



**LINKING LABOUR REGIMES AND  
TECHNOLOGICAL INNOVATION IN  
CENTRAL AND EASTERN EUROPE:  
THE CASE OF AUTOMOTIVE AND  
SOFTWARE INDUSTRIES**

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## **Abstract**

This report studies the link between labour regimes and technological innovation in Central and Eastern Europe, analysing in some detail two key sectors that have gained in importance in the economies of the region: the automotive and software industries. Defining success as a move up-market in terms of production and/or gaining a dominant and stable share in the world markets, both sectors have been successful regionally and, in certain aspects, also globally. Yet, the character and levels of innovation and R&D within them differ. Whereas innovation in automotive sectors – to the extent that it takes place – is imported, much innovation in the software industry is indigenous.

We define a labour regime broadly to include labour availability, quality and provision of skills, labour market flexibility, or industrial relations. We focus on evaluating the role of several institutional and policy areas, especially education and skill provision systems, migration policy, labour market regulation and employment relations. The elements of labour regimes that have the greatest influence on development also vary between sectors. Two sectoral case studies are linked by a focus on three interrelated areas on a) the relevance of the provision and availability of skills and the importance of local labour supply; b) openness to foreign labour as a source of knowledge in some cases and in others of numerical flexibility; and c) the existence and importance of clustering as a source of knowledge-sharing and knowledge-generation. Employment and labour-market flexibility and its links to legal and institutional frameworks are cross-cutting issues that come back in the three overarching themes. Flexibility takes different forms in the two sectors. While it might not be directly related to the innovation process as such, it has contributed to the increased competitiveness of the two sectors and supported a shift up-market in sophistication. Our general finding is that for both types of innovation – ‘imported’, which prevailed in automotive sector and ‘indigenous’ that was shown to exist fairly widely in the software industry – the availability of human capital, its structure and skill-sets have been important in order for the higher-end activities to be localised or nurtured in Central and Eastern Europe. However, the differences in the generation and implementation of innovation and in the nature of the production processes are reflected in significant differences in labour regimes.

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## Joint introduction

The key issue in this paper is the link between labour regimes and technological innovation in Central and Eastern Europe (CEE). Looking at two different sectors – automotive and IT<sup>1</sup> – we analyse the relationship between labour regimes and the ability of these industries in the region to succeed globally. Success is defined as a move up-market in the complexity of a given production (automotive sector) and/or gaining a dominant and stable share in the world market in a given product (software industry). In order to accommodate two quite different sectors and types of innovation that tend to characterise them (radical versus cumulative/incremental), we define a labour regime broadly and consider not only labour and skill availability and quality, but also labour market regulation, industrial relations and general labour market flexibility. By such a broad definition we aim to focus on the institutional context in the region and the extent to which it has been or has the potential to be conducive to technological innovation (and of which type). We recognise that human capital is a key factor underlying technological innovation. Moreover, employment relations take on a greater significance where innovations find their expression in mass production and the large-scale employment of semi-skilled labour. It is therefore important to disentangle the importance and relevance of these factors in the CEE region. So far this has not been sufficiently understood and analysed in a cross-country, cross-sectoral framework and, most important, in a region that does not (yet) find itself at the economic core.

The automotive and IT sectors have gained in importance over the last two decades in the economies of Central and Eastern Europe. The automotive sector has become a leading sector and has grown rapidly, thanks to inward investment by major multinational companies (MNCs). Of the CEE countries, only former Czechoslovakia produced fully indigenous passenger cars in the state socialist period, although motor vehicles and components were produced to some extent in all countries. The automotive sector has upgraded significantly and car producers in the region compete successfully with their consortium counterparts elsewhere. The advance that the sector

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<sup>1</sup> We use 'IT' and 'software' interchangeably to refer to the software and information technology sub-segment of the ICT sector. The ICT sector more broadly includes the communication industry. In the analysis of data, we might refer to the broad ICT sector due to data constraints about the IT/software industry alone, and will make this explicit.

has seen, however, has been heavily dependent on imported technology. The software industry has seen a growth spurt, especially since the early 2000s, and the size of the ICT sector (including communications industry, not only IT) in terms of exports approaches or now matches the scale of car production. However, the composition of the software industry with respect to the origin of firms is mixed. Parallel to foreign firms a number of indigenous companies contribute to job creation and product development. A handful of firms have shown the ability to innovate and grow to occupy leading positions in world markets, especially in the anti-virus industry, leading us to analyse this part of the sector in greater detail.

An overarching question that we pose in the report is: *“What role have labour regimes played in the growth and technological advancement of the sectors analysed?”* The link between labour regimes and technological innovation comes mainly through the premise of the key role of human capital in the high-skilled, high-value added industries where (highly) skilled labour is a complementary input to new technologies or process innovation. However, while both industries are skills-intensive, they approximate two different types of innovation. While the IT sector is characterised more by radical types of innovation, the automotive sector is typified by incremental innovation. Importantly, the two types embody a very different mix of knowledge inputs and are typified by different types of knowledge production and learning (Toner, 2011; Bassanini & Ernst, 2002). In particular, while radical innovation is based on the input of highly skilled professionals, incremental innovation often consists of minor modifications and improvements of existing products, each of which is of small significance but cumulatively lead to major significance, often influenced by direct production workers on the shop floor (Toner, 2011).

Studies that hypothesise about an explicit link between a labour regime as an ‘institutional context’ and innovation are relatively scarce and those which exist target mainly advanced economies. Works by Toner, 2011; Bassanini & Ernst, 2002; Hall & Soskice, 2001; Gereffi, Humphrey & Sturgeon, 2005 all study the impact of the national institutional context on the type of innovation undertaken (or the complete lack of innovation). Hall & Soskice (2001) in particular highlight the impact of institutional complementarities on the competitiveness of their two socio-economic model prototypes – the coordinated market economy (CME) and the liberal market economy (LME). The authors of the volume argue that skill formation systems and industrial relations systems are interlinked and that CMEs tend to excel in specific skills and incremental innovation, while in LMEs general skills and radical innovation prevail. Along these lines Bassanini & Ernst (2002) gathering comparative evidence from OECD countries find that coordinated systems, due to more stringent labour market regulation as an outcome of a coordinated system of industrial relations exhibit greater technological advantage in industries characterised by cumulative knowledge. To the best of our knowledge, no study (perhaps with the exception of Nölke & Vliegenthart, 2009) has to date analysed the relationship between labour regimes and innovation in the CEE context. Regionally specific works on socio-economic models of capitalism in Central and Eastern Europe (Bohle & Greskovits, 2007; Myant & Drahokoupil, 2011a; Duman & Kurekova, 2012; Nölke & Vliegenthart, 2009) have demonstrated that institutional frameworks that have evolved as an outcome of the transition in CEE are *sui generis* and cannot be directly compared to those in the advanced economies. This is

another aspect in which we consider our approach to be innovative and interesting, although we will not be able to relate our findings to this literature extensively (but this certainly represents a possible avenue for further research).

In addition to the work that considers the link between a labour regime, a country's institutional set-up and innovation, our research is loosely anchored in two other broad bodies of literature. The first are more general works which offer theoretical propositions about determinants of country-level innovation and competitive advantage. Examples include authors such as Porter (2000 and 1990), Hidalgo & Hausmann (2009), Bhidé (2008) and Gereffi (Gereffi, 1994; Gereffi, Humphrey & Sturgeon, 2005). To outline the basic concepts of these studies, Porter provides an analytical framework for understanding where the competitive advantage of a country comes from. Hausman conceptualises the issue of product sophistication and complexity and studies how countries are able to move up to more complex products. Bhidé emphasises the importance of consumer rather than producer-driven innovation. Gereffi focuses on explaining the logic of organisation of production between buyer-driven and producer-driven commodity chains and the localisation of high-end production and its resulting innovation. The concepts and hypothesis that these works develop are utilised across the report, but due to spatial constraints these works will not be considered in this introduction further (but can be sent to the reader upon request).

The second stream of literature represents sectorally-specific studies on Central and Eastern Europe (Bernaciak & Šcepanovic, 2010; Kurekova, 2012; Capik & Drahokoupil, 2011; Hardy, Micek & Capik, 2011; Pavlínek, Domański & Guzik, 2009). These works are utilised directly in the sectoral studies and they represent building blocks for further original empirical investigations conducted by us. Informed by these bodies of scholarly literature, our key research question is answered through a focus on three themes that intertwine the sectoral analysis and firm-level studies within them. The first set of issues focuses on the availability of skills and their provision through education and skill formation systems and the impact of that on personnel and HR decisions. Here the sectoral studies aim to understand how the decisions to shift to more sophisticated production by multinational companies (MNCs) located in the region were facilitated by the availability of human capital and other policies that support the utilisation of domestic knowledge (e.g. incentives to establish R&D centres, investment in education programmes, etc.). We consider questions such as who are the core employees (age, education, experience, nationality profile), does cooperation with local universities exist, how internationalised the workforce is (and in which units within the company), and how the internationalisation or localisation of the key managing or R&D personnel has developed. In addition to aggregate-level sectoral data we gather evidence on these questions through analysis of HR decisions and practices within the companies we study.

The second area of closer focus looks at the openness of firms and economies to labour from 'outside'. In some cases this is an issue of knowledge – in the form of highly-skilled labour – while in others it is a matter of large numbers of semi-skilled workers. Particular issues considered are the link between the availability of domestic human capital and the openness of economies or firms towards the employment of foreign workers, which can serve as an alternative means of gaining human capital conducive

to innovation or upgrading. In fast-growing sectors or sectors under pressure of structural transition, the availability of a varied pool of workers might be essential, yet hard to provide in the (relatively) small labour markets of Central and Eastern Europe. Questions considered in this theme relate to how MNCs deal with the very different issues of employing foreign managers and of finding an adequate and flexible body of semi-skilled workers when setting-up or expanding production in CEE, or under what conditions do indigenous software companies decide to internationalise, aiming to understand the link between the localisation of production and the localisation of knowledge. Equally important was the attempt to gain micro-level evidence about the variety of skills that are demanded along different parts of sectoral value chains or in R&D complexity. Immigration policy was one key institutional area to consider in this section. The questions of openness are also more generally related to the relative importance of labour market regulation for the two industries (unionised/automotive versus non-unionised/IT) and different skill groups within these (management versus assembly line workforce), and the degree to which migrant labour serves functional flexibility purposes.

A third aspect which we considered in the common framework was the importance of geographical clustering of firms into innovative communities characterised by fluid horizontal networks, linkages to universities and supportive local and regional governments (Ibata-Arens, 2003). This has been argued in the literature as a key factor for knowledge-sharing across industries. In addition, in the automotive sector, due to the shift towards lean manufacturing and just-in-time delivery, the geographical closeness of the mother-firm and subcontractors has become a characteristic feature of the industry. This, however, also leads to issues of competition for the best workforce (reducing the stability of the labour force) which creates pressure for companies to set up branches in locations some distance from potential rivals in the labour market. In the context of labour shortages, which have been characteristic for both industries and all three countries, geographical clustering, its benefits, disadvantages and effects are important considerations.

Employment and labour-market flexibility is a cross-cutting issue that comes back in the three overarching themes. We will show that flexibility takes a different form in the two sectors. While flexibility might not be directly related to the innovation process as such, it has contributed to the increased competitiveness of the two sectors in global competition and supported a shift up-market in their sophistication. Labour flexibility was also a key factor in helping the automotive industry, especially, survive the economic crisis. Given that CEE economies have moved from a peripheral position closer to the economic core over the last two decades, the contribution of flexibility to this process is important to consider, and it has naturally surfaced as an issue in our empirical investigation as well. Labour market flexibility emerges more directly in two other ways as well: it is relevant in the cases where innovation requires labour force adjustment, while it is also thought to play a role in providing firms and employees incentives for training and learning that might vary depending on the degree of restrictions on hiring and firing (Bassanini & Ernst, 2002; Kleinknecht, 1998).

Concerning the structure of our sectoral studies, the performance of the industries analysed can be linked to specific leading companies. For this reason, as well as feasibility purposes, each sectoral study, in addition to the general sectoral overview,

offers case studies of specific firms. The automotive study analyses all operations of the largest German automotive multinational corporations (MNCs) in Hungary and the Czech Republic in 1989-2012. The companies included the Volkswagen group, Bosch (both active in the Czech Republic and Hungary), and Daimler Benz (active in Hungary only). The choice of German MNCs is partly motivated by their presence on a substantial scale over a number of years. They have the largest presence and the most experience, enabling them to learn how best to live with legal and institutional environments. The selection of one country of origin also means that possible differences in behaviour cannot be attributed to country-of-origin effects. We selected the Czech Republic and Hungary with the longest large-scale presence of foreign MNCs. Software industry analysis looks in detail at three anti-virus firms based in former Czechoslovakia: the Czech-based AVG (former Grisoft) and Avast (former Alwil), and the Slovak ESET. These firms have been positioned among the five most widely sold anti-virus products worldwide over the last few years, controlling about 30-40% of the world security software market. The firms were established in the late 1980s independently by Czech and Slovak engineers and since then have expanded into the world markets, employing hundreds of research staff home and abroad.

