [3], 1993-2001

	Estonia	Hungary	Poland	Slovenia
High-tech				
1993		31.5	44.2	
1994		27.2	33.0	58.5
1995		37.1	35.7	59.7
1996	39.2	54.3	36.4	66.9
1997	55.7	82.3	47.0	65.4
1998	80.1	85.8	55.0	73.8
1999	82.2	88.4	56.6	58.8
2000	82.6	82.1	46.2	73.7
2001	72.7	90.1	50.6	76.2
Medium-high-tech				
1993		45.8	40.7	
1994		48.9	38.0	69.8
1995	78.1	60.8	38.6	71.0
1996	70.9	63.5	29.5	72.6
1997	70.5	69.5	28.8	76.8
1998	66.2	75.1	32.5	78.4
1999	64.3	77.2	36.8	75.4
2000	69.4	80.5	45.4	80.0
2001	78.1	81.6	50.9	80.7
Medium-low-tech				
1993		30.2	19.4	
1994		25.7	23.9	69.6
1995	59.4	27.3	29.1	68.2
1996	57.5	25.7	26.2	68.6
1997	58.8	27.2	26.3	71.2
1998	46.3	30.4	26.7	71.3
1999	51.2	31.0	18.7	66.5
2000	48.2	48.2	15.9	70.5
2001	53.6	32.5	19.1	74.5
Low-tech				
1993		20.0	23.3	
1994		20.9	24.4	46.7
1995	41.4	24.0	24.2	45.8
1996	38.2	25.0	17.6	42.3
1997	42.4	30.1	20.0	47.9
1998	43.7	31.6	20.9	52.7
1999	51.3	31.8	21.5	51.4
2000	57.0	33.2	24.1	61.1
2001	62.0	33.8	23.9	55.7

Notes: 1) FIEs = Foreign Investment Enterprises. - 2) H = high-tech, L = low-tech, MH = medium-high-tech, ML = medium-low-tech industries. They sum up to 100%. - 3) Hungary and Poland for 1993-2001, Estonia for 1995-2001 and Slovenia for 1994-2001.

Source: wiiw Database.

Table A.7

Foreign penetration in the manufacturing sector by technology-defined groups of industries [1] in six CECs, 1993-2001 [2]

(percentage of FIEs [3] in value-added [4] and employment of all enterprises, change in percentage points)

	Employment				Value-added			
	H	**MH**	**ML**	**L**	**H**	**MH**	**ML**	**L**
1993	13.5	15.6	11.1	14.1	22.7	21.2	12.5	20.5
1994	16.9	16.5	14.0	13.9	27.2	23.0	20.3	20.3
1995	15.8	17.3	15.5	14.9	26.2	26.9	21.9	22.8
1996	22.3	21.4	17.0	17.2	33.4	32.0	26.2	26.8
1997	28.7	25.4	19.4	18.3	46.6	38.4	31.4	28.0
1998	33.7	29.1	21.7	20.3	50.3	43.2	33.8	30.9
1999	41.6	32.6	24.4	23.2	56.4	47.9	40.7	35.9
2000	46.5	34.2	27.7	26.1	59.4	49.0	39.6	39.7
2001	49.7	37.8	29.8	27.9	61.7	53.9	46.5	41.1
Change	36.2	22.2	18.6	13.7	39.0	32.7	34.0	20.6

Notes: 1) H = high-tech, L = low-tech, MH = medium-high-tech, ML = medium-low-tech industries. - 2) Czech Republic, Hungary, Poland and Slovakia for 1993-2001, Estonia for 1995-2001, and Slovenia for 1994-2001. - 3) FIEs = Foreign Investment Enterprises. - 4) For Hungary and Poland sales data have been used.

Source: wiiw Database.

Table A.8

Foreign penetration in the manufacturing sector by technology-defined groups of industries [1] in six CECs, 1993-2001 [2]

(percentage of FIEs[3] in value-added[4] of all enterprises)

