THE ELECTRONICS INDUSTRY IN CENTRAL AND EASTERN EUROPE: A NEW GLOBAL PRODUCTION LOCATION

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ABSTRACT:

Central and Eastern Europe (CEE) has emerged as a new global location in electronics industry. The paper analyses (i) which factors explain the emergence of CEE as global production location in electronics, and (ii) what management and policy lessons we can draw from the success of CEE electronics. Integration this industry has been driven by foreign direct investments and global production networks. Hungary has moved the furthest along this path, positioning itself as a major low-cost supply base in the region. Hungary, together with Czech R and Poland form the first tier of CEE countries with other countries being the emerging second tier in electronics industry. A remarkable success of central Europe in this sector rests on still slim foundations as further growth is far from ensured due to weaknesses in national innovation systems. This calls for industry specific innovation policy whose elements are analysed.

Keywords: electronics industry, central and eastern Europe, industrial networks.

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RESUMEN:

Los países de Europa central y oriental (PECO) han surgido como una nueva localización global en la industria electrónica. En este artículo se analiza: 1) qué factores explican el surgimiento de los PECO como localización de la producción electrónica global y 2) qué podríamos aprender del éxito de los PECO en electrónica en materia de política y de gestión. La integración de esta industria ha sido impulsada por la inversión extranjera directa y las redes de producción global. El notable éxito de Europa central en este sector se fundamenta todavía sobre una base bastante exigua, ya que a corto plazo no es previsible un futuro crecimiento debido a la debilidad de los sistemas nacionales de innovación. Se requerirá, por tanto, una política de innovación específica para la industria, cuyos elementos se analizan en este trabajo.

Palabras clave: industria electrónica, Europa Central y Oriental, redes industriales.

1. INTRODUCTION

The way countries integrate at a micro-level into the global economy has major effects on their long-term growth (Radosevic, 1999). Very quickly after fall of the Berlin Wall Central and East European region (CEE) has become an emerging global market location. In a matter of few years we have seen tremendous consumer catch-up in terms of

consumption patterns and standards. However, market integration is necessary but not sufficient condition for benefiting from global integration. Industry integration has been neglected aspect of CEE integration into global and EU economy. It is often assumed that industrial integration would automatically follow from market integration. However, most often this is far from being the case. Countries could be integrated through markets but not necessarily through production and technology networks. World economy is much more integrated through finance and trade than through production and much less through technology. Similar levels of market integration do not necessarily lead to similar levels of production and technology integration. For example, similar integration opportunities of Ireland and Greece into the EU have led to markedly different levels of production and technology integration.

Also, whether FDI will lead to growth depends on a variety of micro/mezzo/macro factors and complementarities among them, i.e. effects of FDI are not automatic.

If we are to understand how globalization at industry level will affect economies we should look into morphology of industry networks as these are the key to understanding what we may expect from FDI in growth.

Elsewhere (McGowan et al, 2004) we approached this issue by looking at factors of coupling between local, national and global production networks in the wider Europe. By relying on so called 'network alignment' concept we explored the ways in, which markets, local and global firms, CEE states and EU actions have brought about the 'alignment' of these networks. Here, by using similar perspective we are interested how industrial integration of the CEE in electronics industry has affected their growth and restructuring. Specifically, we want, first, to explain the emergence of central Europe as global production location in electronics. Second, we want to explore what management and policy lessons we can draw from the relative success of CEE electronics. Section 2 reviews the position of the CEE electronics industry within the world electronics industry. Section 3 reviews the key companies and their strategies, including contract electronics manufacturers. Section 3 tries to systematise factors that have contributed to the emergence of the CEE as global production location in electronics. Section 4 highlights patterns and prospects of further industrial upgrading. Section 5 gives summary of the key points and draws policy implications.

2. CEE IN GLOBAL ELECTRONICS INDUSTRY

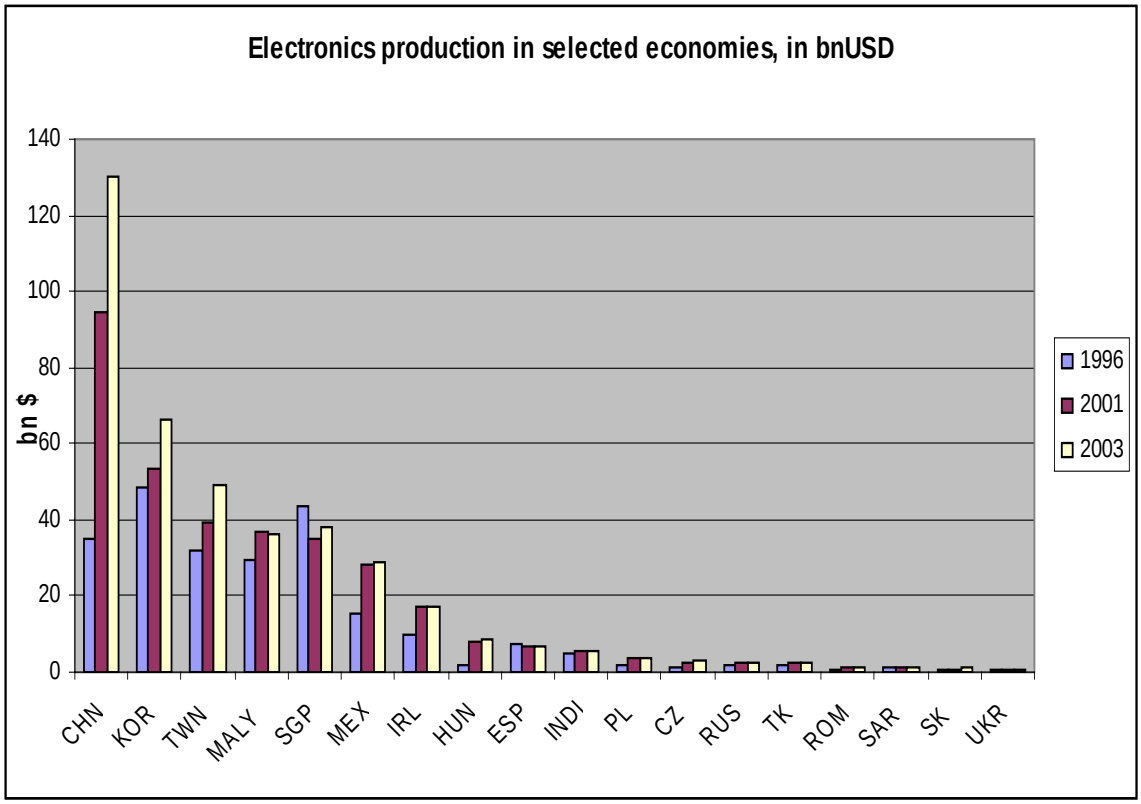
Falling behind of socialist economies of CEE during the 1980s in electronics was one of the important factors behind their economic deterioration. Socialist economies of CEE were uncompetitive in computer production, relying on foreign technology for design and components. For example, their contribution to frontier technology development in electronics was relatively strong only until the mid-1970s.[1] Their high dependence on foreign technology meant that, in the early 1990s, CEECs were still using 1970s electronics technology. This was aggravated by the poor supply of components as a result of COCOM restrictions. Production was undertaken by several large electronics conglomerates which by the mid-1990s all but one (Hungarian Videoton) have been either broken up or slowly deteriorating. In 1989, electronics was suddenly exposed to imports from Asia, which domestic producers could not cope with and were subsequently squeezed out of the market. In addition, illegal imports further aggravated an already difficult situation. The only domestically controlled successful part of electronics during the 1990s was local PC assembly, especially in Poland. However, the