In the general sectoral overviews we used mainly secondary resources (third-party analyses), publicly available data (annual reports and other company publications, media reports, publicly available statistics), and these were supported by expert opinions generated through the interviews. Interviews were the key source of data and information in the firm-analyses part, supported further by publicly available material, through workplace periodicals and websites. The automotive case study relies mainly on discussions with labour union members, both on the level of individual plants and in national union organizations. The software industry case study is built on semi-structured interviews with various persons knowledgeable about the field, ranging from the management of leading domestic and foreign IT firms, representatives of IT associations in the Czech Republic and Slovakia, venture capitalists and the investment agencies (CzechInvest and SARIO). These were conducted during March-June 2012.

This reports aim to contribute to so far scarce academic works studying processes of production and the location of knowledge-intensive activities in emerging economies. Additionally, its findings could enrich policy work by pointing out areas that should warrant financial or regulatory support and intervention, if more R&D and innovation is to take place in Central and Eastern Europe or other countries at similar levels of development and with similar structural characteristics. The rest of the report outlines two sectoral studies, starting with the automotive sector, each of which is structured into a coherent piece of work with its own structure, logic, particular arguments and findings. In the conclusions we summarise the findings with respect to the three broad themes outlined above, and point out similarities and contradictions between the two sectors.

## **Part A. The automotive industry: employment relations with imported technology**

### ***I. Introduction***

The motor vehicle sector has grown rapidly in Central and Eastern Europe thanks to inward investment by major multinational companies (MNCs). Only Czechoslovakia produced fully indigenous passenger cars in the state socialist period, but motor vehicles and components were produced to some extent in all countries. By 2006, total output for the four countries grouped together here had reached almost 2 million, from under half a million in 1990 (Pavlínek, 2008, p. 14), with a strong orientation towards exports. This was therefore one of the major sources of technological advance in manufacturing industries, with that advance being heavily dependent on imported technology.

Our concern here is with the links between technological innovation and labour regimes. We find that MNCs faced problems of finding an adequate labour force with appropriate skills. The appropriate skill levels depended on the kinds of activities they were undertaking, and in turn the availability of skills could restrict the activities the MNC intended to undertake. Apart from numbers of employees, MNCs were also concerned to ensure a reliable and flexible enough labour force to cope with frequent fluctuations in demand for particular products. Numerical and functional flexibility represents a key labour regime issue in a sector where innovation occurs through the coordination of thousands of workers involved in mass production, often in other parts of the world. Flexibility depended on the results of bargaining with employee representatives and on existing employment law. Problems of labour flexibility commonly dog the motor-vehicle sector, but they were especially acute during the conditions of economic crisis starting in 2008. Labour flexibility was a key factor in helping the industry survive the economic crisis and reconstitute its comparative advantage. We therefore devote considerable attention to how companies coped during that period, using this as a helpful guide to the nature and impact of employment relations systems.

We analysed all operations of the largest German automotive multinational corporations (MNCs) in Hungary and the Czech Republic in 1989-2012. The companies included the Volkswagen group, Bosch (both active in the Czech Republic and Hungary), and Daimler Benz (active in Hungary with only a minor operation in the Czech Republic). This allowed us to analyse effects of a) belonging to a MNC, b) host-country labour market and institutional environment (by comparing subsidiaries of individual multinational in the two countries), and c) location-specific factors. We decided to control for the possible country-of-origin effects by analysing German MNCs only. The choice of German MNCs is partly motivated by their presence on a substantial scale across the region for a number of years. We selected the Czech Republic and Hungary as these are countries where different German MNCs are particularly active. Hungary is a country with relatively low levels of employment protection legislation, while the Czech Republic represents an East European country

with higher levels of employment protection (for detailed comparisons, see Beblavy et al., 2011). Moreover, the Hungarian labour code includes flexible work accounts that are deemed as particularly desirable by German automotive MNCs. The Czech labour code includes provision for flexible work accounts in a significantly more restricted form than is permitted in Germany.

Data sources included secondary resources (third-party analyses), publicly available data (annual reports and other company publications, reports in media, publicly available statistics), and interviews with labour union members, both on the level of individual plants and in national union organisations, plus the use of their publicly available material, through workplace periodicals and websites. We used mainly company information and secondary resources to get the perspective of the management (e.g. Bluhm, 2007; Šćepanović, 2011). The people we interviewed were promised (and often explicitly required) to remain anonymous. As a result, some of those claims are not supported by direct citations.

Employment and labour-market flexibility and industrial relations are labour-regime aspects that are directly influenced by local institutions and regulations. Labour market regulations did differ between the Czech Republic and Hungary. Forms of employee representation also differed and that was quoted as a reason for choosing a Hungarian location in one case. However, this does not seem to have discouraged the expansion of activities in the Czech Republic. Hungary had also introduced the flexible work accounts that the German MNCs consistently demand in all East European countries, allowing MNCs to deal with the fluctuation of demand while retaining access to a skilled workforce. However, the strategies of individual plants to deal with these two requirements varied within the countries. At the same time, strategies of individual subsidiaries of a single MNC differed between the countries without any clear link to domestic institutions. The employment of agency workers was a popular strategy to deal with the flexibility problem, but again, the variation on the reliance on agency workers did not correspond to the differences in host-country institutions. The case study evidence rather suggests that rules and practices relating to employment are of limited importance in determining MNCs' investment decisions and hence in determining the adoption of new technologies. Broad issues of an adequate labour supply at a substantially lower cost than in Germany are dominant. They can be solved and that allows for investment in production. The transfer of R&D is much more limited, but the limitation is probably as much a matter of MNCs' strategies as of the adequacy of domestic labour forces.

In what follows, we first introduce the evolution of the automotive sector in the region. Particular emphasis is put on the innovation content of the respective activities. We then analyse the clustering of these activities, particularly as far as R&D is concerned. The following section then introduces the German automotive multinationals and their Central and Eastern European activities, which we analysed in more detail. The findings are then presented in sections analysing the ways the companies ensure access to skilled labour (through tapping into local labour supply, importing labour, and/or through education/training), organise flexible production and relations with labour more generally, and deal with the impact of the crisis.

## II. Motor vehicle production in Central and Eastern Europe

The motor vehicle sectors in Central and Eastern Europe grew partly from the transformation of a base inherited from the past and partly from scratch.<sup>2</sup> Where the latter predominated, the sector largely grew, as in emerging countries that depended on inward investment. It was biased either towards the production of final vehicles, with large trade deficits on components, or towards components, leaving a large deficit on finished vehicles. Both Hungary and Slovakia followed this route and experienced, at a certain point, quite sudden growth linked to inward investment. In Hungary, where practically no passenger cars were made between 1945 and 1989, new investment by Suzuki, the VW group, Opel and Ford turned the trade deficit into a rapidly growing surplus. Slovakia too showed a surplus by 1998, following a sharp rise in the export of cars assembled by Volkswagen. The importance of the sector for CEEC economies is demonstrated in Table A.1 which shows the period of rapid inward investment. Production prior to that was best established in the Czech Republic, but the trend towards a growing trade surplus is very clear in this period in all cases.

Table A.1 Percentage shares of motor vehicle production in industrial output and industrial exports and its contribution to the trade balance

	1999	2004	2008
Czech Republic			
Share in industrial exports	15.9	15.6	16.6
Trade balance, million euros	1609.6	3114.5	7093.3
Hungary			
Share in industrial production	13.1	13.4	17.8
Share in industrial exports	20.5	15.4	19.9
Trade balance, million euros	1154.7	200.5	4641.4
Poland			
Share in industrial production	5.9	8.9	10.5
Share in industrial exports	9.2	17.1	17.3
Trade balance, million euros	-2408.7	1804.9	4201.9
Slovakia			
Share in industrial production	8.0	13.1	21.3
Share in industrial exports	19.5	23.6	22.8
Trade balance, million euros	641.5	1431.3	3458.3

Source: Eurostat, COMEXT database.

<sup>2</sup> Pavlínek (2002a, 2002b, 2002c, 2002d, 2003, 2008); Pavlínek, Domański & Guzik (2009); Pavlínek & Janák (2007); Pavlínek & Ženka (2010); Domański (2001); Domański (2003); Domański (2005); Domański & Gwosdz (2009); Myant et al. (1996); Myant (2003); Drahokoupil (2008); Bernaciak & Šćepanović (2010); Myant & Drahokoupil (2011b); Šćepanović (2011); Kurekova (2012a).

Firms were attracted by the industrial base, by transport links and by a general desire to have a presence in a potentially significant market. They could, as emphasised by the Czech former government minister who headed Opel's eastern European operations, have considered any CEE country for these kinds of investment. Hungary was the most welcoming for greenfield investments at the start.<sup>3</sup>

The Czech Republic, uniquely and consistently from the start, recorded a trade surplus for the sector as a whole, thanks to an ability to export components and vehicles apart from passenger cars. Kilogram prices, an indicator of product sophistication, were well below the German level, but comparable with those of South Korea. The Volkswagen takeover of the Škoda car manufacturer brought obvious benefits in terms of export volume, but the kilogram price of passenger cars in 1996, at only 46% of the German level, or 56% of the UK level, was little different from the relative position in the decades preceding 1989. It was also low relative to other Central and Eastern European Countries, which have developed their motor industries around the assembly of final products under world brand names (Myant, 2003, Chapter 13).

Incorporation into MNC networks brought about an upgrading of car assembly product types, or a start at a high grade where production was previously based on completely imported technology. Thus, in the late 1990s, CEEC production profiles became more similar to those of advanced West European producers, although their positions could still be described as peripheral, with a bias towards low-value-added and labour-intensive production (Pavlínek, Domański & Guzik, 2009; cf. Kurekova, 2012a). This has been linked to the organisational changes within the sector. The producers started to employ platform-based production, standardising interior components across individual brands controlled by an MNC. This ruled out much individuality for CEEC producers, but also made the value chain more flexible and production more mobile, providing opportunities for product upgrading and thus putting CEEC locations in direct competition with western sites.

Differences between countries in passenger-car assembly largely relate to the specificity of the Škoda car manufacturer. As indicated, Czech cars are exported at relatively low kilogram prices, but that does not indicate inefficient production methods. It rather reflects the kinds of cars made in the Czech Republic. Small cars are generally associated with lower profits and lower kilogram prices. The Czech motor-vehicle complex grew from a base of producing small cars using domestically-produced components. The industries in Hungary and Slovakia grew around the manufacture of particular components for export or assembly of finished cars using high shares of imported components. The specificity of Škoda's history and production profile is in turn reflected in a specific position in relation to R&D.

R&D development has been limited in the CEEC automotive industry, with only highly selected functional upgrading on the plant level (Pavlínek & Ženka, 2010; Pavlínek, 2012). Experience has shown that foreign control over the industry and the spatial organisation of international R&D undermine the potential for the successful development of R&D in the CEEC automotive industry (Pavlínek, 2012). Those countries are in a weak bargaining position to persuade MNCs to establish higher-level

<sup>3</sup> A. Barčák, *Hospodářské noviny*, 7 April 2000.

functions like R&D activities, on account of small domestic markets (so that their industries will only be successful with a high proportion of exported output) and weak histories of R&D activity. In general, automotive R&D remains highly concentrated.

This is due to the nature of production networks in car manufacturing: a typical example of the quasi-hierarchical or captive network, with leading firms having a key role and power over component suppliers. Quasi-hierarchical value chains offer favourable conditions for process and product upgrading but hinder functional upgrading in less developed countries (Humphrey & Schmitz, 2004). Thus, the automotive R&D, conducted by leading suppliers, has become more spatially concentrated near lead firms' R&D sites in Western Europe and this has been reinforced by platform-based production. Regional branches, with their own brands, are left with responsibility only over those parts of the car that are brand-specific, and those tend to demand less research input.

Thus, Central and Eastern Europe constitutes an 'adopter' region that has developed production-oriented competencies through the transfer of technology and know-how from the automotive core in the 1990s and 2000s. By 2007, the low automotive R&D expenditures, combined with a high share of these expenditures devoted to automotive components,<sup>4</sup> indicates the predominance of low-level development work, concentrating on product modifications for local assemblers and the technical support of local production. Indeed, most of the activity recorded as R&D represents development supporting production in assembly plants – each plant needs such a development unit – and some localisation of products. The example of Škoda stands out here; modifying the outside of the car, while the interior design is developed elsewhere. Indeed, 70% of automotive R&D expenditure in Central and Eastern Europe is undertaken in the Czech Republic, 12.1% in Hungary and 8.5% in Romania. Table A.2 shows R&D activity compared with Germany; clearly confirming a marked difference to the most advanced countries in Western Europe and the differences across Central and Eastern Europe.

Table A.2 Percentage shares of motor vehicle sector in R&D, 2007

	R&D expenditure/ value added	R&D employment/ total employment
Germany	24.0	9.8
Czech Republic	6.7	2.7
Hungary	1.8	1.6
Poland	0.7	0.8
Slovakia	0.2	0.2

Source: Pavlínek (2012), p. 288.

