FDI trends and patterns in electronics

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1. Introduction

This chapter analyses developments in FDI in the electronics industry in five East Central European countries (the four Visegrad countries: Czechia, Hungary, Poland and Slovakia; and Estonia) which represent the overwhelming majority of total production in the Central and Eastern European (CEE) region, with only Russia, of the region's remaining countries, also having a substantial share[1]. Furthermore, three Mediterranean countries (Greece, Portugal and Spain) are also included in the analysis for comparative reasons. The main research question is whether there are any new post-crisis trends and patterns in FDI and location competition in the electronics industry compared to the pre-crisis period. In the analysis, simple statistical methods and various statistical data are used, given the limited availability of and problems surrounding FDI data.

The chapter shows that the five CEE countries became important locations of the electronics industry, especially from a European perspective, through an FDI-based, ongoing restructuring of the industry. Thus the dominant producers are local subsidiaries of foreign-owned multinational companies, which were even able to gain in terms of their relative country-level shares of production, employment, value added or R&D during the crisis, indicating the higher vulnerability of domestically-owned companies compared to their foreign-owned counterparts. During the crisis, the five CEE countries were able to gain in terms of their shares in European electronics FDI, production, and to a lesser extent in value added, and most probably were able to slightly decrease their dependence on imported inputs. At the same time, the Mediterranean countries basically stagnated in all areas, due less to the increase in the CEE shares and more to larger shares of certain 'old' EU Member States, especially

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Germany, in European production and value added. Thus the restructuring of European electronics production progressed further during the crisis years and changed to some extent direction, reflecting the changes in the competitiveness of individual EU Member States and their differing specialisation in the various, heterogeneous segments of the electronics industry. This latter aspect is boosted by the fact that even inside the CEE group of countries developments differ slightly at country level. Overall, if we assume the continuation of the during- and post-crisis trends, a further increase in the importance of the CEE countries analysed (and even other countries in the CEE region) can be expected in the European electronics industry.

The chapter is structured as follows. First, the main characteristics and pre-crisis developments of the industry are presented, followed by a section on data, data problems and methodology. FDI data are then looked at, supplemented by an analysis of other data on foreign-owned companies, output, value added, employment and exports. Outward FDI (OFDI) and relocations are examined in the penultimate section, while the last section concludes.

2. Pre-crisis trends in the electronics industry with specific regard to the CEE

The electronics manufacturing (and related services) has been one of the main drivers of globalisation, being one of the most integrated industries in global terms and with exceedingly strong links to other industries and sectors. It contributes significantly to economic development and growth, directly and indirectly, through improving productivity in other sectors. The industry is characterised by an increasingly fragmented production process, with individual activities transferred to those locations where they can be carried out at lower costs and/or more efficiently (OECD 2004; UNCTAD 2004). A further interesting feature is the heterogeneity of products belonging to it.[2] These are very heterogeneous in terms of

2. For example, Decision (2009) categorised electronics products by application sector in the following product groups: Audio and video; Home appliances; Data processing; Telecom; Aerospace and defence; Automotive; Industry and Medical. Custer Consulting Group (2013) listed the following market segments: inside the Volume group (the production of which is shifted to low cost areas): Computers and mobile communication devices; Other consumer electronics; Datacom, telecom; and Automotive, and inside the 'Protected' group: Military; Medical; Instruments and controls; High IP Content.

their factor intensity, level of innovation, R&D intensity, the availability of economies of scale, specific transport costs, importance of the speed of response to changes in market demand, etc. Thus their levels of fragmentation, tendency to relocation and the acceptable distance between the host/producing country and the market differ to a great extent.

The industry is very sensitive to business cycles. It is vulnerable to global recessions, not only directly but also indirectly, and on account of its strong links with other industries (e.g. the automotive industry or computer-aided production systems in other sectors). Because of this, electronics was one of the industries hardest hit by the crisis, with the focus being heightened on economies of scale, productivity and cost reductions. This resulted in a restructuring process featuring increased merger and acquisition (M&A) and relocation activities in the companies affected. Different regional specialisations throughout the world explained the divergence between pre-crisis growth rates. While Asia was relatively specialised in mass-market products, Europe focused more on the production of professional and automotive electronic equipment. European shares in global production were high especially in the industrial, aerospace and defence, automotive and medical application sectors before the crisis. (DECISION 2009: 11)

The analysed CEE countries emerged as new locations for the global electronics industry after 1990. Prior to 1990, their electronics industries lagged considerably behind those of developed countries and were to a great extent dependent on foreign technology (Radosevic 2005). All countries participated in the CMEA division of labour in electronics, and thus had substantial capacities. Production was concentrated in large conglomerates and had strong ties with the military sector. Of these large conglomerates, the only one to survive was the Hungarian Videoton, on the basis of an innovative strategy and alliances with large multinationals (Radosevic and Yoruk 2001 and see Box 2 for details). The others were mostly cut up into smaller units and privatised or liquidated (Szanyi 2006). However, the industry's relatively well-developed human capital and expertise remained in place. The mid-1990s saw the start of a revival and quick expansion of the industry in the countries analysed, based mainly on the establishment of new production facilities by foreign multinational companies. In doing so, they have become active participants in the ever-increasing and extensive globalisation of the electronics industry. This FDI-based revival started at different times in

the countries analysed (Linden 1998; Radosevic 2005; Szanyi 2006; Sass and Szanyi 2012). Hungary was the first to open up its economy to FDI, including electronics investments. The special regulation of industrial free trade zones was especially attractive for large, greenfield projects assembling mainly imported inputs for export, using relatively cheap local unskilled or semi-skilled labour – thus attracting certain segments of the electronics manufacturing industry to the country (See e.g. Antalóczy and Sass 2001). Czechia offered substantial incentives to (among others) electronics projects starting in around 1998, while Poland and Slovakia caught up later. Overall, incentives for FDI projects in the electronics industry have been considerable in CEE countries (see e.g. Drahokoupil 2009). As a result of these developments, by 2003 the production of Hungary, Czechia and Poland exceeded that of Mexico, though was still considerably less than that of the East Asian economies and lower than that of Ireland. The three aforementioned CEE countries had a diversified production structure with substantial capacities for basically all segments of the IT manufacturing industry. However, their exports were less diversified in terms of the industry's sub-segments, consisting mainly of computers, parts and components and consumer electronics, and indicative of the persisting technological backwardness of the analysed countries. By 2001, Hungary and Czechia were by far the biggest exporters in absolute terms, as well as being the countries with the highest export intensity (export/production) (Radosevic 2005: 6). In all four Visegrad countries, subsidiaries of foreign multinationals (with the exception of a few, usually smaller-sized locally-owned companies) dominated the industry, with a high integration in global value chains – of which the high export intensity was one indication (see e.g. Kaminsky and Ng (2001) or Sass and Szalavetz (2013) for a statistical analysis, Deutsche Bank (2014) shows that the Visegrad countries are very well integrated in European (EU-15) value chains[3]). It is important to note that, compared to other industries' (agriculture, apparel or automotive) global value chains, the labour component of IT hardware points to a relatively higher share of knowledge-intensive and high-skilled technology-intensive work, at the expense of moderately or low-skilled labour-intensive activities (Barrientos et al. 2010: 11) thus in principle offers plenty of upgrading opportunities for the countries involved. Indeed, there were signs of upgrading in the operating structures of

3. Deutsche Bank (2014) shows that besides Vehicles, Telecom and Electrical Machinery are the most important export goods of the Visegrad countries and Estonia, and that all of them have a comparative advantage in the production of electrical equipment.

foreign-owned electronics companies and increasing local value added in the Visegrad countries (Szalavetz 2004; Sass and Szalavetz 2013).

Furthermore, the FDI-based integration in global value chains (GVCs) went hand-in-hand with considerable technology transfer, one indication of which is the changes in the (revealed) comparative advantages of the analysed countries (IMF 2013; Rahman and Zhao 2013). This development came together with a one-sided specialisation of the analysed countries (Galgóczi 2009) through efficiency-seeking FDI, making them vulnerable to external shocks, an indication of which was the considerable fall in production levels during the crisis.

Besides substantial relocations targeting the CEE region, (Hunya and Sass 2005) a few substantial relocations during that period had already highlighted the sector's high concentration and low locational loyalty and its vulnerability to changes in the demand structure and relative wages (UNCTAD 2003)[4]. The parallel emergence of competitive foreign locations offering enormous amounts of cheap labour, especially in Asia, has also been shaping European developments, to a much greater extent than in other industries as electronics is relatively more rootless (Sturgeon and Van Biesebroeck 2010; Dicken 2011). Against this background the crisis emerged, hitting electronics very hard.

3. Data and methodology

On account of data availability, electronics is defined in this paper as covering categories C26 (manufacture of computer, electronic and optical products) and C27 (manufacture of electrical equipment) in accordance with NACE rev. 2 (2008). In principle, FDI sector statistics are available in this breakdown, but, presumably for confidentiality reasons, Eurostat and certain national banks do not provide data on FDI in C27 (equipment). This is only available together with data on five other manufacturing sub-industries (C15, C23, C31, C32 and C33[5]). The national

4. For example, the transfer of the production of IBM Storage Products from Székesfehérvár, Hungary to China in 2003 resulted in a loss of more than five thousand jobs (including agency workers), and to a substantial decrease in production and exports for Hungary.

5. C15: Manufacture of leather and related products, C23: Manufacture of other non-metallic mineral products, C31: Manufacture of furniture, C32: Other manufacturing, C33: Repair and installation of machinery and equipment.

banks of the analysed countries follow different practices. While the Czech and Polish national banks publish grouped data, no data has been published in Slovakia for the years after 2009. Estonia publishes aggregated data for total manufacturing. The Hungarian National Bank is the only one publishing separate data for C27 (equipment). Furthermore, Eurostat provides FDI data solely for the period starting with 2008 and with data missing for certain countries for the overall period or for certain years. This problem significantly affects the use of FDI data. The magnitude of the problem may be seen in the case of Hungary, the only country among the analysed ones for which we have separate FDI data for C27 (equipment). In Hungary, the FDI stock at the end of 2012 amounted to 2,275.3 million euros in C26 (products), and to 670.6 million euros in C27 (equipment). Adding the second figure to the first increases the stock of electronics FDI by almost 30%.