[1] Analysis of technological capabilities of CEECs based on US patents data shows the technological profile of the region, with electronics having a negligible role after the mid-1970s (see Radosevic and Kutlaca, 1999).

demise of socialist electronics did not lead to the disappearance of this industry. After the mid-1990s, some CEECs, like Hungary, the Czech Republic and Poland, gradually became accepted into the supply base of large electronics companies.

In 2003, total CEE electronics production reached $30.5bn, which is a little above the production level in Mexico ($28.5bn), the bulk of this growth being achieved in the 1997-2000 period. However, this level is still low when compared to East Asian economies and China. For example, Taiwanese electronics production is 5 times larger than Hungarian. (See Figure 1 which ranks selected countries according to their volume of electronics production in 1996, 2001 and 2003).

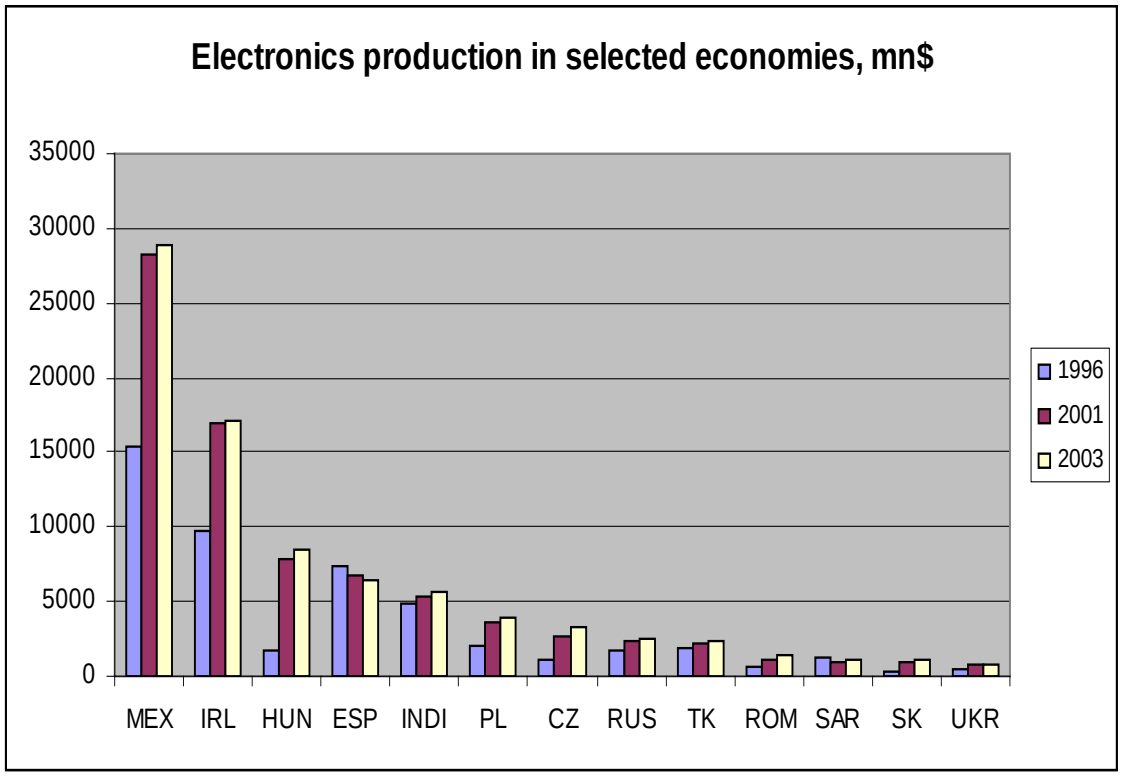
Figure 1: Electronics production in selected economies, in bn$



Source: Reed Electronics Research, The Yearbook of World Electronics Data.
2001/2; 1999/2000 and 2003/4, Volume. 4, East Europe and World Summary
Note: 1996-2001 are current figures at current exchange rates. 2003 figures are forecasts at 1999 constant values and exchange rates (i.e inflation is not included)
For country abbreviations see Annex 1.