<sup>4</sup> The share of R&D dedicated to automotive components was very high in Slovakia (100%), Poland (92%), Hungary (91%) and Slovenia (70%). However, in the Czech Republic 75% of automotive R&D was devoted to automobiles rather than components (Eurostat data in Pavlínek (2012), pp. 290–291).

The Czech Republic and Romania contain two regional development centres for MNCs. Both have their origins in an MNC takeover of an existing car manufacturer, leaving local production there for a time and thus requiring a continuation of independent R&D. These are based on Škoda and its suppliers and Dacia-Renault in the Bucharest-Pitesti region. Škoda and Dacia develop not only regional modifications – the outside of the car – as Škoda is also responsible for developing motors for small cars for the whole VW group. Renault transferred the development of the whole small-car platform to the Bucharest-Pitesti region (Dacia/Renault) in Romania. However, according to Pavlínek, this is not basic research. Škoda is in charge of development and testing of a very specific 3-cylinder motor which is used only in small cars. Much of what they are doing involves incremental innovations. They are not in charge of developing a completely new type of motor for small cars: electric and hybrid motors are dependent on research elsewhere. Similarly, Dacia is in charge of the incremental innovations for a platform developed in France.

Thus, the specifics of history have influenced the location of R&D and innovations and how they are spread across locations and countries. This overshadows any influence from differences in labour regimes, apart from the shortage of local capability in the sense of an adequate supply of qualified labour. In the case of Škoda, that problem was alleviated at the start by the existing R&D centre, which grew further under Volkswagen ownership. The pattern in the sector is consistent with the expected implications of the (quasi-)hierarchical nature of the automotive production network (analysed systematically in Pavlínek, 2012).

### **III. Clusters and R&D**

Innovation and technological advance have often been linked to the concept of clusters (for a critical view on cluster theory, see Martin & Sunley, 2003). Firms located in geographical proximity to each other are well-placed to succeed, it is argued, thanks to direct links between production activities, the sharing of ideas and knowledge, sharing a pool of skilled labour and the direct benefits of cooperation in varied activities, such as research and marketing. However, the concept of the cluster remains ill-defined. It has developed from the observation of successful firms that often develop when close to each other. That empirical observation remains to be linked to a theory, or theories, which explain the phenomenon and for this there are a large number of somewhat different possibilities that relate to different cases. Indeed, the advantages of clustering may be a matter of firms coming together, not to benefit from each other's presence, but because of some other locational advantage. There are even clear pressures in some cases for firms to choose locations well away from each other, so as to have greater control over a limited labour force or to start with a fresh and less-experienced labour force that could be more amenable to accepting management preferences on work organisation.

Thus, inward investment by MNCs need not follow the route of cluster formation. The development of the Czech motor-vehicle sector could also be seen as a process of cluster disintegration as the vertical integration of producers within the country was gradually replaced by the integration of individual plants into diverse international networks. Initially the Škoda car manufacturer stood at the centre of networks; the only significant producer of passenger cars with an output of 183,000 vehicles in 1989 and

using inputs from most of Czechoslovakia's 250 component producers. Over the following 20 years it increased output, but also lost its unique position as the only major car assembler. It also lost its central position in a Czech (or Czechoslovak) production network. As it moved from completely distinct models to build from common VW platforms, the proportion of imported components increased.

However, in view of the degree of individuality that it retained in car exteriors, Škoda also retained and expanded its R&D potential, with over 1,000 specialists in development work by 1999. The view was that Czech labour was adequately qualified and accepted lower pay than the equivalent German workers.<sup>5</sup> The converse argument could also apply: because this R&D base was available, Škoda continued to launch new and distinct models that were developed in Mladá Boleslav, albeit using many of the parts most dependent on research in common with other Volkswagen models.

Even for the parts rejected by Volkswagen, the component sector was not forced into decline. By 2001 it was estimated that 300 Czech firms were supplying the motor industry. An industry had developed that had progressively separated itself from dependence on Škoda and found a place supplying motor manufacturers in Central and Eastern Europe, Germany and even across the Atlantic.

Within this a differentiation can be made into four broad kinds of firm. The first are those firms that retained their links with Škoda, albeit invariably broadening their horizons to supply a wider range of vehicle producers. The second are those that linked immediately into another multinational company without paying much further attention to Škoda. A leading force in this trend was the German firm Bosch which set up three joint ventures with different Czech companies in 1992, all of which led to full control and all of which were strongly export-oriented.

The third grouping are those firms that continued without a foreign partner. These often lost Škoda contracts and were forced to seek alternative production programmes. Success along this route was rare; one of the few examples being the spark-plug manufacturer Brisk of Tábor which proved remarkably resilient and continued to improve products with its independent R&D activity.

The fourth kind of component supplier came without any close link to the former Czech motor industry. They generally took advantage of low labour costs, relative to Germany, to manufacture less sophisticated products. An early important example was Siemens, which started producing wiring systems in December 1992 in a factory in Stříbro rented from Škoda-Plzeň (no connection to the car manufacturer). This was a labour-intensive process, suggesting that the first consideration was to gain the benefits of the cheap labour force without too great an initial commitment. The chosen site was within easy reach of Munich. Employment grew to 2,700 but the operation was sold in 2001 after the loss of a contract with Seat.

Other investors followed this model during the 1990s, starting with 20 on greenfield sites by early 1997. Beginnings were often very small, starting with a cautious testing of the water, but a steady increase led to a sharp upsurge from 2000 onwards, with firms

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<sup>5</sup> V. Kohler, *Právo*, 4 May 1996.

coming from Japan, Spain and Mexico as well as the USA and Western Europe. Typically, these firms aimed to export all, or nearly all, of their output.

The appearance of other major assembly plants (Toyota-Peugeot in 2005 and Hyundai in 2009) reflected a newfound confidence in the CEEC location. It had the continuing benefits of transport links and lower labour costs than Western Europe. Proximity to established component manufacturers was also of value, but any 'clustering' should be seen partly as a result of common benefits for the region, and partly as a result of pioneers demonstrating that problems of regular component delivery, an adequate labour force and reasonable labour flexibility could be resolved in the Czech environment.

#### ***IV. German automotive multinationals in Central and Eastern Europe***

The following sections consider the means of resolving access to skilled and flexible labour in the case of different MNCs that have established production facilities in several Central and Eastern European countries. We follow cases of investment by three German MNCs – Bosch, Daimler-Benz, and the Volkswagen Group – in two countries, the Czech Republic and Hungary, concentrating on five major plants. This section provides an overview of the evolution of individual plants.

##### *i. Bosch Diesel, Jihlava, Czech Republic*

The operations of automotive manufacturing by the Bosch group in the Czech Republic started cautiously, within the protection from the cluster of suppliers to the Škoda car manufacturer. A joint venture was set up with the component manufacturer Motor Jikov of České Budějovice in March 1992, and by 1993 it was supplying engine parts for Škoda. In 1995 Bosch became the 100% owner of its own enterprise. Motor Jikov continued as a separate company. Initially, when still a joint venture, Bosch had 244 employees, but this grew rapidly to 1,659 by 2000. Expansion continued with some interruption due to the 2008 economic crisis, but general plans for expansion remained in place. New plant construction set in motion in 2011 was intended to increase employment to 3,000.

By 2000 it was producing 90% for export and looking to transfer whole production programmes from Germany. In practice it preferred to copy rather than replace German operations: it was, in the words of the plant manager 'comparable' to the equivalent German plant.<sup>6</sup> In 2005 it set up a development and testing centre for a small range of products. Subsequent expansion plans set a target of 360 for the development centre, of which 95% would have university-level qualifications. This was not a base for primary research, but rather a facility for ensuring the adaptation of products to particular customer requirements.

In 1993 Bosch also set up a joint venture with Motorpal of Jihlava, a component manufacturer for the goods-vehicle sector. Bosch later took full ownership, expanding its operation to 600 employees in 2,000, transferring diesel engine production from Germany and exporting all its output. Unsatisfactory results from sub-contracting to Czech firms convinced management that they needed to take full control over their

<sup>6</sup> Milan Šlachta, quoted in [www.autofax.cz](http://www.autofax.cz), 11 October 2011.

production processes. They undertook substantial investment, reaching an employment level of over 6,000 by 2008.

*ii. Bosch, Hungary*

Hungary represents an important location for Bosch. Its component plants in Hatvan, Miskolc, and Eger supply major car manufacturers in Europe and also globally. There is also an R&D centre in Budapest. The production range and employment of the Bosch group were expanding both before and after the crisis of 2008.

The plant in Hatvan is the biggest Hungarian production site of the automotive division within the Bosch group, with over 3,000 employees in 2012. It started its operations in Hatvan in 1998, manufacturing transmission control units. Its product range expanded to include different types of control units for automatic transmissions: ABS, airbags, electrohydraulic servo steering, body electronics, board computers, ESP and complete dashboards. The 2001 acquisition of Mannesmann Rexroth brought the pneumatic production factory in Eger into the Bosch group. The pneumatic production in Eger had a tradition dating back to 1967. Bosch then continued developing the activities in Eger, relocating to a greenfield site from 2003. The group opened another greenfield site in Miskolc in 2003, producing electronic components, starter motors, relays and drives. In 2007, the production of starter motors started at the Miskolc plant. In 2005, an independent R&D centre was opened in Budapest, specialising in electronic and mechanical vehicle components. By 2012, employment there rose to 700 engineers (from 150 in 2005). In 2011, the company opened a second plant producing energy and body systems in Miskolc.

*iii. Volkswagen in the Czech Republic*

Volkswagen came into the Czech Republic by buying the Škoda car manufacturer, first with a part-share in a joint venture and then as the sole owner. This brought control over three production centres, the main one in Mladá Boleslav and two smaller branches in Vrchlabí and Kvasiny. There was an initial commitment to continue production under the Škoda brand name and to develop new models. This commitment was fulfilled and output rose, albeit with a few setbacks along the way, to 623,291 vehicles in 2007. The plan then was to reach 1 million vehicles within a few years, partly by higher domestic output, helped by government investment incentives and above all by government investment in the necessary transport and housing, and partly by higher output in recently-established subsidiaries in India and China.

The bulk of employees are at best semi-skilled. Škoda reported that 11.7% of employees in 2010 had followed higher education – probably a significantly higher proportion than in other manufacturers as 6.8% of the workforce were employed in R&D – and 54.9% with no formal qualification (i.e., no secondary school graduation).<sup>7</sup>

*iv. Volkswagen group in Hungary (Audi)*

The Volkswagen group established a greenfield operation in 1993 in Győr, a region with a long industrial tradition. The plant produced 1.6-5.2 litre motors for the

<sup>7</sup> Škoda Výroční zpráva, 2010, p. 89.

European producers of the Volkswagen group, including Audi, Volkswagen, Seat, Porsche, Lamborghini and Bentley. In 1998, an assembly plant for smaller Audi models was opened (it started with Audi TT, later included Audi A3 and from 2010 also Audi RS3). An R&D unit was opened in 2001, employing around 150 engineers to test and develop engines (the R&D centre can be classified as a local technical centre to support the assembly). By 2012, Audi Hungaria employed 7,322 employees. Construction of the new vehicle production plant started in 2012. The current engine manufacturing and vehicle assembly line was to expand into a vehicle production plant encompassing the entire manufacturing process in 2013, adding a further 2,100 jobs. Seventy engineers are expected to be hired by the R&D centre, which should also start developing machinery.

*v. Daimler-Benz in Hungary (Kecskemét)*

The decision to undertake this large greenfield investment in Kecskemét was made in 2008. Recruiting started in October 2009 and production started in February 2012. Kecskemét should function in one production network with the Benz plant in Rastatt, Germany. The B-Class (a small family car) and the CLS (an executive-size sedan) will be produced in Kecskemét. The G-class cross-country SUV is apparently considered for production in Hungary too. The factory will function as an assembly plant for the B-Class. In the case of the CLS, it will include a pressing unit producing the metal parts that constitute the body of the car. No substantial R&D activities were expected to take place in Kecskemét.

## **V. Access to skills and labour supply**

The choice of location by MNCs, both for production and for R&D, is influenced by the availability of skills, local education systems, and wage levels. Nevertheless, their importance should not be exaggerated. More specifically, Central and Eastern Europe has considerably lower wages and labour costs than Western Europe and that makes them attractive for activities that do not require the highest skill levels. However, labour costs are a small proportion of total costs for passenger-car assembly and for the production of more complex components. Moreover, alongside low labour costs MNCs require both an adequate number of skilled employees, including some specific skills and supervisors and managers, and also of less-skilled, but adequately disciplined, employees for production. Local supply of skilled employees is an important location aspect for R&D centres. Local education institutions and labour supply were less of a concern for other functions, with MNCs being able to solve their skill problems through various means, including importing labour. In fact, the bulk of employees required little by way of prior qualifications and in-company training was relatively simple and quick. The problem was quantity rather than quality. Even where that was not available in a particular travel-to-work area, MNCs found it profitable to choose Central and Eastern European locations and import labour. This depended as much on citizenship and immigration law as on employment law. As indicated below, the theme was taken up by MNCs, but the practical solution for the management was to use workers provided by agencies, as discussed in the next section.