	Czech Republic	Estonia	Hungary	Poland	Slovenia	Slovakia
High-tech						
1993	9.2	0.0	51.1	23.9	0.0	6.7
1994	5.5	0.0	54.2	38.0	27.8	10.5
1995	17.8	0.0	60.0	44.2	22.2	13.2
1996	27.0	30.5	54.1	51.3	21.9	15.4
1997	33.3	36.4	82.6	58.5	25.3	43.4
1998	38.8	49.4	84.9	65.2	28.7	35.0
1999	54.7	67.0	90.1	64.9	30.7	30.6
2000	60.2	61.9	89.8	68.5	33.3	42.7
2001	56.1	61.4	91.6	71.9	37.8	51.6
Medium-high-tech						
1993	8.7	0.0	49.9	17.1	0.0	9.0
1994	9.8	0.0	58.1	16.8	17.9	12.3
1995	17.9	21.6	61.8	21.9	20.2	18.3
1996	22.3	25.1	73.2	31.8	21.0	18.4
1997	33.1	26.6	79.2	38.4	21.4	31.9
1998	37.4	26.8	82.7	45.3	24.8	42.1
1999	49.1	28.8	84.2	52.0	26.2	47.2
2000	47.6	30.9	82.2	55.6	25.1	52.5
2001	52.4	50.2	82.5	55.6	26.2	56.2
Medium-low-tech						
1993	7.7	0.0	24.2	7.4	0.0	10.8
1994	8.6	0.0	65.4	8.2	7.3	12.2
1995	13.7	18.9	58.3	13.2	6.7	20.6
1996	21.6	24.3	64.8	17.4	9.7	19.5
1997	22.8	34.0	65.7	19.6	12.5	33.8
1998	25.2	35.8	66.5	21.8	14.6	38.8
1999	40.4	37.3	67.7	42.5	16.4	39.7
2000	47.7	31.8	34.9	46.5	16.1	60.5
2001	49.4	32.0	67.5	48.9	17.8	63.4
Low-tech						
1993	9.4	0.0	46.4	15.1	0.0	10.9
1994	9.2	0.0	47.7	21.9	8.1	14.5
1995	16.6	14.3	50.4	29.6	8.5	17.6
1996	20.5	20.2	52.3	39.5	8.5	19.7
1997	26.0	21.6	49.8	42.1	9.8	19.0
1998	28.0	22.6	54.0	46.0	11.6	23.3
1999	37.4	28.7	55.2	49.9	11.4	32.7
2000	40.8	32.5	54.8	48.7	16.7	44.8
2001	41.7	33.9	53.3	49.4	21.0	47.3

Notes: 1) H = High-tech, L = Low-tech, MH = Medium-high-tech, ML = Medium-low-tech industries. - 2) Czech Republic. Hungary, Poland and Slovakia for 1993, Estonia for 1995 and Slovenia for 1994. - 3) FIEs = Foreign Investment Enterprises. - 4) For Hungary and Poland sales data have been used.

Source: wiiw Database.

Table A.9

Changes in foreign penetration in the manufacturing sector by technology defined groups of industries [1] in six CECs, 1993-2001 [2]

(percentage of FIEs [3] in value-added of all enterprises)

	CZ	ES	HU [4]	PL [4]	SI	SK
H						
1993	9.2	0.0	51.1	23.9	27.8	6.7
2001	56.1	61.4	91.6	71.9	37.8	51.6
Change [5]	46.9	61.4	40.5	47.9	10.0	45.0
MH						
1993	8.7	21.6	49.9	17.1	17.9	9.0
2001	52.4	50.2	82.5	55.6	26.2	56.2
Change [5]	43.8	28.6	32.6	38.6	8.3	47.2
ML						
1993	7.7	18.9	24.2	7.4	7.3	10.8
2001	49.4	32.0	67.5	48.9	17.8	63.4
Change [5]	41.7	13.1	43.3	41.5	10.5	52.6
L						
1993	9.4	14.3	46.4	15.1	8.1	10.9
2001	41.7	33.9	53.3	49.4	21.0	47.3
Change [5]	32.2	19.6	6.9	34.4	12.8	36.4

Notes: 1) H = High-tech, L = Low-tech, MH = Medium-high-tech, ML = Medium-low-tech industries. - 2) Czech Republic. Hungary, Poland and Slovakia for 1993, Estonia for 1995 and Slovenia for 1994. - 3) FIEs = Foreign Investment Enterprises. - 4) For Hungary and Poland sales data have been used. - 5) In percentage points.

Source: wiiw Database.

Table A.10

FG-pattern in Estonia, Hungary, Poland and Slovenia [1], shares in value-added and exports, and foreign penetration in individual groups of technology-intensive industries, 1993-2001