Figure 2 shows electronics production of the CEE with comparable countries. The value of leading CEE production location – Hungary – has risen from $1.7bn (1996) to $8.5bn (2003) which ranks it behind Ireland ($17bn in 2003) but ahead of Spain ($6.5bn in 2003). In summary, among emerging markets CEE electronics has become important second tier global location i.e. after East Asia.

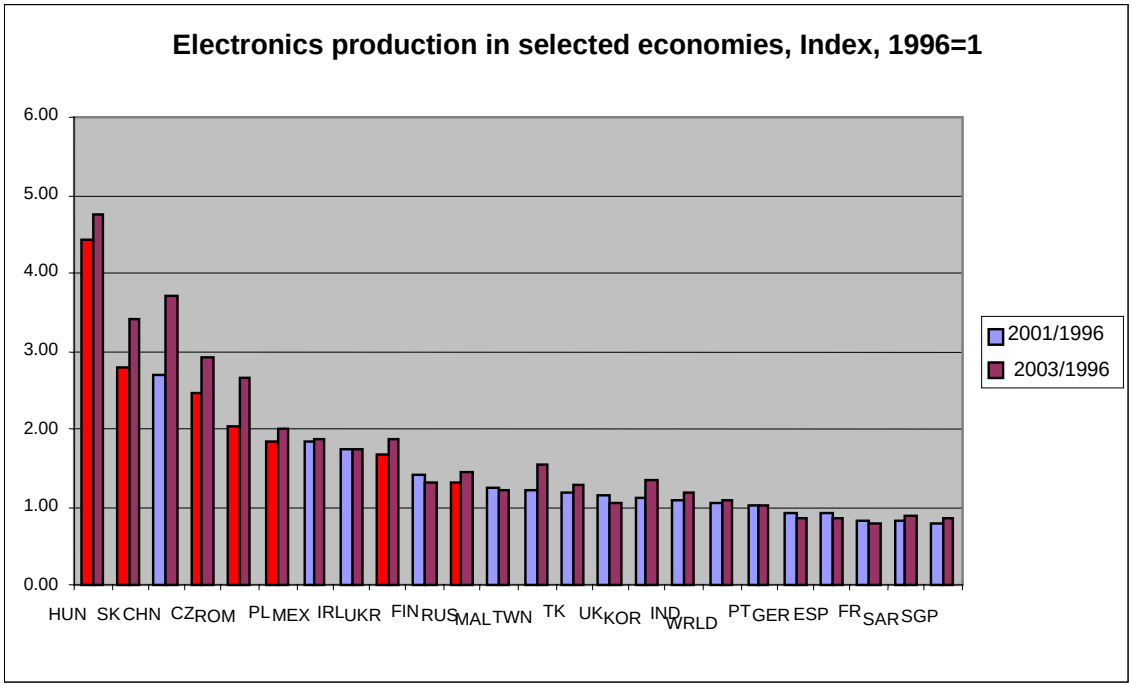
Figure 2: Electronics production in selected economies, mn$



Source: Reed Electronics Research, The Yearbook of World Electronics Data.
2001/2; 1999/2000 and 2003/4, Volume. 4, East Europe and World Summary

However, when evaluating these figures we should take into account that this increase has taken place in just 5 years, between 1996 and 2001. Figure 3 shows that in central Europe increase in this period was in between 2 to 4 times which is much above marginal increases of other countries and quite comparable to China. However, this rise was stopped in the aftermath of Internet bubble and with crisis in industry after 2001. Nevertheless, in most of the CEECs relative difference in terms of growth has remained still substantial. This indicates that region enjoys significant advantages for production in this sector which deterioration of global conditions has not reverted.

Figure 3: Index of electronics production in 2001 and 2003, Base year – 1996



Source: Reed Electronics Research, The Yearbook of World Electronics Data. 2001/2; 1999/2000 and 2003/4, Volume. 4, East Europe and World Summary

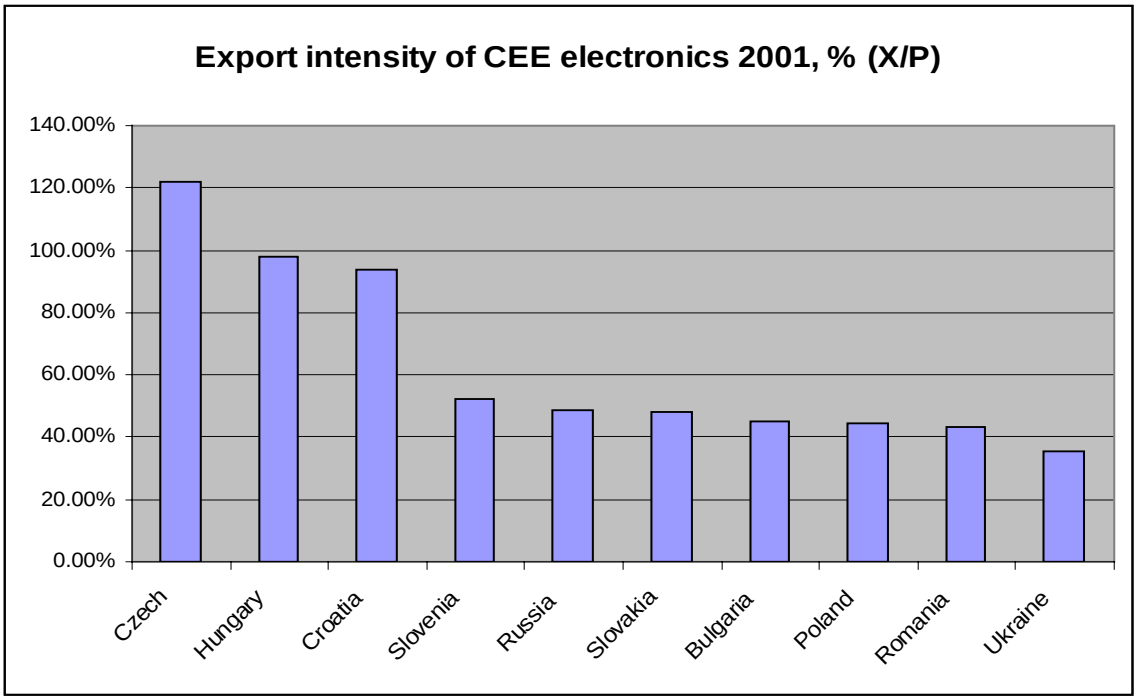
However, despite significant growth of electronics in most of the CEECs electronics export has been very significant only from Czech R and Hungary (see Table 1). In other CEECs, electronics production is not exceptionally export intensive i.e. its growth is driven greatly by local demand (Figure 4). However, this may be changing rapidly as suggested by increasing export rates of electronics from Romania and Ukraine (table 1).