The evidence from past expansion and continuing expansion plans suggests that, although skilled labour is perceived as a difficult area by managements, it is not a

barrier to further expansion. For posts requiring higher education it is common to require knowledge of German or English and to include a training period in Germany or another major branch of the company. There is minimal importing of the most qualified labour and expatriates are used in the most senior management positions, typically spending periods of only a few years in different branches of the same company. Again, by offering high enough pay and by offering to finance some students through their studies, MNCs are able to recruit enough labour to justify continued plans for expansion of production.

Access to skilled labour became a chronic problem with the rapid expansion around and after 2000, and solutions differed depending on the skill levels. German companies complained of difficulty in recruiting employees with technical qualifications and preferred to introduce what was effectively the German system of vocational training across the country. There was no enthusiasm for this solution on the part of the Czech education authorities. The alternative was for companies to devote resources to training their own employees, often linking up with the education system in that country, but some of the largest MNCs also developed independent facilities of their own. There was possible support from EU grants, but the numbers trained explicitly for a particular company remained small.

*i. Bosch Diesel, Jihlava, Czech Republic*

An adequately trained labour force was not a problem at the start: it came with the joint-venture agreements. A numerically adequate labour supply continued to be available within reasonable travelling distance of Jihlava. To ensure adequate skill levels, Bosch in Jihlava set up an education centre providing the practical side of apprenticeships while a school outside taught theory. The numbers required were not large, with only 72 from the highly-publicised programme running with EU funding 2005-2007 (<http://www.bosch.cz>). They advertised benefits for incoming qualified employees, including interest-free loans, allowances to cover housing costs, a company nursery school, sporting and social activities and Bosch products at reduced prices. That was enough to attract the required number of employees with the highest skill levels for a plant that had no development work attached.

They, unlike many other companies, did not use agency workers. This was opposed by the union organisations, despite being the favoured solution for unions in many other plants. The choice of an alternative may also have reflected the specific location, in an area of relatively high unemployment that ensured a satisfactory supply of labour. The union organisations were happy to support an alternative means of achieving numerical flexibility through use of fixed-term contracts; a less popular measure in other similar branch plants of large MNCs.

*ii. Bosch in Hungary*

Bosch's plants typically do not offer wages that would substantially exceed regional averages. They tend to employ a less educated workforce, with many workers having elementary education only. The research centre in Budapest employs workers with university degrees. At the same time, approximately 160 engineers are working at

Bosch's two factories in Miskolc and approximately 300 engineers are employed in Hatvan.

The company developed cooperation with vocational schools where its plants are located. In Miskolc, for instance, the Gyula Andrássy vocational school prepares students for work in the local plant in a three-year programme.<sup>8</sup> Bosch also maintains relations with the University of Miskolc, sponsoring a *Lehrstuhl* (professorship) there, and the Budapest University of Technology and Economics.

The company relies heavily on agency workers to be able to react to fluctuations in demand.

### *iii. Volkswagen in the Czech Republic*

Although taking over a going concern, Volkswagen faced continual difficulties with recruiting an adequate labour force. There had always been labour shortages, leading in the past to use of foreign workers and prisoners. Škoda claimed to provide in-company training to 90% of employees, supplementing qualifications from schools and universities. Its own apprenticeship centre produced about 300 trained personnel annually. The company opened its own 'university' in 2000 with about 1,000 students in 2011, but this was effectively using the company name to promote a private university which focused only on management, rather than technical, subjects. About 100 of the students were employees of the company studying part-time.<sup>9</sup>

The problem of an adequate supply of less-skilled labour became more serious as new motor manufacturers and electronics firms came into the Czech Republic around the time of EU accession. The management sought government help for a solution based on 'managed immigration' from countries with similar languages, because "the Czech population is no longer capable of supplying a labour force".<sup>10</sup> However, it was not the company's intention to recruit in these countries. They were, it claimed, to be attracted by the government with a policy that enabled them to work and settle permanently in the Czech Republic. Government thinking gave some consideration to trying to encourage immigration by the most qualified, but shortages of less-skilled labour were solved by temporary immigration facilitated by employment agencies, themselves often multinational companies.

The most skilled labour was needed for the company's development centre. This was built from the R&D potential inherited from before 1989. Its primary purpose was the development of cars specific to the Škoda group. It therefore expanded with the development of larger cars (the Octavia) and then a four-track vehicle (the Yeti). By 2007 the centre had 1,400 employees, of whom 1,000 were qualified to university level<sup>11</sup> and ranked as one of 18 such centres within the Volkswagen group. However, in this

<sup>8</sup> See <http://www.hrportal.hu/c/miskolcon-is-oktat-a-bosch-20110831.html> and <http://www.agysz-miskolc.hu/index.php?oldal=bosch>.

<sup>9</sup> Škoda Výroční zpráva, 2010, p. 34 ([www.skoda-auto.cz](http://www.skoda-auto.cz)).

<sup>10</sup> V. Kaláb, quoting M. Jahn, *Hospodářské noviny*, 2 October 2006, p. 17.

<sup>11</sup> D. Wittig, *Ekonom*, No. 7, 2007, p. 38.

case there was minimal rivalry for employees from other inward investors as all others in motor vehicle assembly were producing models designed and developed elsewhere.

*iv. Volkswagen Group in Hungary (Audi)*

Audi offers salaries that are substantially higher than the regional average. It also offers roughly 50% more than Daimler in early 2012. The difference with Bosch is even bigger. The company did not report any major problems with hiring a new labour force. The only exception was recruiting highly skilled engineers, but even that was not considered dramatic. Most of the labour force comes from the Győr region (a distance of 80k or less). There are also some people from Miskolc or other former industrial centres of Hungary. Employees are on average relatively highly qualified. According to a trade union leader, the workers with a university degree constitute 35-40% of labour force. The rest have full secondary or three-year vocational training.

It takes approximately three months to train a worker to be able to work on the production line. This is, according to local union estimates, also the case in other plants. When a new line is built, it takes 12 months to create a team that will be able to properly work that line.

Reports from the early 2000s suggest that the company was doing little investment in human resources, preferring to import workers from Slovakia to solve skill availability problems (Galgóczi, 2003). In 2012, dual training was reported to function well by both unions and the employer. In 2001, Audi began cooperation with the Lukács Sándor Vocational School in Győr, providing the school with equipment and accepting apprentices on a six-month practice. The cooperation was then extended to two other schools. Audi's own training facility was opened in late 2011. The number of work placements, however, remained relatively small: in 2009, Audi offered places to about 80 apprentices (Audi Hungaria Annual Report 2010). In 2010, out of the 62 vocationally trained, 53 continued their career at Audi while others chose to continue their studies. In 2012, 190 students were trained within the framework of modular vocational training. Out of these 190, 20 started their training at the Audi training centre.

There is also a cooperation with Széchenyi István University in Győr. There is a chair sponsored by the company from 2007: Audi Hungaria Internal-Combustion Engines Department. The students have an opportunity to write their thesis at Audi. The chair was extended to an Audi Hungaria Automotive Engineering Departmental Group at the end of 2011.

*v. Daimler-Benz in Hungary (Kecskemét)*

The workers underwent company training organised in Germany. A large number of employees therefore first received language training (100-250 hours) during the first 1.5 months. The training in German plants took 3-12 (exceptionally 18) months. Assembly line workers received three-month training. A major concern was for the workers to learn to work in line with 'takt time' – the time allotted for each station on a moving assembly line – and to familiarise themselves with the necessary specific movements while performing their tasks. As the preparation of production in Kecskemét proceeded, the workers performing the simplest tasks were no longer sent for training

abroad. Workers with some managerial responsibility would still receive training in Germany.

The company established its own training centre, providing training for both manual and white-collar workers. There is also an agreement with the Kecskemét Integrated Vocational Training Centre that provides a three-year course (not leading to a secondary-education certificate). Moreover, Daimler established cooperation with the local university of applied sciences (GAMF) in November 2010. There will be a new specialisation in automotive engineering opened in 2012, structured along the German dual principle.

Daimler uses a private recruitment agency that can also lend workers, but the agency workers are rarely used. None of the manual workers were agency workers in early 2012. At the same time, trade unions would not object to using agency workers as they see this as a way of facing fluctuations in demand.

## ***VI. Flexibility and labour relations***

MNCs also seek flexibility to cope with changes in production plans and short-term fluctuations in demand for particular products. The scope for this, and the means companies can use, depend on employment laws and practices in particular countries, but any existing restrictions on flexibility appear not to have discouraged investment or to have had a significant influence on the choice of location for new investment. Problems have typically been solved by provision for fluctuations of working time for permanent employees plus an element of dualism, creating a stable core workforce alongside a flexible periphery. This is also a basis for solving the labour shortage problem, albeit only for the lesser-skilled employees.

In all the cases considered below, employees are represented by trade unions which bargain on their behalf. Bargaining systems vary slightly between countries. In Hungary a system of German-style works councils is required by law. In other Central and Eastern European countries union organisations sign binding, collective agreements with enterprise managements, leaving other representative bodies with peripheral roles. Collective bargaining and union representation is protected by law and union organisations have contacts across international borders within the same company, both through their union centres and through European Works Councils in the larger MNCs. Such international cooperation was unimportant in the early 1990s, but took on greater significance as western, especially German, unions sought to attenuate cross-border competitive pressure and eliminate the East-West benchmarking threat (Bernaciak & Šćepanović, 2010).

Nevertheless, the results of bargaining vary considerably even between plants of the same MNCs, be they in the same or a different country. There are wide variations in wage levels between branches of the same company in different countries, not just in absolute terms but also in terms of placing in the pay hierarchy among manufacturing plants. Outcomes on key elements of flexibility show similar variations. They appear to depend on the preferences of individuals who strike particular agreements. Personnel managers typically come for a short period from Germany and their priority is to reach agreements that can ensure the required flow of production. The pressure to cut labour

costs is weaker. The preferences and determination of union representatives can therefore make a substantial difference.

This is reflected in differences over agreements on shift patterns. The key issue here is preference on the part of German MNCs for flexible work accounts. Under German law these make it possible to vary working hours, with more work in one period and less in another, evening out only over the whole period of an employee's employment. Something similar in Czech employment law had been requested for many years by German firms and was partially introduced in the 2007 Labour Code, albeit in a form that still left them dissatisfied. Employees would receive 80% of pay when on short-time working and would make this up in later weeks over a six month period, extendable to one year if unions agreed. If employers could not provide work to make up the difference, then they had to pay full wages anyway. The theme is pursued below in the individual case studies.

*i. Bosch Diesel, Jihlava, Czech Republic*

In the early years employment and labour relations issues were not major concerns. Adequately skilled labour came with the joint-venture agreements and employment practices were as in Czech, state-owned firms. The local Bosch management in Jihlava chose to discourage union organisation in its operation, until that led to a major and potentially highly damaging conflict in 2001.<sup>12</sup> The issue was sparked by an attempt by a group of employees to set up a union organisation. The management supported and encouraged a counter demonstration which ended in violence, leading to harmful national publicity and threats of legal action over involvement in opposing trade union rights and possibly even in supporting disorder and violence. Negotiations then led to a compromise in which legal actions were dropped, but union organisations were allowed and recognised. By 2008, probably about one third of the workforce was union members, albeit weakened by a division into two branches of the KOVO union.

*ii. Bosch in Hungary*

Trade unions exist in all plants. Most of them belong to the Vasas union, a part of the MSzOSz confederation of unions. Works councils are established at every Bosch plant, but none of the major plants has a collective agreement. Communication between the works councils of different Hungarian Bosch companies is rather weak and organised informally. The works council in Hatvan was set up in 1999 at the time when the company had 350 employees. The establishment of works councils was a management initiative, with the HR department providing technical support for the election process. Relations with the management are considered unproblematic<sup>13</sup> and there are no reports of industrial conflicts. The main matter of conflict is the level of wages, which is on average lower than in other car manufacturers. The councils tend to demand a rise in basic salary for blue-collar workers, using their consultation rights. There were also cases of unions pushing for wage increases, but in no case did it lead to a strike action.

<sup>12</sup> Mladá fronta dnes, 24 May 2001, 8 June 2001, 12 June 2001.

<sup>13</sup> See also <http://www.eurofound.europa.eu/pubdocs/2006/657/en/1/ef06657en.pdf>.

### iii. *Volkswagen in the Czech Republic*

Union organisations were inherited from the communist era and recognition was never an issue. Membership remained high, at around 70% of the core workforce in 2008 and members showed considerable commitment, for example with significant numbers taking part in token strikes and demonstrations against government policies when asked to. Unions also benefited from representation on the company's Supervisory Board, consistently securing the two elected seats out of six and using this as a basis for gaining information on the company's plans and performance. They also had contacts with unions throughout the Volkswagen group, although these operate mostly through infrequent meetings and did not lead to the harmonisation of procedures and conditions. The management had better contacts across the firm as personnel directors moved between branches, usually having started their careers in Germany.