That hiatus in FDI data and the problems of FDI stock and flow data for measuring the size of foreign-owned activity (Lipsey 2006) are dealt with here by supplementing the analysis with output, gross value added and related data of the electronics sub-industries, available from Eurostat for all the analysed sub-industries and for a considerably longer period of time. Another data source on the shares of foreign-owned companies in the analysed countries is published by the OECD.[6] The use of this data is all the more justified, as Lipsey (2006) notes that the balance of payments and national accounts data are only rough indicators of the extent of FDI, and are especially weak in measuring changes over time.

Though foreign trade data may provide a good indication of the role of a given country in the European and international division of labour and of its changes over time, these data refer to gross export and import values without showing local value added. In this field, the data on trade in value added calculated by the OECD and WTO can be used as an indication of the extent of local added value and any changes therein. However, these data are only available until 2009.

6. These data are not available for Greece.

Box 1 **Data problems**

A short note on data problems is important before delving into the analysis of available statistics. The first problem arises when we want to analyse the home country distribution of FDI in electronics. Large and especially non-EU multinationals usually realise their investment projects through one of their subsidiaries for various reasons. Cost minimisation (tax optimisation) plays a role when a tax haven (e.g. Cayman Islands) or a country with advantageous fiscal regulations (e.g. the Netherlands or, in certain industries, Ireland) is 'inserted' between the ultimate owner and the investment project. An 'intermediary' subsidiary can be used for other purposes as well: for example when a regional or European centre manages other subsidiaries on the continent, when the 'intermediary' subsidiary has in-depth knowledge of or close contacts with the final destination of the investment, etc. (Kalotay 2012). As shown by developments in Hungary, the use of 'intermediary' subsidiaries became more frequent during and after the crisis (Antalóczy and Sass 2014). Table 1 shows, that in the case of the top 13 foreign electronics investors (and the top locally-owned company) in Hungary in 2012, the final owner's home country is the same as that of the immediate/direct owner in only four cases (and partially in one case). The same problem may arise in the case of the industry affiliation of electronics investment. The most obvious case is that of certain multinationals in the automotive sector with electronics activities (supplying electronic parts and components for vehicles) but registered under the category 'Transport equipment'. Furthermore, certain multinationals manage their local production units under a local service management unit which acts as the owner. In such a case, FDI is realised and registered under 'Business services' while the activity actually carried out is for the most part electronics. That may also affect output and gross value added data. The above problems teach us to be cautious about the available macro data.

Besides the above-listed data problems, missing data for one or more of the analysed countries and for one or more years add to analysis difficulties. These problems are handled here through using multiple data sources and trying to put together the jigsaw puzzle of developments in the analysed industry. Furthermore, this is the reason for using only simple statistical indicators.

Table 1 **Top companies in electronics in Hungary (2012)**

Name of the company	Nationality of direct owner	Nationality of final owner	Sales (million HUF)	Export/ sales (%)	Number of white-collar employees	Number of blue-collar employees
Samsung Electronics	Korean	Korean	713,517	90.5%	969	712
Flextronics International	Austrian	Singapore/ US	511,215	91.0%	3,342	4,847
Nokia Komárom	Finnish	Finnish	394,376	95.5%	1,085	1,706
PCE Paragon Solutions	Cayman Islands	Taiwanese	379,430	98.5%	347	320
Jabil Circuit Hungary	Dutch, Luxemburgish, Scottish	US	342,333	99.6%	538	4032
National Instruments Hungary	Dutch	US	265,260	99.7%	655	490
GE*	Hungarian	US	(1,395,908) electronics: lighting, e.industry, healthcare, aviation: 208,852	98%	3,169	5,912
Philips***	Dutch	Dutch	157,920	95.3%	44	46
Siemens*	Austrian	German	79,694	45.7%	814	548
Sanmina-SCI (data for 3 subsidiaries)**	Dutch/US/ Dutch	US	4,548+ 44,033+0	96%; 99.9%; -	145+687+0 =832	329+415+0 =744
FIH Europe	Hong Kong	Taiwanese	8,318	3.9%	79	43
IBM (4 subsidiaries)	Irish, Dutch	US	71,558	79.3% (including services export)	total: 3,978	
NXP Semiconductors (formerly part of Philips)	Dutch	Dutch	2,443	99.8%	150	0
Videoton (25 member companies)*	*Hungarian*	*Hungarian*	*98,135*	*58.6%*	*total: 7,052*	

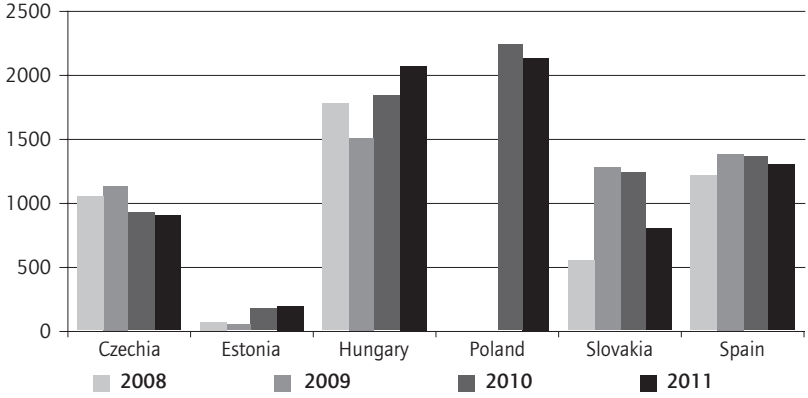
Note: direct owner: the nationality of the company which actually made the investment; final owner: the nationality of the final/ultimate owner company. – * 'Holding-type' organisation, with various activities including electronics – ** Most probably in the process of reorganising into a holding – *** Under liquidation in 2013
Source: HVG (Hungarian economic weekly), company balance sheets

4. FDI trends in electronics

Available data indicate a relatively low share of the five analysed countries in EU27 FDI as well as a small increase in this share during the crisis, indicating some limited changes in the European distribution of labour based on FDI data.

As already mentioned, FDI data are available only for one electronics sub-industry of the two: C26 (products). Inward FDI stock data are relatively substantial in the analysed countries in this sub-industry (cf. Figure 1). Seen in relation to country size (in terms of population or GDP), Hungary and Slovakia stand out as FDI recipients. Overall however, FDI stock decreased throughout the crisis, except in Estonia and Hungary.

Figure 1 **Inward FDI stock in the manufacture of computer, electronic and optical products (C26), 2008-11, million euros**



Source: own calculations based on Eurostat data. Note: data are missing for Greece and Portugal, and for Poland for 2008 and 2009

Overall, the combined share of the five CEE countries in 2010 in total EU27 C26 FDI stock is only slightly more than 3% – a very low percentage (Table 2). Poland and Hungary had the highest shares, each with around 1%. Larger shares can be arrived at through simply adding up CEE country data in the industry[7], but even then the CEE share is still only

7. In Eurostat, EU27 data are considerably higher for 2008, 2009 and 2010 than the simple sum of member country data. Country shares for 2011: Czechia: 1.4%; Estonia: 0.3%, Spain: 2%; Hungary: 3.2%; Poland: 3.3%, Slovakia: 1.2%.

9.4%. However, EU27 FDI stock in this industry is dominated by the UK (32.7%), Ireland (11.3%), Germany and the Netherlands (9.9% each), France (6.4%) and Finland (5.5%). Thus, the combined CEE share is similar to that of Germany (or the Netherlands), but is considerably lower than that of the UK or Ireland.

Table 2 **Share in EU total IFDI stock in the manufacture of computer, electronic and optical products (C26), 2008-10, (%)**

	2008	2009	2010
Czechia	0.58	0.60	0.45
Estonia	0.04	0.02	0.09
Spain	0.67	0.73	0.66
Hungary	0.99	0.80	0.89
Poland	n.d.	n.d.	1.09
Slovakia	0.30	0.67	0.59

Source: own calculations based on Eurostat data

Investor countries differ for the analysed economies, though EU home countries dominate everywhere, according to Eurostat data.[8] Basically all C26 FDI stock in Estonia originates from the EU27. That share is similarly high in Spain (fluctuating between 70 and 80%), lower in Czechia and Hungary (between 50 and 60%), and even lower in Poland and Slovakia (below 50%). The share of the New Member States is substantial only in Slovakia (mainly due to certain Hungarian investments there, partly connected to foreign-owned subsidiaries (e.g. Samsung) investing through their Hungarian subsidiaries in Slovakia, and partly due to 'original' Hungarian FDI). The stock of German and Dutch FDI in the analysed industry exceeds 100 million euros in each of the four Visegrad countries. France is an important investor in Spain, while Austria is an important one in Hungary (partly due to indirect investments by the German Siemens and the US/Singaporean Flextronics, investing in Hungary through their Austrian subsidiaries (Table 1)). Until recently, Finland was an important investor in Hungary (Nokia). Sweden is one of the leading investor countries in Estonia (almost exclusively) and in Poland. The UK is an important investor in Spain, and has some relatively substantial investments in Czechia and Slovakia. From outside the EU-27, in 2011 China was an important investor in Poland; Hong Kong and

8. Due to the reasons discussed in the section on data problems, data on home countries must be handled with care. Eurostat data on investor countries are available until 2011.

Japan in Hungary and Poland; South Korea (Samsung) in Hungary, Poland and Slovakia; and Taiwan (Foxconn) in Czechia.