Table 1: Electronics export of the CEECs, millions current US$

	1996	1997	1998	1999	2000	2001	Average annual rate
Hungary	932	3329	4737	6093	7802	7729	42.3%
Czech	989	1176	1633	1572	2224	3340	22.5%
Poland	612	849	1142	1140	1290	1607	17.5%
Russia	784	965	746	929	947	1138	6.4%
Romania	36	31	58	176	510	497	54.9%
Slovakia	161	246	309	363	382	433	17.9%
Slovenia	298	284	276	228	330	350	2.7%
Ukraine	57	77	85	94	220	251	28.0%
Croatia	123	160	164	124	152	204	8.8%
Total	3992	7117	9150	10719	13857	15549	25.4%

Source: Reed Electronics Research, The Yearbook of World Electronics Data. 2001/2; 1999/2000 and 2003/4, Volume. 4, East Europe and World Summary

Figure 4: Export intensity (export/production) in central and east European electronics industry in 2001, in %[2]

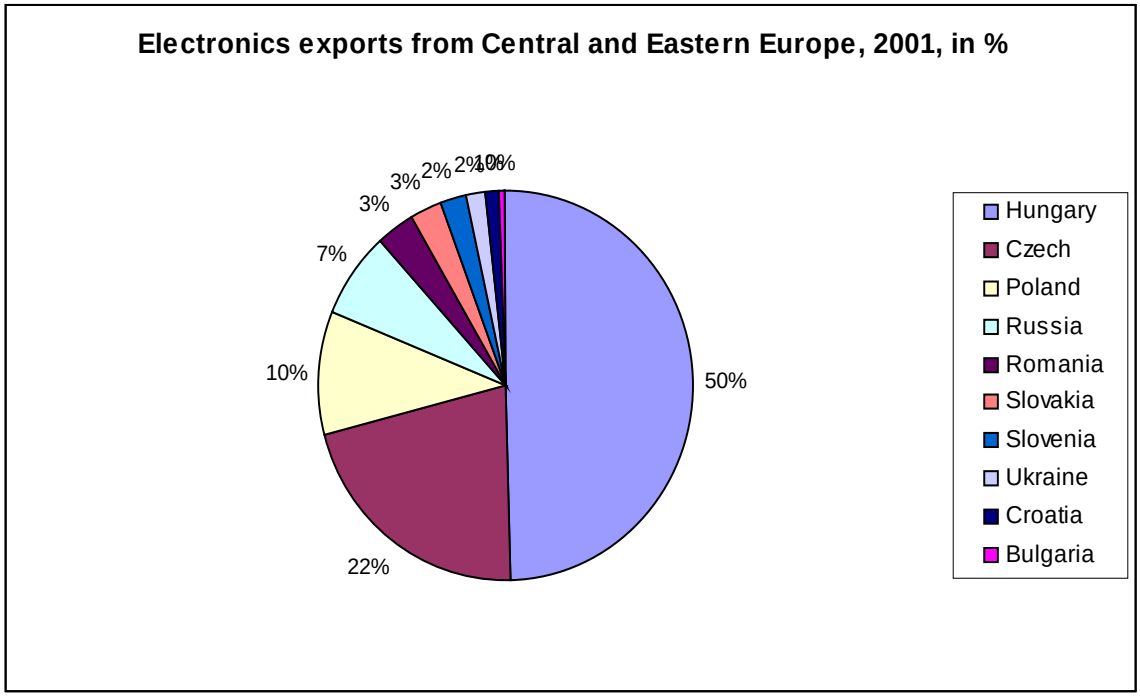


Source: Reed Electronics Research, The Yearbook of World Electronics Data. 2001/2; 1999/2000 and 2003/4, Volume. 4, East Europe and World Summary

In absolute terms, Hungary and then Czech Republic are by far the biggest exporters with the overall share of 77% of regional exports (Figure 5). Other countries are still marginal exporters though rates of export from other countries (Poland, Russia, Romania, Slovakia and Ukraine) are continuously growing.

[2] Figure above 100% indicate that there is high share of re-export in trade. Croatia has high export intensity but low value of its electronics production which is mainly concentrated in Ericsson subsidiary – Tesla.

Figure 5: Structure of electronics export from central and east Europe, 2001 in %