Škoda had a long record of using foreign workers, going back well before 1989, to make up for labour shortages. After 1989 the system developed of private companies offering manpower, much of which they recruited abroad, initially in Poland and Slovakia but increasingly further East including Vietnam. These provided greater numerical flexibility, but were also used to fill persistent labour shortages, particularly in some of the more unpleasant parts of assembly plants. The number increased with rising demand to an average level of 4,680 in 2007; 16% of the total workforce. That was an exceptional figure across the Volkswagen group for which the average was under 5%.

Agency workers were not popular with the regular workforce, because they were judged to be poor workers, in some cases responsible for petty crime and unhygienic habits. The union position was that they were a better alternative than the loss of guaranteed permanent employment for the core workforce. There was periodic union concern over their employment conditions. They were not represented by the KOVO union and were not covered by collective agreements, but the union did set up an advice scheme for individual agency workers.

The issue received publicity that was potentially damaging to the company in early 2008 when a complaint from the Polish Ombudsman, representing Polish agency workers, was investigated by the Czech Ombudsman and the Czech Labour Inspectorate. It was clear that the law, which required the same conditions for agency as for regular employees, had been broken. That finding led to a threat of strike action by some agency workers. It also led to a fine for Zetka, one of the agencies supplying for Škoda, of Kč 0.5 mn, imposed by the Labour Inspectorate, for paying wages below the minimum level guaranteed by law and by the collective agreement with core employees.

It should be noted that the law was anyway interpreted as requiring only the same minimum, so that agency employees' pay should not fall below the minimum permissible level negotiated through collective bargaining. It was not interpreted as requiring parity with actual pay levels of core employees. Similarly, pay for lay-offs was only 60% and not 75% of normal pay and there was effectively no redundancy pay: all of this was within the terms of the law.

The management's reaction, in view of bad publicity, of doubts over the quality of agency employees and of the need for good relations with a stable core labour force, was to seek to reduce its dependence on agency workers, at one point even setting a target of zero.<sup>14</sup> Union representatives were actually not enthusiastic about this, frequently referring to agency workers as a welcome 'cushion' and later arguing with their colleagues from Western Europe that setting a maximum of 5% of the workforce would not be realistic.<sup>15</sup> Nevertheless, they negotiated a new arrangement with management for agency employees under which one firm, Manpower, would be the only contractor from April 2010, and would consult with unions over employment conditions and aim to hire mostly Czech employees. The company management backed this with promises of a better deal for agency workers, such that they had the prospect for promotion and for joining the core workforce. This was in line with the Volkswagen Global Labour Charter, coming into force in the autumn of 2009, which was intended to recognise the benefits of a secure and motivated labour force.

In practice, increasing demand for cars after the depths of the crisis led to increasing dependence on agency workers, the number rising to 2,400 in mid 2011, and about half were still employed by firms other than Manpower. They had allegedly been dissuaded from transferring by financial penalties and threats.

*iv. Volkswagen Group in Hungary (Audi)*

There are two trade unions in the company. The first is the Vasas trade union founded in 1993, the second the independent plant level trade union existing since 1996. In the context of a prolonged conflict between the then local heads of Vasas and its central headquarters, the independent union grew gradually to over 4200 members in 2012.<sup>16</sup> The Vasas union shrank to only a few dozen. A collective agreement was signed in 2001 for an indeterminate period with annual evaluation. The collective agreement limits the number of agency workers to around 5% of the workforce. Documented conflicts between the trade union and employer include the distribution of bonuses,<sup>17</sup> work time, and basic pay. They are typically resolved through negotiations, but some cases, such as the conflict over bonuses, were also settled through courts. The union leaders perceive the relations with management as good, with the employer typically accepting their complaints.

The use of agency work is limited by collective agreement. The company uses the flexible work accounts arrangement to be able to react to fluctuations in demand. The unions generally accept the need for such an arrangement. At the same time, they worry that the employer will be able to enforce concessions on flexibility in order for them to retain the co-determination rights that were denied them by the new labour code (approved in December 2011 and entering into force on 1 July 2012).

<sup>14</sup> *Škodovácký odborář*, 17 December 2008.

<sup>15</sup> *Škodovácký odborář*, 2 November 2011.

<sup>16</sup> See *Hírek*, March 2012, <http://www.ahfsz.hu/hirek/hirek1203.pdf>.

<sup>17</sup> See *Hírek*, November 2010, <http://www.ahfsz.hu/hirek/hirek1011.pdf>.

v. *Daimler-Benz in Hungary (Kecskemét)*

The works council of the Daimler plant in Rastatt and Daimler's European works council encouraged and supported works council and trade union formation in the Hungarian plant from the beginning. The Daimler works council and IG Metall preferred Hungary as an investment location as it was deemed to be a country with the most similar industrial-relations system to that of Germany. The works councils in German Daimler plants had been able to influence management decisions to some extent.<sup>18</sup> German and European works council representatives were actively involved, together with the Hungarian VASAS union, in establishing the trade union and works council in Kecskemét. The first works council election took place on 30 April 2010 and the trade union was founded on 25 May 2010. The management recognized the unions without obstructions. Trade union density had reached 30% by 2012. The trade union in the plant is affiliated with VASAS. There were some undertakings to found an independent trade union, but without success.

A collective agreement was concluded with the trade union including, as in the case of Audi, the use of flexible work accounts. In fact, the incentive for management to reach such an agreement was very strong as the labour code allowed for a 12-month work account scheme only when agreed between unions and management.<sup>19</sup>

The conflicts between the unions and the management included work on Saturday and the organisation of shifts. The employer preferred to run regular shifts for some workers on Saturdays (each third Saturday). Trade union leaders protested and the employer was expected by the time of writing to offer a solution. The unions were prepared to employ a strategy of 'inflexible obedience' of all the rules that would slow down the work processes in case the proposal was not satisfactory. There were also issues of the rest time between shifts. The management wanted breaks after three hours of work, which the union opposed. A new proposal was for two hours. In general, there were very few conflicts and they were resolved through negotiation. The unions were satisfied with the approach of the employer.

The collective agreement includes arrangements on secondment allowing the employer to assign other job tasks to employees for a limited time period, replacing outsourced work with in-house staff. According to the Hungarian Labour Code, work ordered under such arrangements should not exceed 110 days in a year, but the unions agreed, in the collective agreement, to extend it to 180 days. Given the short period of production, it was not possible to observe the actual means of coping with a fall in demand.

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<sup>18</sup> Their strong position can be attributed to the high union density in German plants and the active role of IG Metall.

<sup>19</sup> As a part of crisis management package, a law was proposed in 2009 that would extend the work accounts schemes to 18 months. This was opposed by the unions. The law was not passed.

## VII. *Adjustments to the crisis of 2008*

### *i. Bosch Diesel, Jihlava, Czech Republic*

The economic crisis of 2008 hit the automotive sector very hard. Manual employees in Bosch Jihlava were the highest paid in Czech manufacturing. However, union organisations and employees followed the general trend in Czech manufacturing of accepting that the crisis meant lower output and hence lower employment and also some degree of pay restraint. The first act of management was a cut in output in May 2008, with some employees sent home on 70-80% of the average pay. In September the first dismissals came for the core workforce and almost 430 had gone by the end of the year. Another 300 on fixed-term contracts left during 2008 as their contracts ended and another 130 went the same way in 2009. Dismissals were implemented very quickly and with minimal warning, according to some reports so as to prevent sabotage or theft by workers who were leaving. However, the management broke the law by not consulting with union representatives and subsequently had to pay individuals additional compensation of two-months pay, on top of up to five months pay as compensation for redundancy as set out in the collective agreement.<sup>20</sup> Overall, the labour force was reduced from an average level of 6,173 in 2008 to 4,770 in 2009 by voluntary and involuntary departures. Sales revenue fell by 35%, meaning that the plant was still over-staffed, but it actually still recorded a profit in 2009. The situation was less serious in the České Budějovice plant, which produced parts for petrol engines and demand for them recovered very quickly in 2009: there the labour force fell by about 300 to a level of 1,700.

A two-year collective agreement had been signed for 2008 to 2009, but this was amended to allow for a 20% reduction in the working week and a corresponding reduction in pay. Unions accepted this in the context of the firm's continuing commitment to long-term expansion plans and of an agreement that there would be no redundancies over the period 1 March to 31 August. This ran into teething problems when 17 employees refused to accept the change to their contract, but the union side in turn accepted that their employment should be terminated. The agreement was also reached before unions had consulted with Bosch union representatives from around the world. They subsequently noted that Bosch workers in Germany seemed to have a better deal, with a promise of no redundancies until the end of 2011. There seems also to have been little coordination in the Czech Republic as workers in České Budějovice had a commitment to no redundancies only to July.

In collective agreements in Jihlava for the following years unions successfully pressed for flat-rate pay rises, Kč 300 in 2010, albeit only from July, Kč 650 in 2011 and Kč 550 in 2012. The first of these was seen as indicating restraint, letting the company breathe, but employment actually increased during that year and fears of redundancies receded. In general, the choice of flat-rate increases was pressed by the union side as it gave most protection to the lowest-paid employees who were most likely to be union members. Management in turn was less concerned with maintaining pay differentiation than with cooperation over ensuring labour flexibility.

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<sup>20</sup> Kovák, No. 8, 2009.

This proved a very difficult task. The union side was well-prepared and well-briefed and was not willing to concede more than a six-month period for evening out flexible employment accounts, as allowed under Czech law without negotiation. In the Bosch plant in České Budějovice, unions had allowed a one-year evening out period. Evidently, as on other issues, the outcomes of collective bargaining were highly variable and depended on the individuals negotiating at that particular time.

*ii. Bosch in Hungary*

The crisis led to a 30% drop in demand. The company reacted through redundancies in 2008 and 2009, primarily affecting agency workers. The company continued to expand its activities and employment from 2010. The biggest investment was the construction of the production hall in Miskolc. The activities expanded substantially also in Hatvan, with a 33% turnover increase in 2011. The site benefited from a consolidation of Bosch's activities in Europe that led to a relocation of production from Cardiff, the UK, to Hatvan.

*iii. Volkswagen in the Czech Republic*

The Škoda annual reports ([www.Škoda-auto.cz](http://www.Škoda-auto.cz)) show the effects of the economic crisis. Output by number of finished vehicles was down by 2.7% in 2008, with the biggest fall being 34.7% for the Roomster. The overall decline in 2009 was 13.9% with the Fabia holding up best, falling by only 5.8%. As a small car, this model benefited from the car-scrap schemes in Germany and other European countries. In 2010 total output increased by 11.6% as demand for larger cars increased again. The table shows the overall levels of output and employment through this period.

*Table A.3 The effects of economic crisis on Škoda*

	Car production	Cars sold	Employment	Of which agency workers
2005	494637	493119	26014	3460
2006	556433	555202	26738	3704
2007	623529	623085	27753	4194
2008	603247	622090	25531	1708
2009	519910	539382	24817	1986
2010	576362	583780	23308*	@2774**

All figures are for end year

\* excluding agency workers

\*\* figure for whole Škoda group

Source: Company Annual Reports of Škoda.

The economic crisis hit Škoda at a time of expansion, and even greater plans for future expansion. The target for 2008 was 700,000 and to make this possible the management negotiated with the union for an agreement on voluntary extra shifts on Saturdays. By the late summer stocks of finished cars were building up, and employees were complaining at the cancellation of the extra shifts. On 22 September unions and management negotiated over terms of cutting production and agreed to 75% of

average pay (meaning the average daily level that that employee would receive) on days without work, against the legal minimum of 60%.

Thus the key issue for the management was the handling of the effects of instability and the shares of risk to be borne by the two sides. Unions were successful in negotiating through stoppages in production in late 2008 and early 2009 for 75% pay on days laid off and no redundancies among the core workforce. They also won acceptance for the effective elimination of all agency workers with their jobs to be taken by transferring core workers from other parts of the enterprise. About 1,000 moved in the first weeks of 2009 as the number of agency workers fell from over 4,000 to 600 in January 2009. There was a lot of grumbling among those core workers forced to move, but only a few refused to accept the more unpleasant work in the welding shop that had been dominated by agency workers. This seemed a better option than losing the guarantee of employment.

Early 2009 saw a sudden increase in demand following the introduction of the car-scrap scheme in Germany. By April Škoda was back to full production, but still could not meet orders. Part of Octavia production had been transferred to Bratislava in 2008 because of inadequate capacity in Czech plants earlier in the year. In April 2009 Volkswagen started transferring workers to the Czech Republic from its plants in Slovakia. The number of agency workers also escalated again, from a low point of 458 in February 2009 to 3,021 in July.

Throughout this period the management insisted that demand was still very unstable and pressed for the introduction of flexible working accounts, as, it was claimed, existed in all but one other Volkswagen branch. The company was also lobbying the government to allow for this flexibility over a four-year period, as in Slovakia and as operated in the Volkswagen plant there. The union response in late 2008 was very hostile, but management was very insistent, implicitly linking acceptance of such a scheme to long-term investment plans and hence job stability. Opposition continued through early 2009, when extra shifts were paid extra at the time, but agreement was reached at the end of the year on a trial scheme for 2010.