The share of electronics in total FDI is low: in CEE it ranges from 1% (Czechia) to 3.3% (Slovakia), and seems to be lower in the Mediterranean countries (Spain: 0.3%). In the analysed country group, Hungary and Slovakia are the only countries where that share exceeds the EU-27 average (2.3%).[9] The latter may point to the fact that more footloose capacities (i.e. with lower invested amounts and thus sunk costs[10]) were transferred to the CEE countries. Separately collected data on relocations also show how this movement of capacities has added to existing capacities in the CEE countries. In a previous paper (Hunya, Sass 2005) we showed that in the FDI literature, relocation is identified as efficiency-seeking or vertically integrated FDI, as opposed to market-seeking or horizontally integrated FDI. However, FDI statistics are not able to grasp the whole extent of relocation, offshoring and offshore outsourcing. For the pre-crisis period, on the basis of the data of the European Restructuring Monitor we showed that in 2005 a large number of relocation projects transferred capacities to the CEE countries, resulting in substantial job creation in the NMS-8, mainly in the electronics and automotive industries, and job losses in Germany. But based on the available information one cannot find any link between the two processes. We later analysed Hungary separately for the period 2003 - 2011, finding out that electronics – together and interlinked with the automotive industry – was the most important sector for relocations, both to and from Hungary, in the period 2003 - 2011 (Sass and Hunya 2014). In another paper (Sass and Szanyi 2012) we analysed relocations in the electronics sector in Hungary for the period 2003 - 2010, finding out that on the basis of the number of cases electronics relocations were more frequent in the crisis period. We also found that it is usually Western European locations (mainly Germany) which are affected (i.e. capacities are transferred from there to Hungary), and that not only Western European multinationals are moving their capacities: many US, Japanese and other East-Asian companies relocated electronics activities to Hungary.[11] While

9. Calculations based on Eurostat data.

10. We assume the relatively low invested amounts on the basis of comparing FDI and the output/production data. A similar conclusion is drawn on the basis of detailed data provided by the Deutsche Bundesbank on total assets per employee of German FDI in CEE and other countries in 2003 by Lipsey (2006).

11. We saw relocations *inter alia* by the US IBM, Jabil, National Instruments, Delphi and Sanimna-SCI, the Dutch Philips, the German Continental, Epcos, Zeiss and Robert Bosch, the French Kontavill and Schneider Electric, the Japanese Clarion and Sanyo, the Korean Samsung and the Finnish Elcoteq.

relocation is basically an intra-European phenomenon in terms of the locations affected at both ends, compared to other industries, non-EU locations are more frequently involved. Interestingly enough, among the foreign locations affected, there was only one case where the source country was one of the analysed Mediterranean countries (Spain) out of 48 cases of relocations to Hungary for the period 2003 - 2010 (Sass and Szanyi 2012). Furthermore, there were only a few cases of backshoring during the crisis, with activities previously relocated away from Hungary to other (mainly Asian) countries being moved back. On the basis of the analysis of the Hungarian case we found that the employment impact of electronics relocations is possibly the highest among all industries, possibly pointing to the relatively labour-intensive nature of the activities involved. As the presence of backshoring indicates, there are relocation cases where multinational companies transfer activities away from the analysed countries. In the case of Hungary, in Hunya and Sass (2014) we identified various instances of relocations of the Hungarian subsidiaries of multinational companies away from Hungary in the period 2003 – 2011, with the highest number of cases (13 of the total 42) in the electronics industry. Six of these involved relocations to China and were usually relatively large projects causing a high number of job losses in Hungary. For example, the most recent relocation in 2014 was by Nokia, which closed its Komárom plant (opened in 2000) after the business line in question (production of mobile phones) was acquired by Microsoft. The shutdown of the factory resulted in the dismissal of 1800 workers and production being moved to Asia. In terms of their distribution over time, there is no clear-cut pattern concerning the pre-crisis and post-crisis numbers of relocations from Hungary, possibly due to their overall low number. We suspect that relocations to and from other CEE countries may be similar in terms of frequency and magnitude.[12]

The role of the state has already been underlined in terms of attracting FDI, among others in electronics, through offering generous incentives to investing firms. As far as developments during the crisis are concerned, they are much less documented. An analysis by Paul et al. (2014) of the New Members States of the EU shows that a composite index, evaluating infrastructure, quality of institutions, labour market and taxation from the point of view of FDI, declined in all CEE countries except Poland between 2007 and 2010, mainly due to a reduction in tax competitiveness.

12. Furthermore, we found a few cases (though not in electronics), when the concentration of capacities results in relocations from one CEE country to another.

A more detailed analysis is yet to be undertaken on post-crisis FDI promotion in the analysed countries.

5. Foreign-owned companies in electronics

Market players can be grouped into three categories in all the analysed CEE countries. The first, most important group from the point of view of production or export is that of large-sized foreign-owned companies. Subsidiaries of foreign multinationals form two sub-groups: (i) ones with their own brands, and (ii) OEMs (original equipment manufacturers), EMSs (electronics manufacturing services) or ECMs (electronic contract manufacturers). Locally owned large-sized companies belong to the second group and may function as OEMs, EMSs, ECMs and/or as integrator companies supplied by smaller, locally owned companies. A third group consists of small and medium-sized companies, both foreign- and locally-owned, which are usually suppliers of the local or geographically close subsidiaries of foreign multinationals, in many cases with the mediation of a company from the first or second group. According to the literature, the share of foreign-owned subsidiaries has played a dominant role in all the analysed countries.[13]

The OECD publishes statistics on the share of foreign-owned subsidiaries in various sectors and industries. Compared to the FDI data discussed in the previous section, the time series here are longer, available for more countries and for both electronics sub-industries. The indicators show that foreign-owned companies play either an important (Mediterranean countries) or a dominant (Visegrad countries and Estonia) role. These data also give a further indication of changes during the crisis years (Table 3).

First of all, it should be noted that in all the analysed countries the industry is dominated by a few large subsidiaries of multinational companies, while domestically owned firms are usually of much smaller

13. In Czechia (Guimón 2013); the list of major investors in Czechia contains numerous electronics firms (CzechInvest 2008). In Estonia, 'The sector is strongly orientated towards foreign markets as most of the large companies are foreign-capital owned'. http://www.tradewithestonia.com/exporters-db/sector/18/electronics-and-optics, or see Tiits and Kalvet (2012). For Hungary see Plank and Staritz (2013) or Sass (2013), for Poland: Woodward (2005) or Garbacz (2010). For Slovakia: http://www.sario.sk/sites/default/files/content/files/electrotechnical_industry.pdf

size in terms of the number of employees and/or production values. Though the number of foreign-owned companies is usually very low compared to the total number of companies[14], they are responsible for the bulk of employment and especially of production, value added and R&D. Foreign-owned companies represent the overwhelming majority of electronics production and value added in the five CEE countries, and they are the largest employers in Estonia, Hungary and Slovakia. Concerning the qualitative aspects of employment Plank and Staritz (2013) analyse whether economic and social upgrading has occurred through the increased involvement and integration of Hungary (and Romania) into global production networks in the electronics industry. They show that the activities in the electronics industry in the analysed countries are still mainly of a labour-intensive nature where the majority of work can be performed by un-/semi-skilled workers. Work practices in the sector are neo-Taylorist, featuring very flexible employment regulations and direct control regimes with the consequence that working conditions differ from those in Western Europe: they 'are characterized by a polarized workforce, relatively low wages with a high variable share, flexible working time arrangements and precarious employment relationships, as well as hostility towards trade unions. The social upgrading experiences in Hungarian and Romanian electronics plants shed a differentiated light on the socioeconomic impact of "high-tech" industries' (Plank and Staritz 2013: 19). The uniform nature of these developments in Hungary and Romania may indicate that in the other analysed countries, FDI-based integration into global production networks or global value chains may result in similar problems.

Foreign-owned subsidiaries are the most important sources of R&D in electronics in the CEE countries, except to a certain extent in Poland, the country with the lowest absolute values of ICT R&D expenditure and personnel amongst the countries analysed. On the other hand, in Hungary electronics R&D is carried out almost exclusively by foreign-owned companies. Various studies indicate the increasing though still minor importance of the CEE countries for foreign R&D activities. Back in 2005, Kalotay (2005) already noted the emerging importance of the CEE countries for R&D investments, emphasizing that mainly European multinational companies in the automotive and electronics industries were locating R&D facilities in Czechia, Hungary and Poland. There are currently several studies underway to investigate the possibility of

14. The exception is Estonia, where the total number of electronics companies is very low.

relocating R&D activities to CEE countries with considerable production capacities in the given industry. This is also true for the electronics sector. While the search for knowledge as a driver of R&D FDI in CEE is still of secondary importance, there are signs that this has changed to some extent recently (Gauselmann et al. 2011; Sass 2013). Gauselmann (2013) has shown that CEE sub-regions are seemingly catching up as target locations for knowledge and technology sourcing of MNEs, and the factors determining the location choices are increasingly similar to those in developed economies, indicating the region's emergence as a competitor to Western European and Mediterranean R&D locations. Further important findings concern the actual content of R&D: Rugraff (2014) analysed foreign direct R&D investment in Central Europe (Visegrad countries) and based on a detailed analysis of the Czech electronics, electrical equipment, machinery and automotive industries found that it continued to be mainly in support of production and associated with the international exploitation of technology produced in Western headquarters and subsidiaries. His results are all the more important as Czechia was the Central European leader in foreign direct R&D investments and the Czech government led the region in promoting foreign R&D investment. In Sass (2013), I have analysed the R&D activities of Hungarian subsidiaries of foreign multinational companies in the automotive and electronics industries. On the basis of case studies, I found great diversity in terms of subsidiaries' R&D activities, ranging from simple testing to fundamental research. The knowledge-seeking motive, though still minor, is increasingly present in locating R&D activities to Hungary. In Sass and Hunya (2014) we also noted the increase in the number of R&D relocations, including electronics manufacturing and services, especially after 2008, which may be related to the crisis-related strengthening of the efficiency-seeking and cost-reduction motive of the Western European companies concerned.