	1993	1994	1995	1996	1997	1998	1999	2000	2001
ESTONIA									
Distribution of value-added, %									
High-tech	n.a.	n.a.	6.2	7.0	7.6	6.9	8.4	10.3	8.9
Medium-high-tech	n.a.	n.a.	26.0	20.1	17.6	13.9	13.7	14.5	13.9
Medium-low-tech	n.a.	n.a.	9.2	13.2	13.6	17.0	14.2	15.9	17.2
Low-tech	n.a.	n.a.	58.6	59.7	61.2	62.2	63.8	59.3	60.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Distribution of exports, %									
High-tech	n.a.	n.a.	3.4	5.0	5.3	7.9	9.5	10.7	9.0
Medium-high-tech	n.a.	n.a.	29.5	24.5	20.2	17.9	17.0	17.6	17.2
Medium-low-tech	n.a.	n.a.	8.4	12.1	11.3	12.1	11.2	12.0	13.7
Low-tech	n.a.	n.a.	58.7	58.4	63.1	62.1	62.4	59.7	60.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Foreign penetration, % [2]									
High-tech	n.a.	n.a.	0.0	30.5	36.4	49.4	67.0	61.9	61.4
Medium-high-tech	n.a.	n.a.	21.6	25.1	26.6	26.8	28.8	30.9	50.2
Medium-low-tech	n.a.	n.a.	18.9	24.3	34.0	35.8	37.3	31.8	32.0
Low-tech	n.a.	n.a.	14.3	20.2	21.6	22.6	28.7	32.5	33.9
HUNGARY									
Distribution of value-added, % [3]									
High-tech	4.7	5.0	5.2	7.4	11.9	13.5	16.4	14.9	16.8
Medium-high-tech	24.5	25.0	27.1	27.5	28.7	31.5	32.3	33.7	33.3
Medium-low-tech	27.9	26.8	27.2	25.8	24.9	22.3	21.4	22.7	21.7
Low-tech	42.9	43.1	40.5	39.3	34.4	32.7	30.0	28.7	28.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Distribution of exports, %									
High-tech	5.0	4.3	4.9	11.4	21.6	23.0	27.2	22.6	27.1
Medium-high-tech	39.6	39.7	43.8	43.7	41.7	45.0	44.9	49.0	46.4
Medium-low-tech	25.6	26.7	24.0	19.9	16.7	14.1	12.9	13.3	12.5
Low-tech.	29.9	29.4	27.3	25.1	20.0	17.9	15.0	15.1	14.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Foreign penetration, % [2]									
High-tech	51.1	54.2	60.0	54.1	82.6	84.9	90.1	89.8	91.6
Medium-high-tech	49.9	58.1	61.8	73.2	79.2	82.7	84.2	82.2	82.5
Medium-low-tech	24.2	65.4	58.3	64.8	65.7	66.5	67.7	67.8	67.5
Low-tech	46.4	47.7	50.4	52.3	49.8	54.0	55.2	54.8	53.3

Table A.10 (cont.)

FG-pattern in Estonia, Hungary, Poland and Slovenia [1], shares in value-added and exports, and foreign penetration in individual groups of technology-intensive industries, 1993-2001

	1993	1994	1995	1996	1997	1998	1999	2000	2001
POLAND									
Distribution of value-added, % [3]									
High-tech	2.6	2.5	2.9	3.2	3.5	3.9	3.9	4.1	4.2
Medium-high-tech	27.9	26.9	28.0	28.8	29.6	29.5	29.3	29.7	28.4
Medium-low-tech	28.0	31.8	30.2	27.2	27.1	26.8	27.7	29.8	28.7
Low-tech	41.5	38.8	38.9	40.8	39.7	39.8	39.1	36.8	38.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Distribution of exports, %									
High-tech	3.1	2.5	3.1	4.0	5.7	7.3	7.2	6.1	6.7
Medium-high-tech	46.5	41.0	41.5	42.2	41.0	41.7	43.6	47.3	45.8
Medium-low-tech	23.0	27.8	26.0	23.7	23.3	21.7	20.4	19.8	21.2
Low-tech	27.5	28.8	29.4	30.2	30.0	29.3	28.8	26.9	26.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Foreign penetration, %									
High-tech	23.9	38.0	44.2	51.3	58.5	65.2	64.9	68.5	71.9
Medium-high-tech	17.1	16.8	21.9	31.8	38.4	45.3	52.0	55.6	55.6
Medium-low-tech	7.4	8.2	13.2	17.4	19.6	21.8	42.5	46.5	48.9
Low-tech	15.1	21.9	29.6	39.5	42.1	46.0	49.9	48.7	49.4
SLOVENIA									
Distribution of value-added, %									
High-tech	n.a.	6.1	5.3	5.5	6.5	6.5	6.4	6.9	6.8
Medium-high-tech	n.a.	31.9	31.0	31.0	31.7	32.4	32.4	32.5	33.2
Medium-low-tech	n.a.	20.8	22.1	21.8	21.6	21.9	23.0	23.7	24.2
Low-tech	n.a.	41.2	41.6	41.8	40.1	39.2	38.2	36.9	35.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Distribution of exports, %									
High-tech	n.a.	5.9	5.3	5.7	6.0	5.7	5.8	6.3	6.1
Medium-high-tech	n.a.	41.7	42.9	44.6	45.3	47.5	45.0	44.3	44.1
Medium-low-tech	n.a.	21.6	22.8	21.8	21.6	21.2	22.9	23.5	24.2
Low-tech	n.a.	30.9	29.0	27.8	27.1	25.6	26.4	25.9	25.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Foreign penetration, %									
High-tech	n.a.	27.8	22.2	21.9	25.3	28.7	30.7	33.3	37.8
Medium-high-tech	n.a.	17.9	20.2	21.0	21.4	24.8	26.2	25.1	26.2
Medium-low-tech	n.a.	7.3	6.7	9.7	12.5	14.6	16.4	16.1	17.8
Low-tech	n.a.	8.1	8.5	8.5	9.8	11.6	11.4	16.7	21.0

Notes: 1) Only countries with available export data are taken into account. - 2) Foreign penetration measured as % of FIEs in value-added of all enterprises. - 3) Sales data have been used.

Source: wiiw Database.

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