The terms related to extra shifts on Saturdays. Unions were to be informed ten days in advance and employees seven days in advance, after which work would be compulsory. Plus and minus shifts were to be evened out over a year and the seriousness of implicit promises of job security were demonstrated when the threatened Vrchlabí plant was given a future in June 2010 by the transfer of production there from other plants. However, there was a lot of employee discontent over flexible work accounts, as in effect they were being forced to do extra work at short notice and losing the extra pay for overtime.

Renegotiation for 2011 led to what the union side claimed to be the softest scheme in the whole Volkswagen combine. Plus and minus shifts evened out over a four-month period meaning, in practice, that there was very little chance of extra work appearing to compensate for days laid off or of lay-offs to compensate for extra shifts. In practical terms, the payment system had hardly changed and management had transferred hardly any of the risk onto employees. It can be added that only then did union representatives gain (or at least make explicit reference to) clear information from German union representatives on experiences of German flexible working systems.

The systems used there did indeed appear substantially more favourable to the employer. The union organisation in Škoda entered negotiations on the 2012 system with the position “in general we reject the flexible work account as a model” and definitely aimed to keep the balancing on a quarterly basis.<sup>21</sup>

It should be noted that pay negotiations continued very much as normal, albeit with an emphasis on the union side for commitments of some kind to job security. In February 2009 they settled for a deal with a flat-rate one-off payment plus a percentage increase, meaning a move towards slightly greater pay equality. For 2010 the flat-rate element was bigger but the overall percentage increase was around 6% for most employees. For 2012 the expectation was that the collective agreement would include employee protections lost from changes to employment law coming into effect at that time.

*iv. Volkswagen Group in Hungary (Audi)*

The sales of motors fell by 35% in 2009 (see Table A.4). Car production has seen even larger fluctuations. Employment proved to be remarkably stable, shrinking by just 4% in 2009. Nobody from the core labour force was sacked.<sup>22</sup> Redundancies were restricted to agency workers and those on temporary contracts. Audi stopped cooperating with many of its subcontractors, shifting their tasks to its core workforce. In exchange, trade unions did not ask for wage increases in 2009. The workforce continued expanding from 2010. In March 2012, the 7000<sup>th</sup> employee began work in the factory.

*Table A.4 The effects of the economic crisis on Audi in Hungary*

	Motor production	Motors sold	Car production	Employment (as of Dec 31)
2005	1,693,609	1,690,736	12,307	5,022
2006	1,893,600	1,875,982	23,675	5,373
2007	1,913,053	1,875,230	56,982	5,845
2008	1,900,333	1,838,446	60,359	5,879
2009	1,383,909	1,361,218	32,603	5,624
2010	1,648,030	1,609,200	38,541	6,138

Source: Annual reports of Audi Hungaria.

During the crisis period, there were special crisis laws introduced to make the labour force more flexible. The short-time working scheme did not exist in its German state-subsidised form. However, the company could reduce work time from 40 to 36 or 32 hours and pay lower salaries. The Audi trade union did not agree with the use of this provision and management did not use it. Employees were given extra paid days off during the fall in demand.

<sup>21</sup> Škodováký odborář, 15 December 2011.

<sup>22</sup> This contrasted with the experience in Bosch and also Suzuki, another major automobile producer that made a large part of its core workforce redundant (approx. 1200 people). See <http://www.eurofound.europa.eu/emcc/erm/factsheets/18235/Audi%20Hungary?template=searchfactsheets&kSel=1>

### ***VIII. Conclusion***

The main sources of technological advance and the introduction of innovations in Central and Eastern Europe has been an inward investment by MNCs. This process differs markedly from indigenous innovation. The institutional requirements are much simpler, for example with fewer demands on a skilled and innovative labour force and much fewer relevance clusters. Indeed, inward investors are often seeking isolation from other similar companies.

Links between employment relations and innovation relate primarily to the willingness of MNCs to choose a particular location and to continue investing there. Labour costs are one factor, but are less important with more advanced technology and higher capital costs, both of which lead to a lower share for labour costs. An adequate local supply of labour is important, but can be covered by imported labour, often at an even lower cost, even if covering only lower skill levels. It is harder and more expensive to relocate more skilled labour and that is one reason for the continued concentration of the main R&D activities towards core areas. There have been no major innovations in the motor-vehicle industry in Central and Eastern Europe, but there have been incremental changes and product adaptations, within frameworks laid down by company headquarters.

There are problems of labour flexibility. Various means have been tried to ensure the right labour is available when, and only when, demand for the product exists. Legal frameworks, bargaining systems and the strength of trade unions clearly affect the systems adopted. The Czech experience shows that systems devised in Germany can be successfully opposed by well-prepared and determined trade unions.

However, our study of different plants of the same MNCs points to considerable variation in how problems of flexibility are handled. There is as yet no evidence of these leading companies to choose another location. They are concerned primarily with the total cost for achieving production aims. The rejection of forms of flexible working adds something to total costs, as the company has to bear more of the costs associated with output fluctuations, but that is relatively small when set against the advantages of established locations in Central and Eastern Europe.

## **Part B. Into the first league: the contribution of labour regimes to the success of the anti-virus industry in Central and Eastern Europe**

### ***I. Introduction***

This research was inspired by an intriguing observation that three domestically-grown anti-virus companies from the former Czechoslovakia have occupied leading positions in the security software world market. AVG (former Grisoft), Avast (former Alwil) and ESET, established independently in the late 1980s by Czech and Slovak engineers, have grown into medium-size companies and expanded into world markets. Positioned among the five most widely sold anti-virus products worldwide over the last few years (OPSWAT, 2011 and 2012),<sup>23</sup> the three companies are considered the security software ‘ivory league’. Their success can largely be attributed to the ability to continuously innovate and deliver genuine R&D, which has been recognised internationally by repeated recognition of their product quality by independent evaluators. No other home-grown sector in Central and Eastern Europe has experienced similar success. We therefore find it important to better understand factors that have contributed to such outcomes. We hope to contribute to the literature studying processes of production and location of knowledge-intensive activities in emerging economies, but also generate insights for policy-makers by pointing out areas that warrant attention, if more R&D and innovation is to take place in Central and Eastern Europe or in other countries at similar levels of development and with similar structural characteristics.

Our analysis of security software companies is positioned in a broader framework which also provides an overview of trends and developments in the software industry in the region generally. We believe that studying the processes of “*internationalisation into*” (localisation of software production and other ICT activities by foreign firms) and “*internationalisation out*” (internationalization of home-grown antivirus companies) can bring a fuller picture of determinants that shape the development of the software industry and determine the types of activities that are conducted and localisation decisions over them. Given that human capital is clearly a key factor underlying technological innovation, we focus this work on understanding *what role labour regime has played in the growth and technological advancement of the anti-virus industry and IT sector generally*. We define labour regime broadly to include education and skill provision systems and labour market regulatory framework which affect the availability and quality of labour force and degree and form of labour market flexibility.

We structure our work in two major parts. We first outline the general trajectory of the software industry, demonstrating the growing importance of the IT industry in the Czech and Slovak economies. Here we rely mainly on the available data about the IT sector, but complement it with the information gained from semi-structured interviews with various persons knowledgeable about the field, ranging from the management of leading domestic and foreign IT firms, representatives of IT associations in the Czech

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<sup>23</sup> Using usage data for security applications on Windows systems.

Republic and Slovakia, venture capitalists and the investment agencies (CzechInvest and SARIO). The second part of our work concentrates on a detailed analysis of the three selected company case studies. It is built on a composition of detailed trajectories of the firms, relying on the available firm data and a series of semi-structured interviews with management and/or board members of the three companies. By contextualising firm-level data into a broader overview of sectoral characteristics, we isolate factors that explain the different growth trajectories of our company cases and evaluate the relative importance of labour regimes vis-à-vis other factors, such as structural country-level characteristics (e.g. geographical location), international influences (EU accession) and potential firm-level idiosyncrasies (freemium model as a marketing strategy; the role of company founder).

We find that the human capital, and how it is made available by labour market regulation and skill formation systems, was a key and necessary condition in the success of the security software firms and also explains the move up the ladder of sophistication within the IKCT sector represented by foreign firms. However, while human capital quality and its ability to innovate were crucial, other factors were of importance in the growth trajectories of antivirus firms too. Firstly, contrary to other sectors in CEE where foreign direct investment (FDI) proved to be crucial due to bringing expertise and capital (Bohle & Greskovits, 2006; Kurekova, 2012), the fact that foreign investments in IT sector lagged behind for most of the 1990s created a period of shielded growth for domestic companies and prevented them from aggressive competitive pressure. FDI was not necessary because the security software firms had their own expertise that matched or exceeded foreign knowledge that could be developed due to lesser necessity of large amounts of capital. Moreover, the firms were able to initially cross-subsidise anti-virus improvement by retained earnings from other activities and soon after generate profit from licensing their antivirus engines to other companies. The second factor that contributed to especially fast growth in the last decade was the timing of the spread of the internet in the early 2000s, which led to online sales, further decreasing costs of marketing and sales, and enabled a rapid expansion into world markets.

With respect to the institutional framework, labour regimes have been crucial and beneficial in a number of forms. Labour market regulation in its current form is satisfactory and provides a framework that is both flexible and secure. In addition, firms have developed functional alternatives that substitute flexibility, such as testing of skills through internships or by a network of subcontractors of smaller firms which employ IT specialists on multiple projects at once. Although labour supply to date seems sufficient, many indications suggests that much more needs to be done to make the 'knowledge advantage' sustainable. The current model might be reaching its limits, and this is the case especially for innovative companies with the ambition to globalise, which need to draw on international expertise and face many barriers that disable such processes. Therefore, institutional changes should target the quality of the education system and changes to the migration framework to enable recruitment outside the EU. This, we believe, is likely to intensify further inflow of FDI into the IT industry; support a shift further up the R&D hierarchy, which we show to exist in the sector; encourage growth of existing firms and the location of their key R&D activities in the region (rather than abroad); and support the emergence of new genuine start-ups.

## II. *Characteristics of the computer and software industry*

### *i. Definitions and concepts*

We use the term ‘IT sector’ interchangeably with ‘software industry’. In the statistics it is typically defined by NACE 72 group (Rev. 1) or NACE JC (62 + 63) (Rev. 2) – computer and related activities – which includes hardware consultancy, publishing of software, other software consultancy and supply, data processing, database activities, maintenance and repair of office, accounting and computing machinery, and other computer related activities (Guzik & Micek, 2008).<sup>24</sup> IT sector defined in this way is only a subpart of the broader ICT sector, which includes both manufacturing (electronics, office equipment, telecommunication equipment) and ICT services (IT, telecommunications, postal services, radio and TV broadcasting) (Guzik and Micek 2008). Broader ICT definition is often used in international comparative statistics and might have been the focus of some studies on which we built this work. This leads us to use data or references for the ICT sector more broadly, which we make explicit in the text, especially where including communication sector might bias the results for the IT sector.

### *ii. The main features of this ‘new industry’*

The IT industry is a high valued-added sector where the most important input is highly skilled, qualified and innovative labour. It is characterised by one of the fastest product life cycles when a life-span for new software application can be as little as 2-3 years (Bell, 1995), therefore high and constant product innovation is necessary for a given company to continue generating profit (Tsai, Lin & Kurekova, 2009). The need for a rapid and flexible response to changing market dynamics is reflected in the way work and employment is organised (Benner, 2002; Grimes & White, 2005; Wickham & Bruff, 2008). Work is typically structured in projects where project teams have short and fluctuating membership. Skill sets have a short life-span and skill requirements are fluid; both generic and specific skills are typically needed. Formal professional qualifications are relatively unimportant with occupational licensing not widely spread (but growing).

Given that the ability of firms to effectively adapt to changing market conditions and respond to new opportunities and challenges is a matter not only of competitive advantage but also of mere survival. Firms in the IT sector are dependent on internal as well external flexibility in employment, which leads to a relatively high labour turnover. Internal flexibility aims to enable easy reallocation of personnel within the firm and is reflected in the utilisation of teamwork, broad job categories, or redeployability. External flexibility is ensured by practices such as a high use of subcontracting or home-work, temporary or part-time employment, or labour leasing which enables access to specialised skills and adjustment to fluctuating labour demand (Benner, 2002). Such practices are further echoed in the fact that the software industry

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<sup>24</sup> For more on comparability and differences between NACE Rev.1 and NACE Rev.2 classification, see [http://epp.eurostat.ec.europa.eu/cache/ITY\\_OFFPUB/KS-RA-07-015/EN/KS-RA-07-015-EN.PDF](http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-07-015/EN/KS-RA-07-015-EN.PDF)

typically utilises migrant labour (Wickham and Bruff 2008; Millar and Salt 2007), but this so far has not been the case in Central and Eastern Europe.