The structure of the industry differs somewhat in the two Mediterranean countries from that of the CEE countries, with the share of foreign-owned companies in all areas being smaller (except for their size), indicating a stronger locally-owned production base (Table 3).

As far as developments during the crisis are concerned, the data in Table 3 indicate that the share of foreign-owned companies in the total number has grown in all countries except Slovakia, indicating that the crisis affected local companies much more seriously than foreign-owned ones – resulting in some of them disappearing. The share of foreign-owned

Table 3 **The share of foreign-owned companies in % of total**

		No. of enterprises		Employment		Production value		Value added		R&D expenditure		R&D personnel	
		2008	2011	2008	2011	2008	2011	2008	2011	2008	2011	2008	2011
Czechia													
26	Computer, electronic and optical products	4.2	4.8	72.3	66.1	91.5	90.7	67.6	56.3	54.9	...	48.4	...
27	Electrical equipment	1.6	1.7	60.6	65.6	67.8	73.7	57.1	67.2	59.0	...	55.8	...
Estonia													
26	Computer, electronic and optical products	63.6	68.8	89.9	91.6	90.2	98.7	88.7	95.8	50.0*	100	55.6*	38.5
27	Electrical equipment	56.8	58.8	67.5	71.5	71.6	76.6	68.1	76.6	100*	50.0	55.8*	72.9
Hungary													
26	Computer, electronic and optical products	5.8	7.6	85.3	85.6	97.1	97.4	91.2	91.2	94.1	...	78.9	...
27	Electrical equipment	12.6	13.5	75.6	71.5	90.1	86.9	89.4	80.2	89.6	...	84.6	...
Poland													
26	Computer, electronic and optical products	23.7	22.2	58.4	61.0	77.4	85.2	60.4	64.4	18.4	5.6	11.1	7.2
27	Electrical equipment	19.0	25.0	51.1	56.6	71.5	66.5	62.0	62.3	49.1	81.0	32.0	63.6
Slovakia													
26	Computer, electronic and optical products	19.4	6.7	77.0	79.3	97.5	97.4	89.3	88.0	57.1*	...	42.4*	...
27	Electrical equipment	21.6	5.9	67.4	68.5	78.8	79.1	58.5	67.3	100*	...	56.1*	...
Portugal													
26	Computer, electronic and optical products	7.7	6.9	46.6	36.2	67.3	29.7	57.6	36.6	...	...	...	...
27	Electrical equipment	4.6	4.8	47.7	50.4	51.5	48.3	56.7	53.8	...	...	...	...
Spain													
26	Computer, electronic and optical products	2.5	2.0	19.0	13.9	34.5	15.5	18.3	15.0	16.6*	11.5	13.4*	10.1
27	Electrical equipment	2.9	4.5	32.4	41.2	37.0	54.8	38.6	52.2	22.2*	42.1	19.6*	12.8

Notes: *2009; data for Greece are not available; Employees: for Portugal and Spain: number of persons employed; other countries: number of employees (in full-time equivalent units).
Source: own calculations based on OECD AMNE (http://stats.oecd.org/Index.aspx?DataSetCode=AMNE_IN)

companies in employment, production and value added also grew in most cases, also indicating that locally-owned companies were losing ground to foreign-owned ones.

6. Other indirect measurements of FDI trends

In this section, data providing information on changes to the European distribution of production in electronics and possible developments in local value added are analysed, i.e. changes in the level of integration of the analysed countries into the European distribution of production, providing indirect information about FDI in the sector. We start by analysing output, value added and employment, before looking at data on net exports.

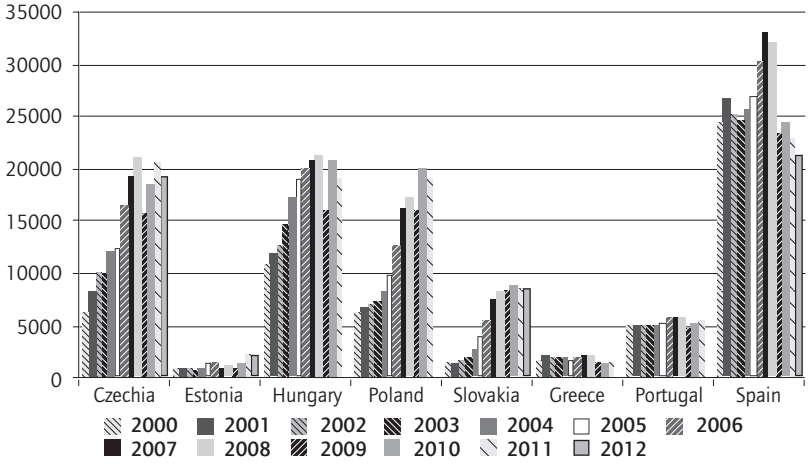
7. Developments in output

Output and value added trends, partly due to the dominant or important role played by foreign-owned subsidiaries, provide indications of shifts in the European division of labour. Electronics production has increased in the Visegrad countries and Estonia, while stagnating or decreasing in the Mediterranean countries. However, the relationship between these two trends is not as straightforward as it seems.

Eurostat national accounts data provide information on the two electronics sub-industries (C26 and C27) at both country and European level, allowing us to see how production output and value added data have evolved in absolute terms and in terms of the given country's share in the EU27 for a longer period of time, i.e. 2000 – 2012. This period includes the crisis years more fully than the previous data.

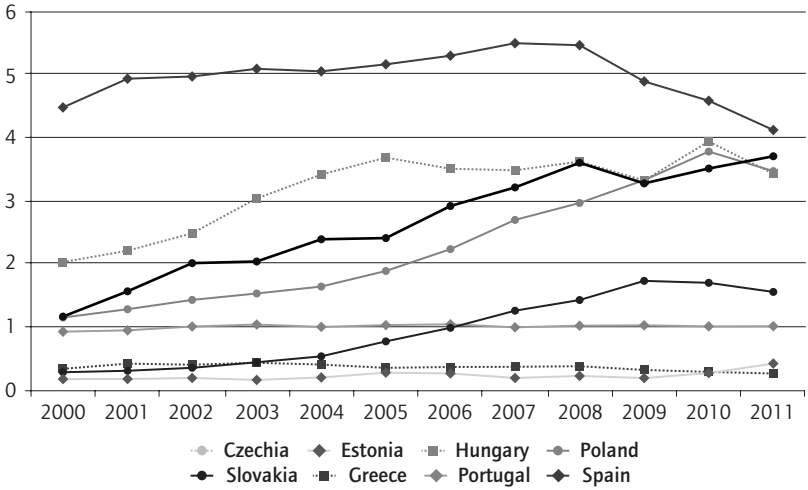
Combining the data on the two sub-industries (Figure 2), we see clearly that output in the five CEE countries increased substantially in the period analysed, with a short break during the crisis, especially in 2009. Looking at the Mediterranean countries for the same period, output stagnated in Greece and Portugal, while in Spain it increased substantially until the crisis, only to decrease in the post-crisis period. Even so, Spain was the largest producer in 2011 among the analysed countries, followed neck and neck by Czechia, Hungary and Poland.

Figure 2 **Combined C26 and C27 output in the analysed countries, 2000-2012, (million euros)**



Source: author's calculations based on Eurostat national accounts data (NACE classification)

Figure 3 **Share of the analysed countries in the EU-27's total C26 and C27 output, 2000-2011 (%)**



Source: author's calculations based on Eurostat national accounts data (NACE classification)

The above statements are reinforced by Figure 3: while Spain still had the largest share in EU27 production in 2011, it had declined steeply to the levels progressively attained by Czechia, Hungary and Poland. Slovakia's electronics output was less dynamic, while the shares of Portugal and Greece remained basically stagnant. While the total share of the Mediterranean countries was between 6 and 7% until 2009, it then declined to below 5.5%; in the same period that of the five CEE countries grew from 4.8% in 2000 to almost 12% in 2008 and 2009 and to 12.6% in 2011. In terms of the breakdown of EU27 electronics output, there was thus a considerable shift away from the Mediterranean countries during the crisis to other countries, including the five CEE economies.

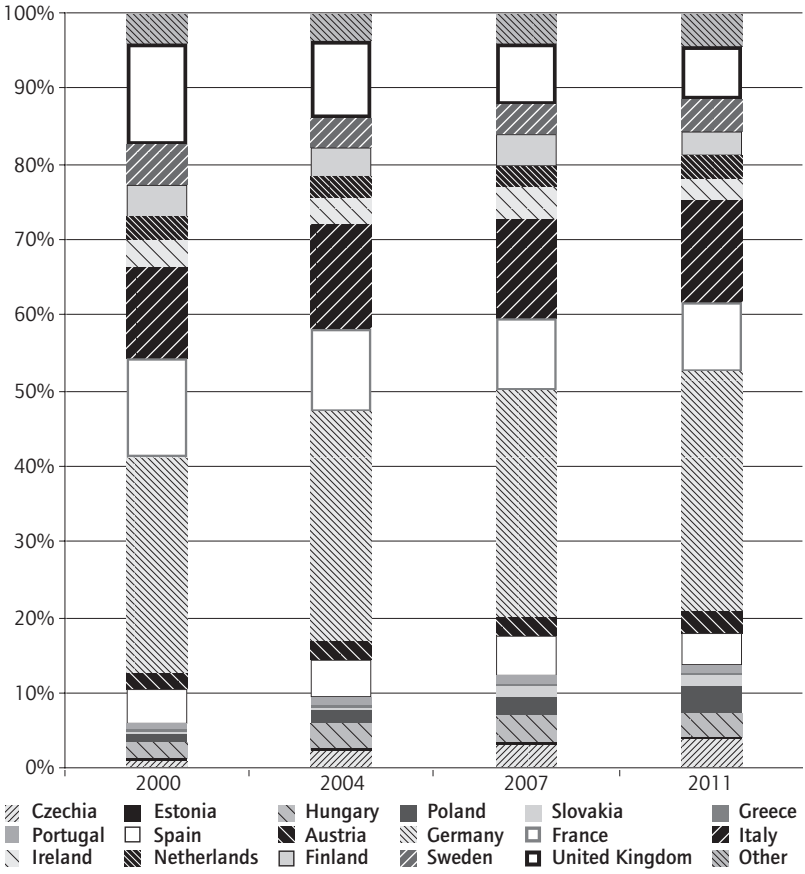
Changes in the shares of the individual Member States in the total electronics output of the EU27 (Figure 4) show interesting developments, putting the relative gains and losses of the analysed CEE and Mediterranean countries into another perspective.