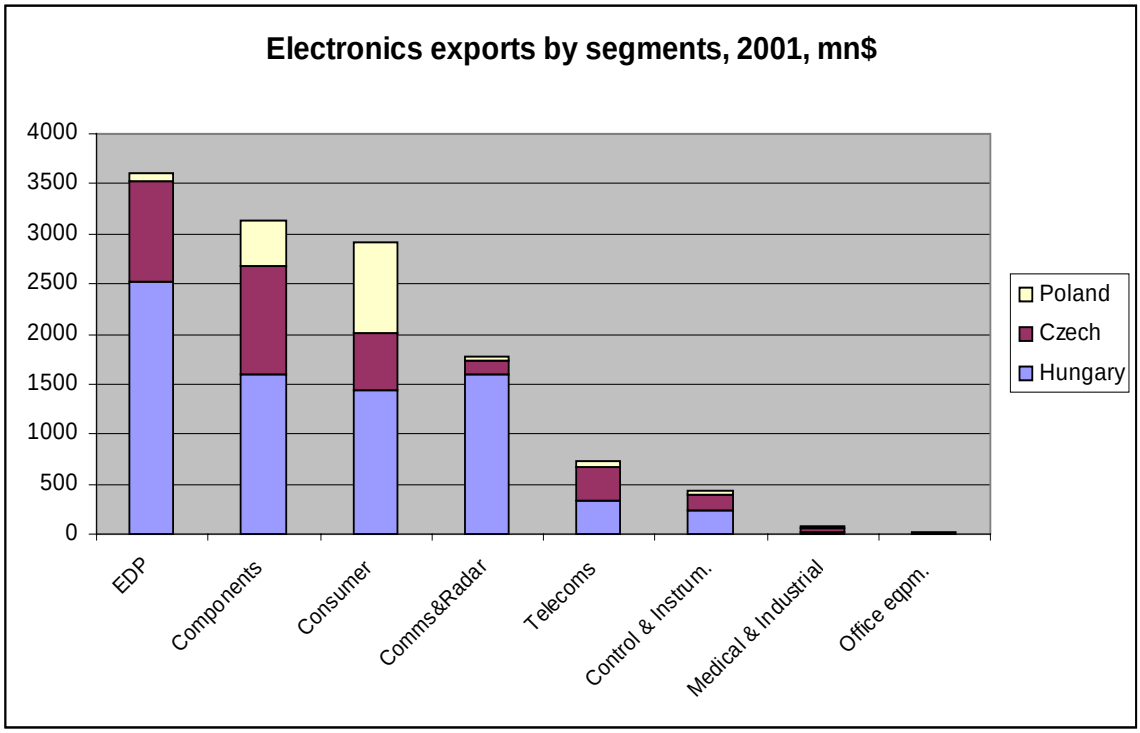


Source: Reed Electronics Research, The Yearbook of World Electronics Data. 2001/2; 1999/2000 and 2003/4, Volume. 4, East Europe and World Summary

The electronics industry is comprised of segments with a wide range of technological levels. At the upper end of the technology spectrum are microfabrication and software engineering, sub-sectors that require highly skilled workers and design capabilities. At the lower end is the assembly**,** which is dependent primarily on low-cost labour.

CEE has relatively diversified production across segments except to some degree in three countries (Hungary, Czech Republic and Poland). However, export is concentrated on smaller number of segments. If we focus on three major exporters (Hungary, Czech R and Poland) we see that their export is concentrated on Electronic Data Processing (EDP) (which includes computer assembly, peripherals, accessories and parts), components and consumer electronics (Table 5). Exports in other segments (communications and military, telecoms, medical and industrial electronics) are much smaller, reflecting a relatively low technological level of electronics in CEE. In telecommunications no CEE is clearly specialised. This reflects poor technological capabilities in this area in the past, as well as a primarily domestic market orientation of foreign telecoms equipment operators.

Figure 6: Electronics exports by segments, 2001, mn$



Source: Reed Electronics Research, The Yearbook of World Electronics Data. 2001/2; 1999/2000 and 2003/4, Volume. 4, East Europe and World Summary

In summary, CEE has become in a very short period of 6-7 years a second tier global production location in electronics. Regional production and export are concentrated in three central European countries (Hungary, Czech R and Poland) with Hungary having half of regional production and exports. Growth of industry seems to have withstood global recession in electronics after 2001 as export and local production continues to grow at high rates. This may suggest that there are certain factors of regional competitive advantage (labour costs, skills and proximity to EU) that work in its favor. Region is involved mainly in low technology segments of electronics that raise the issue of how sustainable is the current growth given increasing labor costs.

3. COMPANIES AND THEIR STRATEGIES

A defining feature of production networks in electronics is their organisation around geographic regions, with each lead firm establishing similar production organisations in Asia, Europe and North America (Linden, 1998; Ernst, 2000). The opening of CEE as a production location enabled EU MNCs in electronics to expand regional core networks. This enabled them access to a diverse array of production costs and capabilities in close proximity.

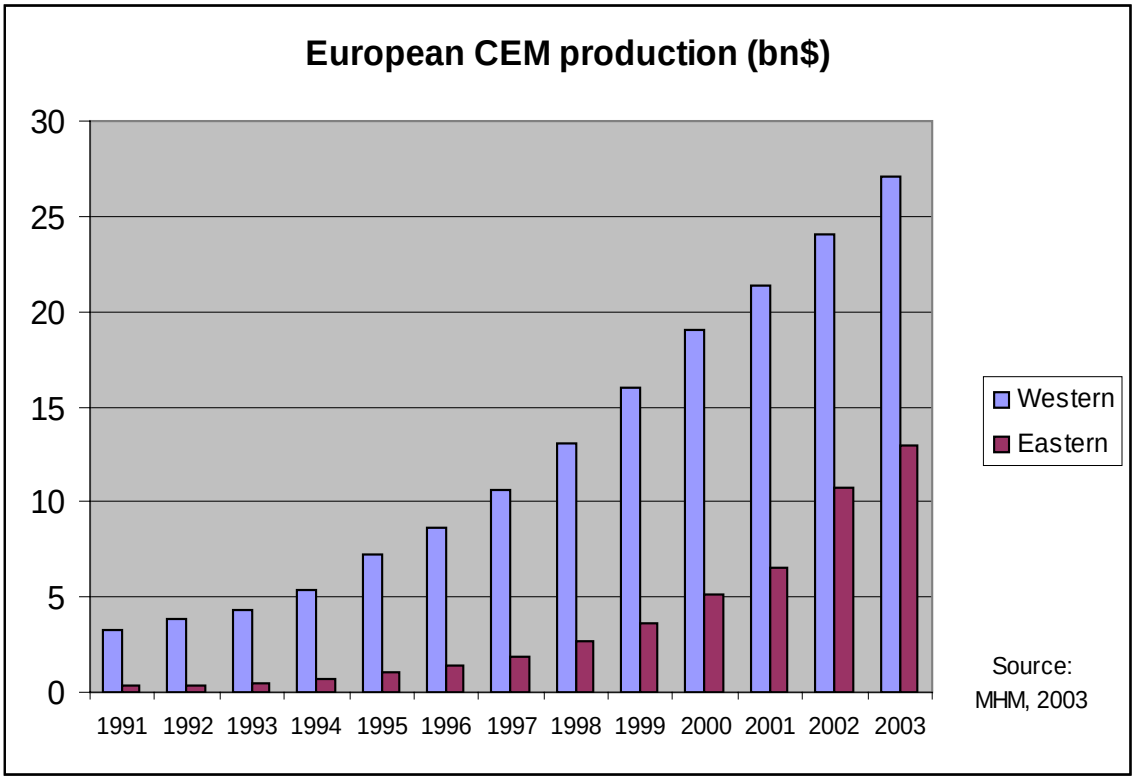
Philips and Siemens have taken the lead in investments, motivated, initially, by geography and lower labour costs. Philips has built an extensive network for consumer electronics in Hungary and made electrical sector investments in Poland. Siemens has invested in all three countries in telecommunications equipment and electrical parts. Korean firms (Samsung and Daewoo) have also moved into the region early, looking to use central Europe as a production platform for the European market. By the mid-1990s, US firms had also joined. IBM established a large-scale disk drive assembly plant in Hungary (which subsequently has been moved to China), while Motorola invested in an