Relative to capital-intensive industries, such as the automotive sector, large capital investments are of lesser importance, at least in the initial stage of the establishment of the firm or a new product. The availability of capital plays an important role at a point when a company aims to grow and establish itself on the world market. Being a high-risk high-profit sector, the IT industry is typically a target of different types of private capital (venture capitalists, angel capitalists, private equity funds) rather than being supported by 'patient' bank money or public resources. In more sophisticated products that need a longer period of time to be developed and improved into quality, patient capital or cross-subsidising from other firm activities might be crucial. Networking and clustering to facilitate the exchange of knowledge and ideas have been noted as important accompanying features of a vibrant IT sector, with the Silicon Valley in the US being a prime example, where an important outcome of the presence in the Valley is the amalgamation of investors seeking to support promising projects.

### *iii. Trends of internationalisation and diversification*

Over the last two decades, the computer and software industry has been characterised by a number of general trends that contributed to major changes in its functioning and organisation. Developments in the sector over the last two decades are foremost characterised by the processes of internationalisation and diversification. First, with the spread and availability of internet connections, IT and computer services companies turned away from serving traditionally limited national markets to providing services more effectively in an open and global market space. The globalisation of demand and supply has been taking place simultaneously (Coe, 1997). The internationalisation of major manufacturing firms was one of the key trends that spurred the expansion of IT and computer services, which typically follow their clients to new destinations (Coe, 1997; Grimes & White, 2005; Guzik & Micek, 2008). This has been the trend typical to the CEE region too (Capik & Drahokoupil, 2011). Additional factors that have contributed to a rampant internalisation of the ICT industry since the 1990s have been declining language barriers, with English becoming a universal communication language, the standardisation of hardware, increasing compatibility of existing systems, the introduction of international (rather than national) computing standards, and the deregulated nature of public procurement in the EU supporting global competition in the industry (Coe, 1997; Micek, 2008). A general shortage of skilled IT professionals in the US and Western Europe might be concomitant factors contributing the internationalisation and 'delocalisation' of the IT sector (Guzik & Micek, 2008).

Second, for global computer services companies, the size and geographical scope have become important as manufacturing multinational corporations (MNCs) as their clients have created demand for both geographical and product diversification and so requested a growth of computer services providers (Coe, 1997). Internationalisation has been a response to the demand for extensive client support in terms of consultancy, systems design, customisation, installation, training, upgrading, and after-sales services, and has been accompanied by the second major trend in the industry - the diversification of the products and services offered (Bell, 1995). Diversification began with the hardware producers extending to software and services (Coe, 1997) and has

continued by further advances in the provision of integrated services, such as ‘security suites’ or ‘cloud computing’. Such a development has also been described as ‘service encapsulation’ implying that services are embedded in products and there is a close interlinking between products and services (Grimes, 2006). Contrary to global computer services companies, small software firms typically offer highly specialised services or products targeted to narrow niches (Bell, 1995; Fak, 2004). Further, software SMEs tend to internationalise very rapidly rather than in small incremental steps (typical for manufacturing) which is a function of the dynamic nature of the software industry as a whole and the need to commercialise new applications as quickly as possible. The possibility to sell products online further decreases ‘export’ costs and the time to market a product, and revolutionalises possibilities and ways of PR and marketing (I-11, I-6).<sup>25</sup>

*iv. Redefinition of ‘services’ and implications for the R&D model*

The evolution of the service sector is also reflected in the statistical redefinition of software which, prior to the spread of internet, was delivered as a physical product but is now offered electronically, and may be delivered as part of an overall package including an array of other services (Grimes, 2006). This is in stark contrast to the original definition of service activity, which is defined as intangible, non-storable and non-transportable output consumed and bought at the moment of its production and thus requiring a physical proximity of producer and consumer (Sass & Fifekova, 2011). This de-linked and re-shaped nature of ‘proximity’ in computer services industry, defined by the availability and appropriate competence rather than physical presence, has important implications on a more diffused localisation of employment in certain segments of the industry, including the higher value added activities, such as software development and R&D generally. Hence, while follow-the-client behaviour of large ICT firms implies a specific ‘geography of employment’ whereby the location of client firms determines the location of computer services companies (Coe, 1997), this logic of localisation is not necessarily valid in the case of software companies focused on innovation or knowledge-creation. Innovative firms in the sector, such as antivirus companies analysed in this work, rather follow an internationalisation model where M&A are guided by strategic decisions in acquiring essential complementary knowledge to the current or envisaged expertise in the firm (I-5, I-8) (Coe, 1997). This seems to imply possibilities for a ‘parallel’ rather than ‘hierarchical’ headquarters-branch model of organisation of work and the localisation of R&D (Aranya, 2008). Such a paralleled or horizontal organisation of highly sophisticated activities in multiple locations is driven by the fact that fast-growing IT or knowledge-based activities are highly dependent on the availability of a sufficient volume of high quality human capital. Fast-growing companies quickly reach the limits within local economies (especially small ones) and turn to the establishment of R&D centres globally (interview: I-8, I-9, I-10) (Aggarwal & Pandey, 2004).

<sup>25</sup> For interview coding, please see Annex.

### III. *IT sector in Central and Eastern Europe*

#### *i. Moving upwards*

The expansion of the IT sector in Central and Eastern Europe evolved in parallel to the more general processes happening globally. In line with the international trends, the structure of FDI in Central and Eastern Europe re-oriented from manufacturing FDI to service sector FDI and the boom started in the early 2000s. Service sector and especially business services FDI has been motivated by market-seeking (penetrating markets growing in affluence; follow-the-client behaviour) and efficiency-seeking motives (lower labour and business costs) (Sass & Fifekova, 2011; Capik & Drahokoupil, 2011; Coe, 1997). Within ICT industry considered broadly, market-seeking penetration first touched hardware and telecommunications services as these areas were underdeveloped. Software and computer services markets were initially unattractive to foreign investors due to the costs and difficulties of translating products for different local markets, the fear of political instability and a general lack of trust related to the very high level of software piracy and the perceived character of the whole post-communist region as a bed of production for malware and viruses (Coe, 1997; Třešňák, 2007) (I-11, I-8, I-6). During the 1990s, computer hardware was spreading, but purchasing power for the most part was not sufficient to create large demand for additional software (I-10).

Incoming ICT companies began their presence with offshoring services with lower value added, such as back-office, corporate functions and customer care (Capik & Drahokoupil, 2011; Hardy, Sass & Fifekova, 2011; Piech & Radosevic, 2006). However, with the prolonged presence of IT companies in the region, regardless of the initial motives for entry, the awareness of the availability of skilled and talented labour attained through the interaction with the local labour market led to the localisation of more sophisticated activities, such as shared service functions (accounting and finance), IT support and IT problem-solving centres (Hardy, Sass & Fifekova, 2011) as well several R&D centres <sup>26</sup> (I-7, I-13).

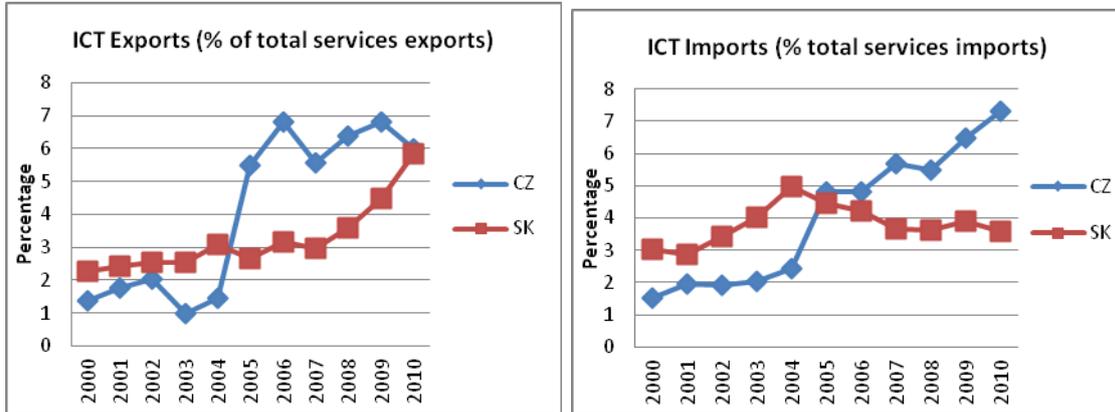
The growing importance of the ICT sector in the Czech and Slovak economies since the mid-2000s is also shown in the figures presented below (see Figures 1 and 2, showing the broad ICT sector). ICT exports as a share of total exports in services rose very sharply in the Czech Republic in 2005 and attained a relatively stable share up to 2010, when the value of ICT exports totalled nearly \$21 billion. The Czech imports followed a similar trend and neared \$17 billion in 2010.<sup>27</sup> According to the Czech ICT Union, in 2010 the total ICT exports (services and commodities together) were higher than the export of cars (380 billion CZK versus 239 billion CZK) (Čapek 2012). Slovak ICT exports represented about 6% of total service exports in the country in 2010 and equalled nearly \$6 billion, a drop from 8.5 billion in the peak year of 2008. ICT imports in Slovakia as a share of total service imports have been in decline since 2004, reaching 7 billion in value in 2010 (all data from UN Services Trade Database). Value added in

<sup>26</sup> Examples in the Czech Republic include investments of Sun Microsystems/Oracle, Red Hat, SolarWinds, NetSuite; and in Slovakia investments of Alcatel Lucent, or NESS Kosice Development Centre.

<sup>27</sup> See <http://unstats.un.org/unsd/servicetrade/default.aspx>.

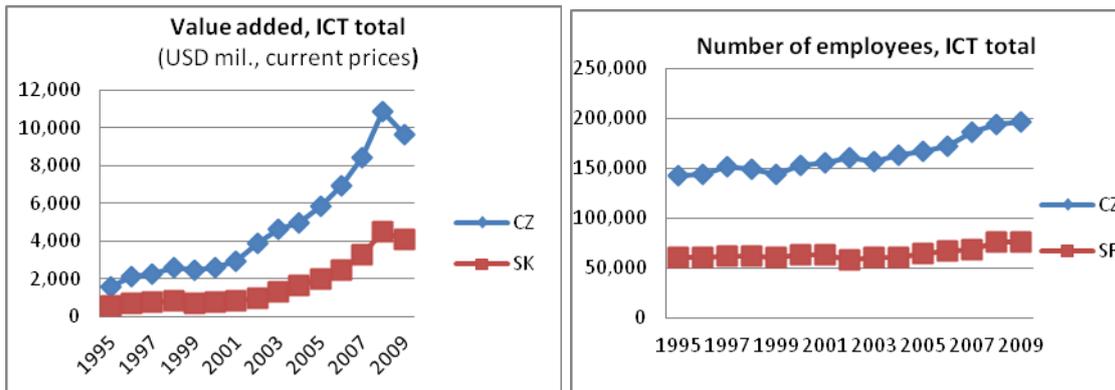
the ICT sector total (services and goods) multiplied manifold in both countries and outpaced the growth in the number of employees engaged in the total ICT sector (Figure 2).

Figure 1. ICT exports and imports – share of total in services (EBOPS 2002 classification)



Source: UN Services Trade Database 2012. Own calculations. EBOPS 2002 Classification, code 262.

Figure 2. Value added and employment (NACE Rev. 1 classification)



Source: Czech Statistical Office based on OECD „STAN Database“. Value added – current prices, mil. USD. Employment – total number of persons engaged in ICT total (services, trade and goods), NACE Rev 1 – codes: 30 – 32, 51, 64, 72

The efforts of national inward investment agencies played a role, but the incentives offered were considered a bonus rather than a decisive factor in the decisions of foreign companies to establish R&D functions in the Czech Republic or Slovakia (Hardy, Sass & Fifekova, 2011) (I-7, I-9). The aggregate amount of the incentives to the ICT sector relative to other sectors has been very low and the majority of financial support went to support job creation rather than physical infrastructure (ITAS, 2011).

The sector is today composed both of large internationalised firms which typically offer a range of products and a variety of services, but also by a myriad of small and medium-sized firms of domestic origin, of which a few have globalised, but most seem to specialise in offering tailor-made services to local governments or local firms. For them the knowledge of the local legal and regulatory environment and local language

form a competitive advantage in a regional perspective but also seem to pose a limit on a fully-fledged globalisation and expansion.<sup>28</sup> Recently, the software sector has been increasingly characterised by the emergence of start-ups, especially in the Czech Republic (Lauder, 2010; Kočí, 2012) (I-8, I-7, I-6). The efforts of government agencies as well as private initiatives (or their cooperation) to support the start-up scene have been growing. Examples include incubator or accelerator initiatives, such as the Start-up Development Program<sup>29</sup> of SARIO (Slovak investment agency) or the StarCube program in the Czech Republic (a program of South-Moravian Innovation Centre<sup>30</sup>), but it is too early to evaluate the impact of these interventions on the start-up scene.<sup>31</sup> An important characteristic of several IT R&D centres established in the Czech Republic or in Slovakia is the fact that a foreign investor developed it by acquiring or developing an already existing successful domestic company (e.g. Sun Microsystems acquiring NetBeans (Němeček, 1999), Microsoft Slovakia acquiring Caligari (I-3) – a phenomenon which can be dubbed as “*offshore R&D*” (I-8). This highlights the multiple positive effects that domestic start-ups in the sector can have on the further advancement of the industry in these countries generally.