The relative losses in the shares of the Mediterranean countries result only to a lesser extent from the gains of the five CEE countries. Germany and Austria alone gained by far more during the crisis period than these CEE economies.[15] Thus the relative losses in shares in EU output of the Mediterranean countries can be attributed to two developments: increases in the shares in the CEE countries, and to a greater extent, increases in the shares of certain 'old' EU Member States. This indicates significant divergences in the relative competitiveness of EU Member States, 'old' and 'new' alike, in the electronics industry.

However, developments differ to a great extent in the two sub-industries. With regard to C26 (products) (cf. Appendix Figure 1), output grew dynamically in all the analysed CEE countries, while decreasing in the three Mediterranean economies. This momentum came to a halt in the crisis years, and even saw a decrease in 2010. Hungary became the largest producer, replacing Spain in 2005. The total share of the eight analysed countries in EU27 output grew from 9% in 2000 to 19% in 2011, clearly led by the gains of the CEE economies (from below 5% to 16%). On the other hand, in the other sub-industry, C27 (equipment) (cf. Appendix

15. Other 'during-crisis winners' include Italy, the Netherlands and Sweden. It is interesting to note that in the case of these countries, with the exception of Austria, relative shares in EU output had been continuously declining in the pre-crisis period, while quite substantially increasing after 2007.

Figure 4 **Shares of the EU Member States in total EU C26 and C27 output; 2000, 2004, 2007 and 2011 (%)**



Note: without Luxemburg, Malta (2000, 2004, 2007 and 2011) and Latvia (2011).
Source: author's calculations based on Eurostat national accounts data (NACE classification)

Figure 2), a dynamic increase characterised Czechia, Estonia, Poland, Portugal and Slovakia, which was to some extent broken by the crisis, but recovered soon afterwards. On the other hand, in Greece, Spain and Hungary, the crisis had a lasting negative impact on output. Even so, Spain was the largest producer among the analysed countries in 2012, followed by Poland and Czechia. The share of the eight countries in EU27 total output went up from 13 to just 17%, while the share of the CEE countries exceeded that of the Mediterranean countries only from the

crisis years onwards. In this sub-industry, the shift was thus much less spectacular. This can be partly attributed to the fact that in the C27 category, lower growth was expected for the EU as a whole compared to the world and Asia (Custer Consulting Group 2013), mainly due to the decline in telecom production, in which Europe has become increasingly de-specialised. Differences in relative specialisations thus caused different during-crisis changes at country level.

8. Developments in value added

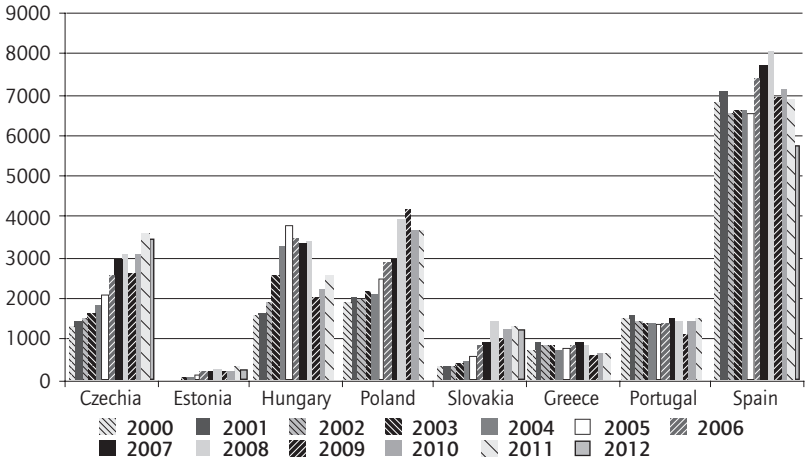
Data on value added provide a somehow different picture (Figure 5). The dynamism characterising developments in output is much less present in the development of gross value added, especially for Hungary and Slovakia. As regards Spain, stagnation turned into a decrease during the crisis years, while in Greece, output stagnation has been coupled with a decrease in value added. In the case of Poland, the crisis had a lasting negative impact on value added. It would thus seem that for the most part capacities linked to production with lower value added have been shifted within Europe.

As regards the shares of the analysed countries in EU27 electronics value added (cf. Figure 6), Spain remains in pole position, even though its share has been decreasing since 2009, taken up mainly by Czechia. Poland's and Hungary's shares have also considerably decreased, in particular during the crisis.

In terms of the share of the eight countries in the EU27 total, this grew from 8% in 2000 to almost 13% in 2008, before declining somewhat during the crisis. While the Mediterranean countries were characterised by a stagnant share between 5 and 6%, that of the analysed CEE countries grew to almost 7%, though also with some stagnant periods. Thus in value added, the shift away from the Mediterranean countries towards other countries including the CEE economies was much less pronounced, with stagnation characterising the three Mediterranean countries and small gains the CEE countries.

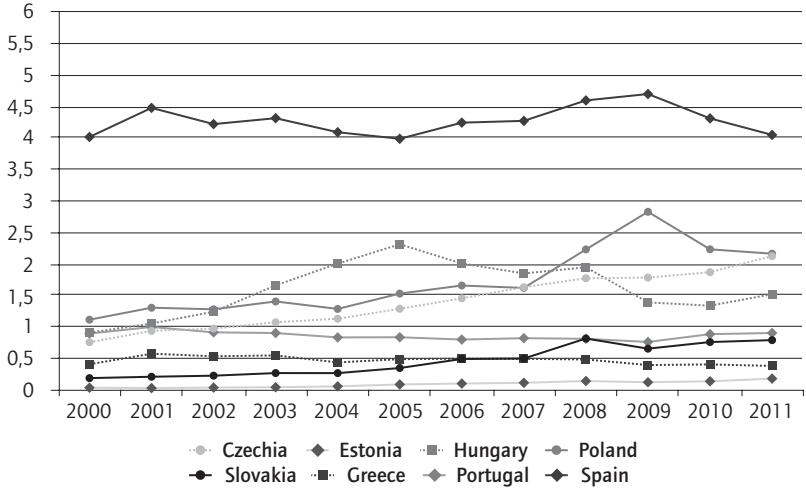
Looking at the country breakdown of total EU value added (cf. Figure 7) in the analysed period and also during the crisis years, gains characterise the five CEE countries, except for Hungary, and stagnation the Mediterranean countries. However, certain 'old' EU Member States

Figure 5 **Gross value added of C26 and C27 in the analysed countries, 2000-2012 (million euros)**



Source: author's calculations based on Eurostat national accounts data (NACE classification)

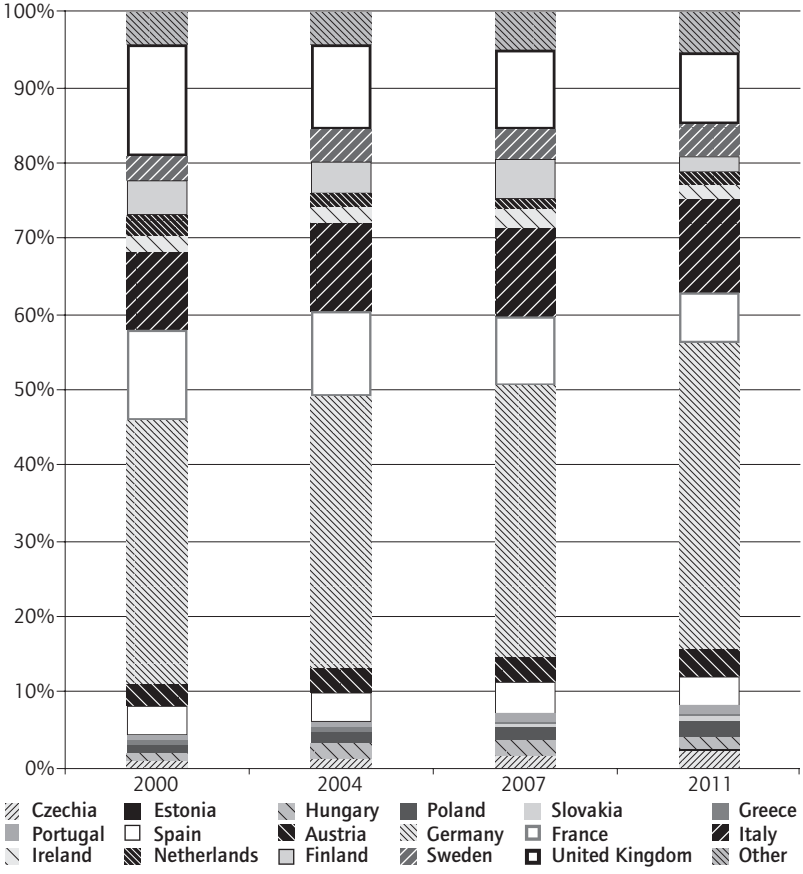
Figure 6 **Share of the analysed countries in the EU27 gross value added of C26 and C27, 2000-2011 (%)**



Source: author's calculations based on Eurostat national accounts data (NACE classification)

gained shares, especially during the crisis years. Here again, the relative gains of the CEE countries are far surpassed by the percentage point gains of Germany alone, indicating that shifts amongst the 'old' EU-countries were again more significant. One possible explanation for this is that electronics activities characterised by higher added values were retained by and even moved back to certain 'old' EU countries presumably with a higher level of competitiveness in the area in question.