existing Czech wafer fabrication plant, and later invested into a new software centre in Poland. More recently, several US-based contract manufacturers have expanded their European operations to Czech R, Hungary and Romania. By the end of the 1990s, Japanese firms had joined, some of which relocated their facilities from the EU, in particular from the UK.

There are three groups of companies that make up the electronics landscape in CEE: OEM electronics producers, contract manufacturers and local electronics firms[3].[4]
Major OEM companies in region are Phillips, Siemens, Nokia, Motorola, Sony, Matshushita and Samsung. All the major contract manufacturers are also present – Flextronics, Celestica, Jabil, Solectron, Sanmina, Zollner, Elcoteq and PCSM. The only two important endogenous manufacturers that have survived transition period are Hungarian Videoton and Czech Tesla Ecimex. Videoton has transformed itself form being OEM into contract manufacturing company which offers subcontracting services to major world OEM producers (see Radosevic and Yoruk, 2004).

CEE has gained a significant share in European contract manufacturing sector. Figure 7 shows increasing share of CEE in contract manufacturing in relation to 'old' EU. Value of electronic contract manufacturing in CEE has reached $6.5bn in 2001, which is 30% of 'Western', European value with estimates for 2003 of $12.9bn.

Figure 7: European contract electronic manufacturing, 1991-2003



[3] OEM stands for Original Equipment Manufacturer

[4] Contract manufacturers, or electronics manufacturing service companies, have emerged as an important new player in world electronics. These companies assemble a wide array of electronics products in whole or in part for OEM producers. Initially, contract manufacturers were doing only "board stuffing" or putting IC on motherboard and serving OEMs on an overflow basis. However, they gradually shifted towards full turnkey manufacturing services serving as a primary supplier of Electronics Manufacturing Services.

Sturgeon (1997) argues that in comparison with North America and Asia, the contract manufacturing sector in continental Europe has been very slow to develop. However, developments in the last five years suggest that situation in Europe has changed, especially with the arrival of US and Asian contract manufacturers and the emergence of indigenous European contract manufacturers.

Videoton is the main indigenous contracting manufacturing company in the electronics industry in central Europe. It is Hungary's fifth biggest employer with more than 16,000 employees in Hungary, plus a further 1,000 in a newly acquired company in Bulgaria. It is a holding company with 34 business units located across 11 sites. Before 1989, Videoton was a producer of numerous final products in the electronics area. When faced with threats to its survival, it had to close most of its lines and following privatisation continued only with the manufacture of loudspeaker systems, colour TVs and defence equipment. However, it has begun production of CDs. The major strategic shift though, is the expansion of contract manufacturing which today forms the majority of Videoton's revenues. Exports based on contract manufacturing arrangements represent 80% of total sales. Videoton's main areas are electronics, electrical appliances and automotive supplies.

The important factor in the emergence and then growth of Videoton is that the company was not broken up before privatisation. Videoton continued to operate as a holding company that enabled it to develop a strategy based on building diverse production activities and synergies among its company units.

In summary, structural changes in the electronics industry induced companies to respond strategically by outsourcing to achieve flexibility and faster time-to-market. On the EU market, EU companies have become increasingly exposed to Japanese competition via their subsidiaries, which forced them to shift production to CEE in order to remain competitive.

The EU companies Phillips, Siemens, Alcatel and Ericsson, followed by the Korean firm Samsung, first responded to strategic opportunities offered by the opening of CEE. In just a few years, Philips has managed to establish a network of 17 subsidiaries in Hungary. Korean Samsung established a TV sets plant, while Siemens established subsidiaries in all CEECs.

A truly entrepreneurial response was the entry of the Flextronics US contract manufacturer, which opened the way for other contract manufacturers, both from the US and the EU. In the mid-1990s, the structural factors working in favour of central Europe in electronics became obvious and provoked relocations of several Japanese plants from the UK to Hungary and the Czech Republic.

As Linden (1998) pointed out, economic conditions in Europe have hindered speedy and large relocation of production by European firms to CEE. Although leading EU electronics companies reacted to new market opportunities, especially in telecoms, or immediately tapped new supplies of skilled labour, as in consumer electronics, this response did not involve medium and small sized electronics firms. This may have to do with rising unemployment during the 1990s, which made it difficult to engage in outward relocations given the relatively inflexible EU labour market. However, downturn in industry has speeded up restructuring and relocations in European electronics industry whereby CEE has become increasingly integrated into European electronics industry network.