Figure 7 **Share of the EU Member States in total EU value added for C26 and C27, 2000, 2004, 2007 and 2011 (%)**



Note: without Luxemburg, Malta (2000, 2004, 2007 and 2011) and Latvia (2011).
Source: author's calculations based on Eurostat national accounts data (NACE classification)

Different shares of the sub-industries in value added are responsible for changes at country level (cf. Appendix Figures 4-8). Overall, the relative specialisation of the CEE is still much stronger in C26 (products) with on average lower added value than in C27 (equipment) compared to the Mediterranean countries.

9. Employment

Developments in employment reinforce the above-described changes – at least until 2008, the latest year for which comparable data from Eurostat are available. According to these, total European employment in the two electronics sub-industries declined by 10% between 2000 and 2008. All four Visegrad countries belonged to the EU Member States[16] which gained at least half a percentage point in terms of their shares in EU electronics employment. Germany and Romania were the other two members of the 'gaining club'. By contrast, Ireland, France, the Netherlands and the United Kingdom each lost more than 0.5 percentage points.

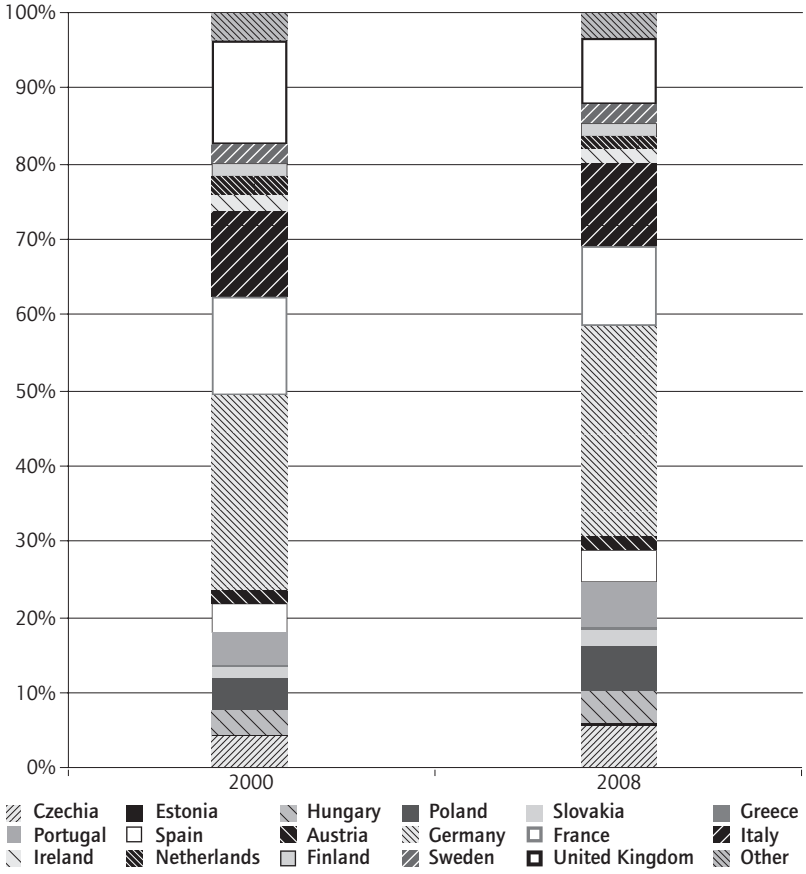
10. Developments in net exports

It is interesting to see to what extent changes in the share of European production and value added are attributable to the activities of local and/or locally-owned companies. Statistics on the internationally competitive part of production, i.e. that which is exported, may give an indication of local content. However, '…conventional trade statistics are a poor guide to bilateral export exposures for supply chain countries' (IMF 2013: 13). As a result, the OECD-WTO data on trade in value added are used.[17] Unfortunately, these are calculated separately solely for C26 (products) and not for C27 (equipment). This database gives an indication of the extent to which the analysed countries are integrated into electronics global value chains and of the role of foreign-owned companies (and imported inputs) in the exports of a given country. Unfortunately, 2009 is the latest year for which data are available.

16. Estonia gained only 0.15 percentage points, reaching a 0.4 % share in total EU electronics employment – due to its small size.

17. http://stats.oecd.org/Index.aspx?DataSetCode=TIVA_OECD_WTO#

Figure 8 **Country breakdown of EU electronics employment, 2000 and 2008 (%)**

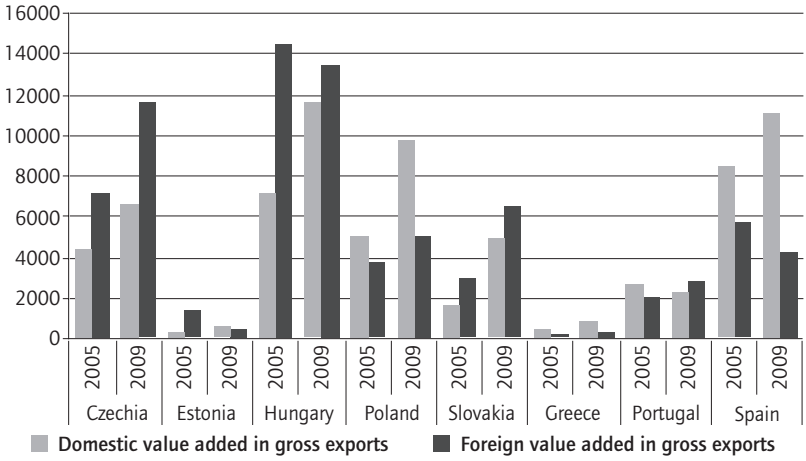


Note: used for 2000 due to a lack of data for Estonia 2001, Greece 2003, Latvia 2002, Malta 2001, Poland 2002, Slovenia 2002; for 2008: 2007 data for Greece, Spain, France, Latvia, Malta, UK, Croatia, Cyprus, Latvia, Luxemburg, Malta not included (due to missing or very low data – below 10000).
Source: author's calculations based on Eurostat

In a previous analysis using this database, the IMF (2013) noted for manufacturing exports as a whole that the Visegrad countries' bilateral exposure to final demand in Germany was at a much lower level than indicated by 'traditional' trade statistics, and thus their exposure to European and world trade was at a much higher level. This indicates the importance of non-German companies in integrating CEE countries in GVCs as well as the high export intensity of German electronics produc-

tion. Furthermore, the analysis showed the evolution of revealed comparative advantages (RCA) of the Visegrad countries, Germany and the Mediterranean countries, indicating a substantial shift between 1995 and 2009 (Rahman and Zhao 2013). There is a clear RCA shift away from labour-intensive towards capital- and knowledge-intensive manufacturing in the Visegrad countries, while maintaining their advantage in labour- and capital-intensive industries.[18] This may indicate upgrading shifts in the role of the CEE countries in the European distribution of activities. Changes are less straightforward in the Mediterranean countries, as Spain lost its RCA in knowledge-intensive activities, maintaining it only in capital-intensive ones; Greece had lost its RCA in all activities by 2009, while Portugal's large RCA in labour-intensive activities was still there, though with a smaller magnitude, in 2009, while its RCA in capital-intensive manufacturing operations was slowly increasing.

Figure 9 **Foreign and domestic value added as reflected by the gross exports of the analysed countries, 2005 and 2009 (USD million)**



Source: author's calculations using basic decomposition of OECD gross export data

Comparing data for a pre-crisis (2005) and the latest available year (2009), it is clear that the share of foreign value added embodied in gross exports is relatively high in the analysed country group, ranging from 28% (Spain) to 63% (Czechia) in 2009 (cf. Figure 9). Overall, this ratio in 2009 was still considerably higher in the CEE countries than in the

18. Hungary had RCA in knowledge-intensive activities only.

Mediterranean countries. While in all countries there was an increase in the absolute values of domestically produced parts between 2005 and 2009, in 2009 in Czechia, in Hungary, in Slovakia and in Portugal more than half of gross exports was not produced locally. However, the share of foreign value added content of gross exports declined in all the countries, except for Czechia, Greece and Portugal. Thus while there were signs of growing local value added during the crisis, the analysed countries' participation in ICT trade was still very much dependent on imported inputs.

11. Outward FDI (OFDI) and relocations in the electronics industry in the analysed countries

While much less important than inward FDI and inward relocations, OFDI and outward relocations are also to be found in the countries analysed. The restructuring of the division of labour in electronics are part of an ongoing process which gained in momentum during the crisis period as a result of growing competitive pressure on companies, inducing them to find further ways to reduce costs. One way to do this is to transfer activities to locations where they can be carried out more efficiently and/or at considerably lower costs. Against this background, one could expect increased relocation activity during the crisis. While the CEE countries were still net receivers in this process, there were a few relocations in the other direction.

As already seen, the sector is usually dominated by the subsidiaries of large foreign multinational companies, with only a few indigenous firms. We could thus expect relatively low OFDI by indigenous firms due to their relative weakness, while indirect OFDI by foreign-owned subsidiaries of multinationals could be more substantial.[19] According to the data, OFDI stock in electronics has been negligible, with the exception of Hungary and Poland and to a certain extent Greece (Table 4).

Further data reveal that the most important host countries in the case of Hungary are Slovakia and Brazil, and in the case of Poland various developed European countries (France, Germany, UK) and developed

19. Data should be analysed with care, as closures of foreign affiliates appear in FDI (and not in OFDI) statistics as a negative number. However, when a local affiliate is the parent of a foreign investment (the so-called indirect OFDI), it is recorded on the OFDI side.

countries outside Europe (in North America, and in Asia, notably Singapore). For Greece, the most important host country is Romania.[20]

Table 4 **Direct investment position abroad in C26 (products), EUR million**

	2008	2009	2010	2011	2012
EU-27	194,369	191,009	207,472	421,791	
Czechia	1	2	3	2	:
Estonia	2	-1	2	1	5
Greece	32	32	32	32	:
Spain	:	:	:	:	:
Hungary	388	473	502	563	:
Poland	:	:	847	836	:
Portugal	:	:	:	:	:
Slovakia	2	1	1	0	:

Source: Eurostat, EU direct investment positions, breakdown by country and economic activity (NACE Rev. 2)

There are signs that resident firms, including a few indigenous local firms, are attempting to enhance their productivity and competitiveness through relocating the most labour-intensive activities to neighbouring or geographically close countries with lower wages, i.e. realising efficiency-seeking investments. On the other hand, the strategy of certain indigenous and highly competitive companies includes OFDI to developed countries, where they are acquiring existing brands, patents, etc. or simply being much closer either to the innovative centres of the given segment of the industry (thus investing with a strategic asset-seeking motive) or to their (potential) customers (market-seeking motive) or both.

The most obvious example for relocations is the case of the Hungarian Videoton (see Box 2). Other such companies from Poland are TelForceOne operating in wholesale trade and consumer electronics, with subsidiaries in Czechia, Romania, Slovakia and Ukraine; Relpol, a manufacturer of electromagnetic products with two production plants abroad (in Ukraine and Lithuania) and several distribution-oriented subsidiaries in other European countries; and Apator, a producer of metering and switchgear with six foreign subsidiaries in Russia, Germany, Czechia, Ukraine and

20. This may refer to ICME ECAB S.A., a company producing power, telecommunications and data transmission cables. See http://www.cablel.ro/index_en.php. ICME ECAB is one of the largest cable producers in Romania. The company had over 490 employees and sales of EUR 88 million in 2009. ICME ECAB is part of the Greek group Hellenic Cables. See http://www.romania-insider.com/greek-money-fuel-romanian-companies/27544/

Box 2 **Videoton**

Videoton is a large-sized Hungarian-owned electronic manufacturing services (EMS) provider, which now belongs to the largest regional players, supplying European, US and Japanese electronics and automotive companies. It supplies, among others, Robert Bosch, Continental, Delphi, Luk, Suzuki and Visteon in the automotive sector and ABB, Braun, Electrolux, Legrand, Panasonic, Philips, Siemens, Stadler, Schneider Electric in electronics. It is the fourth largest European EMS. Based on its own traditional technologies and competencies and close cooperation with its partners, the company manufactures parts, sub-assemblies and modules in electronics, plastics and machinery. Videoton provides a wide range of products for the automotive, consumer electronics, household appliances, IT, office equipment and telecommunication industries.

Its predecessor was established back in 1938. It became a major state-owned company in the 1980s, employing 18 000 people. After the collapse of its regional markets it was bought by three Hungarian individuals in the framework of privatisation in 1992.The company group at present employs more than 7300 employees, out of which more than 1200 work in the foreign subsidiaries. Its revenues amounted to more than 300 million euros (more than 380 million USD) in 2011. With regard to its production operations, besides producing electronics and automotive products, the company also produces related metal and plastic products. It also provides various services to its customers, such as engineering, supply chain management, back-end technologies, logistics etc. The company's headquarters are located in Székesfehérvár, though it has eleven locations in and outside Hungary. It is a group of at least twenty companies linked to each other through various direct and indirect equity holdings.

As for its foreign subsidiaries, Videoton acquired 98% of the shares of a Bulgarian firm in Stara Zagora in 1999. It established a joint venture with a Ukrainian company, Tochpribor, in 2009 in Mukachevo. Moreover, it owns a Bulgarian holding company located in the capital, Sofia. Wages in both countries were and still are substantially lower than in Hungary. As a response to pressure to increase wages in Hungary, the company transferred its most labour-intensive activities to these foreign subsidiaries, explaining why it is considered as one of the few examples of efficiency-seeking outward investors in Hungary.

Sources: http://www.videoton.hu/downloads/videoton_general_eng.pdf,
balance sheets of the company and Radosevic and Yoruk (2001)

the United Kingdom[21] (Kaliszuk and Wancio 2013). The case of Apator, a company which has invested in developed 'old' EU Member States as well, points to the second type of strategy, i.e. being closer to (potential) customers and to the innovative centres of the segment.

On the other hand, there are a few cases of local subsidiaries of foreign multinationals investing abroad. For example the Hungarian subsidiary of the Korean firm, Samsung, is the parent company of a Slovakian and a Czech subsidiary and of one Romanian branch. The electronics OFDI of Hungary in Brazil can be attributed to a Hungarian Foxconn subsidiary, FIH Europe. Nevertheless, overall inward FDI still dwarfs OFDI in the CEE electronics sector, in terms of both its value and the number of projects.

12. Conclusion

CEE countries have become important locations for the global and especially for the European electronics industry, due to an FDI-based shift in the global and especially European division of labour and capacities. Local subsidiaries of foreign-owned multinational companies are the most important players in the industry. Given the higher than average manufacturing sensitivity of the industry to business cycles, we suspected that major changes occurred during the crisis. We were only able to partially document this due to missing data and data problems. This forced us to rely on multiple data sources for direct or indirect information on the industry. According to this, the share of the five CEE countries in EU27 electronics FDI is still relatively low, probably indicating that the activities transferred here are relatively footloose due to low invested amounts and thus low sunk costs. Furthermore, foreign-owned companies were able to further increase their shares in employment, production, value added and R&D during the crisis, indicating that the crisis negatively affected locally-owned companies much more. Output data of electronics show that, after a decline during the crisis, the CEE countries were able to restore their pre-crisis momentum, while the Mediterranean countries were characterised by stagnation or decline. Interestingly enough, the stagnation of the Mediterranean countries went hand-in-hand with an increase in electronics activities not only in the analysed CEE countries but also –

21. http://www.apator.com/uploads/files/consolidated-report-2012.pdf

and even more - in certain 'old' EU Member States, especially Germany and Austria. The during-crisis gains by these 'old' EU Member States were much larger (in % points) than those of the CEE countries. Thus the crisis induced a redistribution of electronics activities among EU countries based on their levels of competitiveness. The magnitude of the changes in electronics value added is smaller compared to that of output. However, the two sub-industries differ significantly: overall, the relative specialisation of CEE countries is still much stronger in C26 (products) with on average lower value added than in C27 (equipment) compared to the Mediterranean countries. Different industry mixes per country and different relative specialisations may thus be responsible for differences in changes at country level. The average share of foreign value added was still higher in the CEE in 2009 than in the Mediterranean countries, indicating a higher reliance on imported inputs, and indirectly, a presumably higher share of assembly and/or lower value added activities. While new capacities have been created in the CEE countries, relocations from other, mainly Western European countries were also responsible for these changes. On the other side of the coin, it is interesting to note that the ongoing restructuring of the European electronics industry resulted in OFDI and relocations away from the CEE countries, though their extent is of course much smaller compared to incoming FDI. It is also interesting to see the emergence of indigenous multinational electronics companies from the region, especially from Poland and Hungary, indicating their increasing level of competitiveness.

As for the future, it is important to note that among the 'old' EU Member States there is a clear divergence in terms of the size of the electronics capacities they host, a process which seems to have accelerated during the crisis. Besides wage competitiveness, other factors influencing national and regional competitiveness are playing an increasing role in determining the location of electronics capacities, and we were unable to rule out an emerging home-country bias, especially during the crisis years. These factors will certainly affect further developments in the CEE countries. On the one hand, assuming the continuation of the during- and after-crisis trends, a further steady increase in the importance of the analysed CEE countries can be expected in European electronics production, as they host major capacities and there is evidence of capacity upgrading. Reflecting relative wage increases, the CEE countries may thus climb slowly up the added-value ladder, partly due the most labour-intensive activities being relocated to lower-wage European and non-European locations and partly due to further relocations of higher

added-value activities there, including some R&D. On the other hand, in connection with developments in the EU-15, differences between individual countries with different levels of competitiveness in the various electronics activities may cause further divergence in terms of their roles in the European division of electronics activities.

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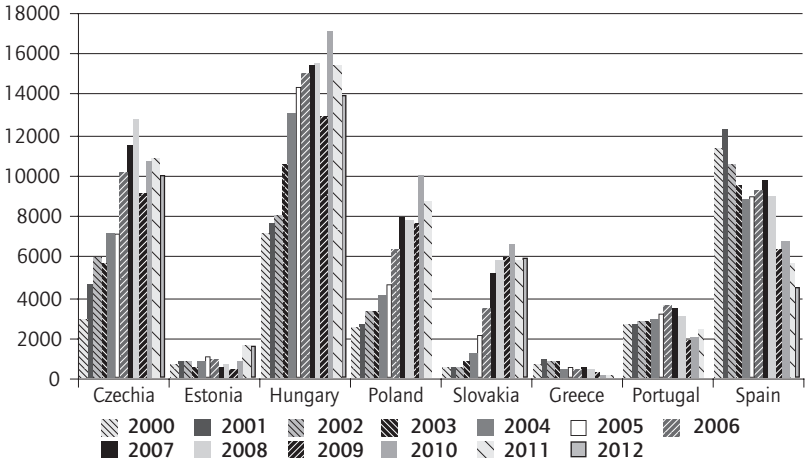
All links were checked on 2 July 2015.