4. FACTORS THAT LED TO GLOBAL INTEGRATIONOF THE CENTRAL AND EAST EUROPEAN ELECTRONICS INDUSTRY

What explains the emergence of CEE as global production location? Economists would argue that it is factor advantages like skilled labour or low labour costs or proximity. However, political economists would point out that factor advantages by themselves couldn't explain it as variety of institutional and political factors should be taken into account.

We think that analysis of determining factors should start from recognition of structural change in electronics industry which worked in favour of CEE as production location. During the 1990s electronics industry has undergone shift from being highly localised to highly globalised industry. This has been accompanied by decoupling of manufacturing from product development and their dispersion across firms and national boundaries. This led MNC to focus on reducing costs of integral supply chain through outsourcing, relocation to low cost sites, reduction in number of suppliers, and introduction of common standards to improve flexibility and global product range. In addition, we have seen a shift from expensive to cheaper areas but also to trend to locate close to main markets in order to achieve flexibility.

Although all these factors worked in favour of the CEE they are insufficient as explanation if we do not take into account the state of production factors (capital, labour, infrastructure, skills) in CEE.

When we analyse production factors we find relatively favourable quality of general factors of relevance for electronics industry. CEE has a large pool of skilled but low cost labour with secondary level skills. Educational level is generally favorable but there are emerging constraints in sector specific skills. R&D and engineering capacities are also developed. Development of IT infrastructure has been quite fast in the last 10 years though its level and quality varies across region. The most important attractor for electronics MNCs is the proximity to EU. However, local markets are still with limited purchasing power and with unsophisticated local demand. In short, general factors are favorable but they cannot explain differences across CEECs in terms of presence of FDI and degree of local production and exports. Factors or resources operate only as potential advantages, which require favourable governance environment to be realized.

So, if we want to explain big differences in development of electronics across the region factor based explanations are not of much help. Elsewhere (Radosevic, 2004) we argue that it is the (un)favourable constellation of different economic, institutional and political factors that operate at different levels, which we label 'network alignment', that has produced virtuous circle in Hungary and Czech R and has operated with much less power in other countries (Poland) or has not been present in other CEECs. Our major argument is that strong complementarities between strategies of MNCs, local large and SMEs, state administrative capacity and FDI incentives, jointly with actions of local governments and attraction of EU demand and EU accession have to be taken into account if we are to understand why CEE countries have managed to integrate into global production networks in electronics.

MNCs play a major role in shaping the way CEE integrates into global networks in electronics. However, EU demand is crucial in pulling MNCs towards further integration of CEE into their production networks.

Two other important factors for synergies between different factors are the actions of local governments, specific incentives and actions of national government. When compared to other regions, local industry networks, including large and small firms in CEE, do not play an important role; they are on average weak and undeveloped as network organisers. Also, the accession process does not seem to bring about a closer

alignment of networks. The network alignment is driven by MNCs, is pulled by EU demand and confined to local subsidiaries of MNCs. In Hungary and the Czech Republic (after 1996) local and national governments played an important role through subsidies and industrial park policies. As in the east Asian story of electronics dynamics (Hobday *et al*, 2001) the key driver is the FDI i.e large electronics MNCs.

1. Foreign investment is the primary vehicle of integration of CEE electronics firms into global production networks and Hungary has moved furthest along this path, positioning itself as a major low-cost supply base in the region. Czech and Polish electronics industries are connected, in smaller but increasing degrees, to international electronics production networks. Other countries have much less integrated industries though this situation may change in the medium term, primarily through the activities of contract manufacturers.

2. The EU operates as the main source of demand for CEE electronics industries. This is the main pull factor that gives cohesion to the actions of MNCs and of local and national governments in CEE. However, this also means that CEE electronics firms mirror to a great extent the strengths and weaknesses of EU electronics firms in terms of market segments and dynamics of growth.

3. Networks that are being built in CEE reflect the strategy of the dominant actor – the MNC. They are usually confined to subsidiaries with still limited local subcontracting, are export oriented and are expanding. Local subsidiaries have mastered production capabilities and several subsidiaries in Hungary are European mandate suppliers in their respective lines of business.

4. Ex-socialist electronics conglomerates have substantially decreased in size and most are operating as loose associations of medium- and small-sized firms. Videoton Hungary is a notable exception to this pattern in terms of successful domestic-led restructuring. The layer of local firms in electronics is still very weak with very limited capabilities in core technologies. This is the key weakness for further alignment of networks in CEE electronics. CEE still seems far from the situation in East Asia where former managers at companies like Intel and Hewlett-Packard have started some of the best local companies in the electronics sector. The weak financial systems of CEECs, and still undeveloped capabilities in electronics technologies and lack of experience in competition in this sector, means that the local networks will remain very much dependent on foreign investors.

5. Local governments in Hungary and Poland played an important role in working jointly with foreign investors on establishing industrial parks and new capacities. In Hungary, and after 1996 in the Czech Republic, national government played an important role in attracting FDI to electronics. We can conclude that local governments, as the least powerful actor, will have made the greatest efforts in relation to their capacities to reconcile their interests with those of MNCs.

In countries where the synergies or coupling between these factors are weak we can talk about network alignment failure. This failure should be distinguished from a failure to develop networks. The asymmetries in quality and development of local, national and global networks and actors, rather than the mistakes in the process of alignment, can often explain why networks fail, ie, do not align.

5. PATTERNS AND PROSPECTS OF UPGRADING OF CENTRAL AND EAST EUROEPAN ELECTRONICS INDUSTRY

In reality, industrial upgrading is always a dynamic process with countries moving up or down industry ladders. Hence, whether a country will become an important global location in electronics will depend on the technological diversity of plants and their functional upgrading. In this section we want to briefly highlight what have been the patterns of upgrading and what are prospects for further upgrading of CEE electronics.

Expansion of the existing facilities in manufacturing in terms of increased investment, employment and exports has been pronounced during the 1990s. This has involved extensive upgrading of production capabilities. In general, a review of the business press suggests that mastery of production capability has been quite extensive in the region. This is in line with figures on productivity of foreign investment enterprises in CEE, which are much higher when compared to domestic firms (Hunya, 2000).