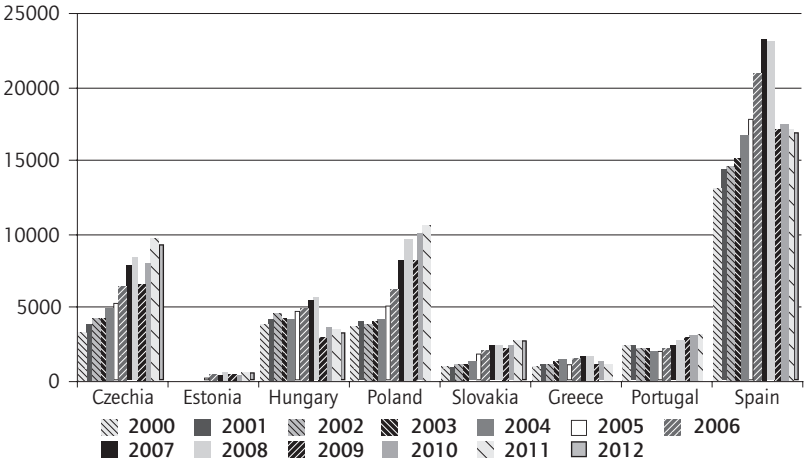
Appendix

Figure 1 **Output of Manufacture of computer, electronic and optical products (C26) in the analysed countries, 2000-2012, (million euros)**



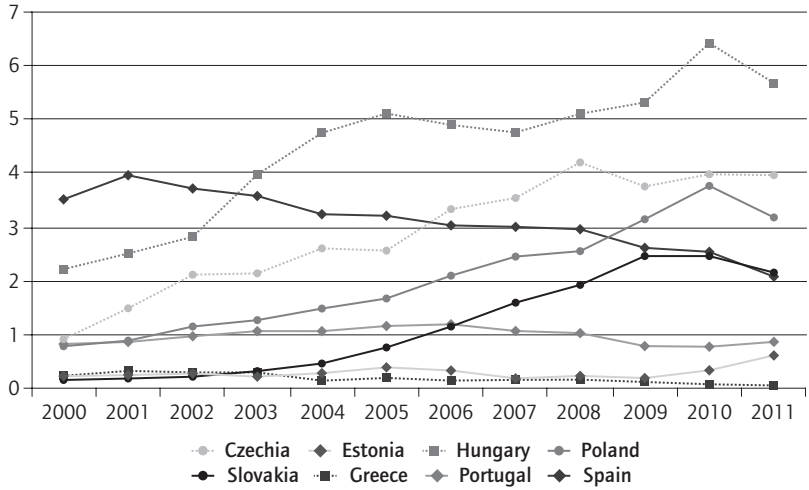
Source: author's calculations based on Eurostat national accounts data (NACE classification)

Figure 2 **Output of Electrical equipment (C27) in the analysed countries, 2000-2012, (million euros)**



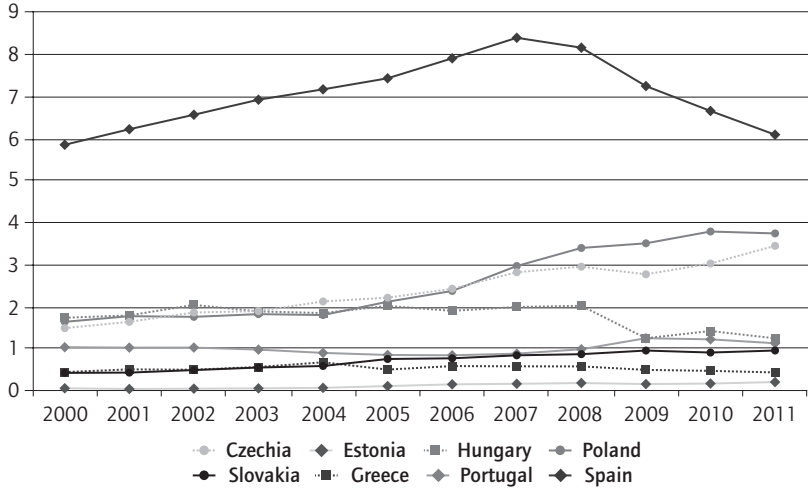
Source: author's calculations based on Eurostat national accounts data (NACE classification)

Figure 3 **Share of the analysed countries in the EU27 output of Manufacture of computer, electronic and optical products (C26), 2000-2012 (%)**



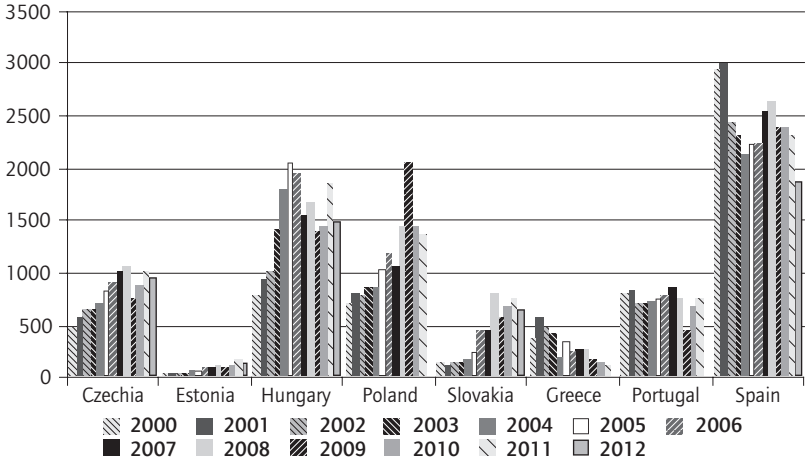
Source: author's calculations based on Eurostat national accounts data (NACE classification)

Figure 4 **Share of the analysed countries in the EU27 output of Electrical equipment (C27), 2000-2012 (%)**



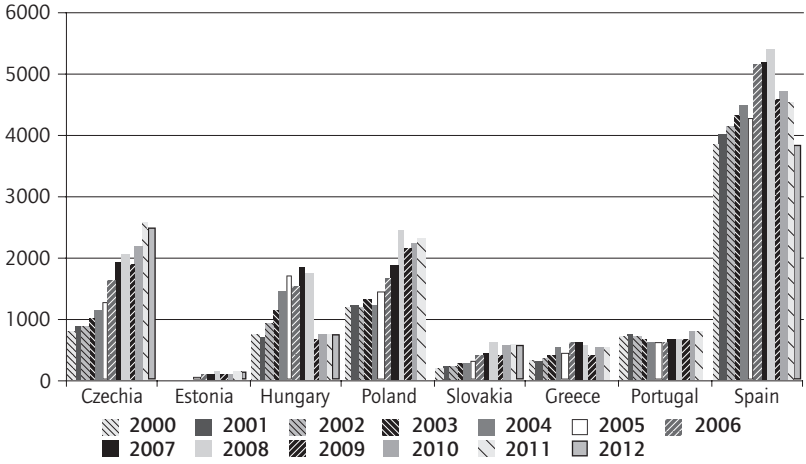
Source: author's calculations based on Eurostat national accounts data (NACE classification)

Figure 5 **Gross value-added of Manufacture of computer, electronic and optical products (C26) in the analysed countries, 2000-2012, (million euros)**



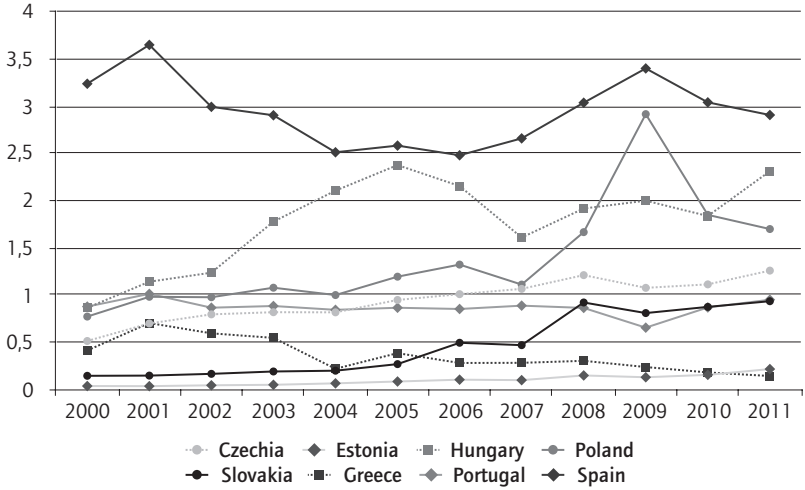
Source: author's calculations based on Eurostat national accounts data (NACE classification)

Figure 6 **Gross value-added of Electrical equipment (C27) in the analysed countries, 2000-2012, (million euros)**



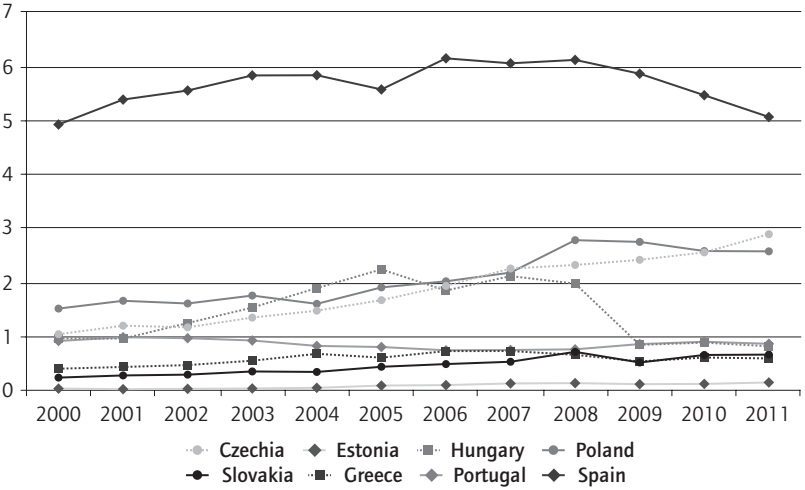
Source: author's calculations based on Eurostat national accounts data (NACE classification)

Figure 7 **Share of the analysed countries in the EU27 gross value-added of Manufacture of computer, electronic and optical products (C26), 2000-2012 (%)**



Source: author's calculations based on Eurostat national accounts data (NACE classification)

Figure 8 **Share of the analysed countries in the EU27gross value-added of Electrical equipment (C27), 2000-2012 (%)**



Source: author's calculations based on Eurostat national accounts data (NACE classification)