However, it seems that cases of functional upgrading or moving from manufacturing to engineering within the same firm are rare. Although we find several examples of foreign controlled R&D, software and design centres in electronics, they are mainly in the telecommunications area, not in core areas of electronics. This, together with the strong product specialisation of foreign plants, suggests that the mastery of technology has been confined to process improvement technology.

The mastering of process technologies has primarily taken place within the foreign firms and in some successful domestic firms. In some respects, the situation in Central Europe in electronics is similar to the situation in Malaysia and Thailand (but not Korea and Taiwan), where the overwhelming dominance of MNC investment is matched by the absence of major local exporting firms (Hobday *et al*, 2001). In terms of modes of entry, the frequent pattern is a shift from subcontracting to FDI. A precondition for this shift is the mastery of production capability by subcontractors To sum up, we find indications of the mastery of production capability but relatively limited functional upgrading. As local companies prove themselves to be competent subcontractors, they are then taken over by foreign partners. Most often they operate as product specialist plants or rationalised operators, which explains the limited possibilities for functional upgrading. Also, the limited autonomy of subsidiaries indirectly confirms this impression[5].

A key issue for further upgrading is how to spread gains in achieved production capabilities to technology activities (functional upgrading) given rise in labour costs. Also, currently FDI in R&D and software in CEE are primarily in 'stand alone' investments which are rarely integrated with local manufacturing facilities. It seems that weaknesses of national systems of innovation and of local firms, in particular, are crucial hindering factors for further industrial upgrading in central Europe[6].

Regarding eastern Europe it seems that their inclusion into European production networks will continue. This is largely driven by labor costs differences within central and Eastern Europe as well as by improved investment climate in Eastern Europe, including Ukraine. Investors perceive this in terms 'tiering' of the region in three groups: CEE 'sweet spots' (Hungary, Czech R and Poland), developing CEE (Romania, Bulgaria, Baltics), and future CEE low – cost bases (Serbia, Belarus, Ukraine, Russia, Bosnia, Moldova).

[5] However, given our sparse evidence we may be wrong and further case study work along the analysis of Polish and Romanian clothing sectors would be needed (see Yoruk, 2004).

[6] In next section, we address some of the policy issues which such situation entails.

6. SUMMARY AND POLICY IMPLICATIONS

FDI have been the primary vehicle of integration of the CEE electronics firms into global production networks. Hungary has moved the furthest along this path, positioning itself as a major low-cost supply base in the region. Central Europe (Hungary, Czech R, and Poland) have become the first tier countries while eastern countries, including Ukraine, are the emerging second tier. EU has been the main source of demand for the CEE electronics industry. Industrial networks have emerged reflect the strategy of the MNCs. For the time being, industrial networks are confined on parent - subsidiary relationships with still limited local subcontracting; they are export oriented and are expanding.

Local subsidiaries have mastered production capabilities with several subsidiaries in Hungary have become European Product Mandate Suppliers. Ex-socialist electronics conglomerates have significantly reduced in scale and most have been transformed into loose associations of SMEs. Hungarian Videoton is notable exception and leading endogenous electronics contract manufacturer.

Layer of local electronics firms is weak with very limited capabilities in core technologies. This is the key weakness for further industrial upgrading as local firms remain very much dependent on foreign investors.

Local governments in Hungary and Poland played an important role in network alignment. In Hungary and, after 1996 in Czech Republic national governments played an important role in attracting FDI in electronics. EU demand is a strong 'focal point' (attractor) to the emergence of new industry networks. It generates necessary 'coherence' for initial and still rudimentary local clustering organized by MNCs. Regions are important players in coupling needs of local and foreign networks despite limited decentralization and lack of financial autonomy. This points to need for the EU policy actions which would be focused around improvement of regional infrastructure.

How to ensure that the initiated process of integration into electronics industrial networks continue and deepen? From our perspective policy should aim to identify relevant complementarities between firm and region specific advantages and disadvantages and try to address them. Alignment of different networks cannot be enhanced by centralized and coordinated change. The real policy challenge is to know what are the *triggering or missing elements* that might generate complementarities between national and global production and technology networks. Rather than trying to be generally attractive to foreign investors policy should aim to develop those parts of its infrastructure and national innovation system that *complement* the business strategies of companies that are moving towards knowledge based activities.

This should involve supporting the weakest link in network alignment process which is currently domestic large and small firms. The East Asian experience shows that host countries can effectively determine the degree to which they benefit from the proliferation of network linkages with foreign electronics companies (Linden, 1998).[7] However, CEECs today have much less possibility of determining the degree to which they can benefit from international production integration. Nevertheless, they should use opportunities within the EU institutional and financial support to enhance national innovation system the CEECs within the wide EU system of innovation. This should be done by supporting local and international networking and diffusion activities. There is danger of continuing FDI as the only industrial policy and there is prevalent need to

[7] Hobday *et al* (2001) argue that this is much less the case as government strategies appear to be much less effective than the initial accounts of electronics development in east Asia have suggested.

integrate FDI policies with innovation policy. Key policy challenge for the CEECs is how to couple policy towards value chains and policy for national system of innovation.

Annex 1: Country abbreviations

A – Austria; BG- Bulgaria, CHN – China; CRO – Croatia; CZ – Czech Republic; ESP – Spain; FIN- Finland; FR – France; GER – Germany; GRE – Greece; HUN – Hungary; IND - India; IRL- Ireland; MAL – Malaysia; MEX – Mexico; PL – Poland; PT – Portugal; RKOR – Korea, Republic of; ROM – Romania; RUS – Russian Federation; S – Sweden; SAR – South African Republic; SG – Singapore; SI – Slovenia; SK – Slovakia; TK – Turkey; TWN – Taiwan; UK – United Kingdom; UKR – Ukraine.

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