In sum, recent trends in the IT sector in the Czech Republic and Slovakia seem contrary to the conclusions offered by Capik & Drahokoupil (2011) that little R&D takes place in FDI-established companies in Central and Eastern Europe. A trend towards higher value-added services in the companies established by foreign investors and a continued inflow of firms establishing high valued added units is accompanied by a growing number of domestic start-up firms in the IT industry, broadly speaking.<sup>32</sup> Our evidence suggests that this trend is more evident in the Czech Republic than in Slovakia. Whether in the latter country this reflects a lag in the development of ICT industry, as suggested by some of our interviewees (I-13, I-14, I-9) and the data presented earlier, or rather signals important structural disadvantages that are likely to hamper further growth and upgrading is a question for further research.

## *ii. Human capital and labour regimes in the ICT sector in CEE*

Human capital resources are a key input into the IT sector, and their quality and availability has affected the inflow of computer services FDI into Central and Eastern Europe (Sass and Fifekova 2011). Similarly, it is a necessary condition for the emergence and growth of domestic start-up companies. As we mentioned before, a gradual shift towards a greater share of high value-added activities has been influenced by the discovery of human capital potential in these countries. In the late 2000s, and prior to the economic crisis of 2008-2009, the quest for qualified labour was

<sup>28</sup> An example of important regional player, now listed on the Warsaw stock exchange is ASSECCO: <http://assec.com/ce/company/company-profile/>

<sup>29</sup> See <http://www.sario.sk/?start-up-en>.

<sup>30</sup> Brno incubator of enterprises, financed by private investors as well as subsidies from the city of Brno, the South Moravia region and European Union funds. It is considered to be very successful (Šúra, 2009). See also: <http://respekt.ihned.cz/video/c1-37286380-start-up-a-technologicky-inkubator-v-brne>.

<sup>31</sup> See <http://www.jic.cz/starcube-en>.

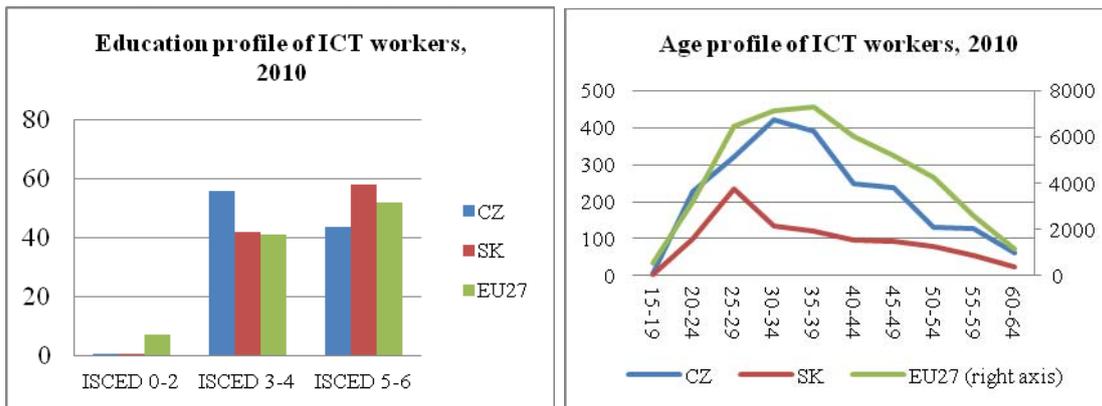
<sup>32</sup> Guzik & Micek (2008) and Micek (2008) make a similar argument for the case of Poland.

intensive and many references to the shortage of qualified IT workers appeared (Lauder, 2010; SME, 2008). With growing demand for workers in IT sector, it is important to understand whether supply is sustainable and a ‘knowledge advantage’ (Sass & Fifekova, 2011) is sufficient to ensure success in global competition. Moreover, to date very little information exists about the dynamics of employment relations and firm strategies in hiring suitable candidates in the two countries. In this section, we therefore aim to provide insights into the typical profile of employees, labour recruitment strategies and labour relations in the sector. We base our inferences on information gained through the interviews and from available statistical data about the sector.

### *Employee profiles*

Our analysis of the profiles of workers employed in the ICT sector based on the Labour Force Survey (LFS) data from 2010 shows that the sector employs more males than females (70% in both countries are males), but this is at the level of a EU27 average. Data for the IT industry only were not available and we therefore show data for the total ICT sector, which includes communication. Figure 3 shows that nearly 60% of currently employed workers in the ICT sector in Slovakia have tertiary education, while in the Czech Republic and in EU27 this is much less (44% and 52% respectively). Given a generally lower sophistication of the ICT activities in Slovakia compared to the Czech Republic, this seems to confirm information gained from the interviews (I-2, I-7) and other studies (Capik & Drahokoupil, 2011; Hardy, Sass & Fifekova, 2011) that the ICT sector might be formally employing more qualified labour than the complexity of tasks actually requires. A high reliance on the graduate labour market is evident from the age profile of employees. In the EU27 employees are much more spread across the age groups with a peak group of workers in the late 30s. In the Czech Republic this is the early 30s and in Slovakia the late 20s. Such curves might reflect the initially lagged but then relatively massive entry of large ICT firms into these countries.

Figure 3. Age and education profiles of ICT workers, 2010



Source: EU LFS, own calculations. NACE Rev. 2, Code J: “Information and communication technology”.

The companies we interviewed described a typical employee as a young person with a technical education background. Graduates represent a key and preferred source of

labour, which is underscored by the fact that more than experience, the ability to learn and other soft skills (team work, foreign language) were considered key by a number of the companies. More experienced employees were sought for team-leading and middle management positions where, in addition to technical expertise, foreign language proficiency, communication and organisational skills, were necessary (cf. Figure 4) (I-3, I-6, I-9, I-16).

The most recent studies evaluating the ICT sector have provided a relatively sceptical view of skills upgrading in foreign companies, concluding that companies tap into existing human capital resources, typically employing university graduates, but do not bring new know-how, nor transfer it to the economies in which they are based (Capik & Drahokoupil, 2011). Hardy, Sass & Fifekova (2011) further find that graduates were desired not because of the knowledge and skills gained during the university studies but specifically because of the language skills they possessed. Our analysis, which looked at different types of IT companies in the two countries, brings a more nuanced view which in particular highlights a hierarchy of competences and positions within the sector (I-2, I-10, I-15, I-11, I-12, I-3).

#### *Restrictive immigration policy as a key barrier*

The more globalised an IT company is and the more it seeks to grow, the more it needs to rely on an international labour pool. Internationalisation can take different forms and affect different parts of the company. Typically, the first to internationalise are the sales and marketing teams. In the case of IT companies with a global presence, other parts of the company internationalise as well, in particular the management and increasingly also the R&D functions. The motives for internationalisation – here meaning hiring non-nationals for key functions – differ: staff internationalisation of sales and marketing typically seeks to ensure foreign language availability for customer support and reaching different markets. The internationalisation of management, we found, is often performed with the aim to attain global recognition and trust and gain access to international networks, know-how (including entrepreneurship and soft skills) and capital. The internationalisation of key R&D functions, as discussed earlier, seeks to ensure continued supply for innovation potential. Depending on its availability at home, firms make decisions about paralleled locations of R&D elsewhere. A flexible immigration framework therefore represents a key institutional area through which supply can be brought in.

While domestically available human capital might suffice in Central and Eastern Europe at this point in time, our interviews have shown that the existing migration frameworks were viewed by innovative firms that seek to recruit internationally and outside the EU as a major obstacle. From this perspective, the EU accession brought about a constraint on recruitment of third-country nationals, as by joining Schengen the Central and Eastern European countries also had to change their policies towards the countries east of the EU, such as Ukraine or Russia, which potentially represent rich pools of IT expertise. Moreover, liberalisation of employment within the EU intensified competition for IT workers and contributed to an IT brain drain from Central and Eastern Europe further West (I-10) (Lauder, 2007; Valášek, 2012).

*'Knowledge content' versus 'knowledge creation': Tasks, skills and R&D hierarchy*

Within the IT sector, a hierarchy of competences and skills exists along technical expertise, management functions and soft skills (Figure 4). While all levels of the hierarchy have a high *knowledge content*, they do not necessarily entail *knowledge creation*. These dimensions and the skill types within them are in close interaction and a combination of expertise is needed at any point in time. Due to the nature of the work – team work, fast changes, the need for continuous learning, the global character of the sector – soft skills such as independence, self-initiative, problem-solving, communication skills, sales skills and foreign language proficiency are needed in addition to a set of technical skills. Even within technical skills, different level of expertise sophistication exists (for example different programming languages in programming segment) (cf. Micek, 2008, p. 176). With increasing hierarchy, more diverse and demanding skills and abilities are needed and education requirements might also rise. In the future, with increasing general knowledge of IT, in-firm IT positions and functions are likely to give way to more innovative occupations, such as network and security specialist, web developers, or designers of new application and games (Valášek, 2012). Interestingly, our interviewees were persuaded that Central and Eastern Europe is very competitive in hard skills (technical expertise) but lacks the soft skills on most levels, and especially with respect to key management positions where networks, access to sources of finance and entrepreneurship become crucial (I-5, I-11, I-8).

In our view, the existence of such hierarchy is not well recognised in policy discourse, simplifying the debate and obscuring the objectives that could be pursued. Similarly, academic literature relying on a value chain framework typically divides value chains into activities of progressively increasing sophistication, at the pinnacle of which is R&D of new products (Capik & Drahokoupil, 2011; Gereffi, 1994; Henderson et al., 2002), failing to recognise a more fractured nature of R&D activities in the software sector.

Acknowledging the hierarchy helps to understand several related issues. The first is the varied sophistication of R&D within the IT sector, which is very often considered a high-tech sector without fully understanding differences in the complexity of conducted tasks. This insight is relevant in evaluating the value added of foreign investors in Central and Eastern Europe. Second, the skills matrix is useful with respect to identifying areas where a particular IT segment/sub-sector might need specialised support and can allow better targeting of policies or possible interventions to the areas where most benefits can be gained. With respect to the institutional framework, this in particular relates to the provision of skills. Third, this hierarchy transfers into recruitment practices, types of demanded skills, forms of labour contracts offered to employees and by extension to the forms of knowledge-sharing and training. In the next sections we discuss these elements in greater detail.

Figure 4. Model of hierarchy of technical expertise and soft skills

R&D hierarchy (hard skill based)	Complexity of management and processes	Soft skill hierarchy
Key element: <b>technical expertise</b>	Key element: <b>management and team work</b>	Key element: <b>range of soft skills and abilities</b>
<b>Conceptualisation and/or creation of new products</b> (ability to anticipate future trends)	<b>Key managing positions</b>  <b>Start-up establishment</b>	Ambition, drive, international networks, self- confidence, presentation skills, sales skills, ability to anticipate future trends, <b>entrepreneurship</b>
Architecture (creativity, thorough knowledge of processes)	Technical account manager	Language proficiency, experience, team work, organising and communication skills, problem solving
Designing (Sophisticated programming skills)	Maintenance and support	Language proficiency, experience, team work, organising and communication skills, problem solving
Coding (simpler programming languages)	Developer - Programmer	Willingness to learn, self-motivation, team work, independence, reliability
Testing	Software tester	Willingness to learn, self-motivation, independence

Source: Authors. Based on interviews and Ali-Yrkkö & Jain (2005).

*How is 'knowledge advantage' being sustained?*

Evaluations of the companies interviewed about the availability of workers and their quality in the IT sector were mixed. In general, the situation is better in the Czech Republic than in Slovakia. It is however clear that the IT recruitment market transcends the political borders of these two countries. This is an outcome of liberalised access of Slovak students to Czech universities and linguistic and cultural similarities, but is also related to locational factors, whereby especially firms located in Brno area count on a potential workforce from nearby Slovak universities in Bratislava or Žilina (I-9, I-8). On the other hand, leading Slovak IT companies – domestic and foreign – actively recruit

on the Czech labour market, sometimes even through an aggressive headhunting among direct competitors (I-3, I-6). Recruitment and employment of IT specialists from the other two countries in the region – Poland and Hungary – is less widespread and the interviewees were typically unable to provide insights into the functionality of those labour markets. The *de facto* unified nature of the Czech and Slovak labour market represent an important ‘competitiveness’ asset for both countries as it effectively enlarges the available human capital resources.

Given the high reliance on an intake of graduates, linking companies directly to education systems and university programs has become a matter not only of competitive advantage but of strategic survival, as it best ensures direct access and selection at a very early stage. Across companies – domestic or foreign, globalised or regional – HR departments made extensive efforts to enter curricula by various means, such as offering classes or lectures, or supervising students. The reasons ranged from gaining direct access to young brains, improving the quality of education or testing the students on initiatives aimed at increasing the attractiveness of technical fields and IT specifically to ensure continued future supply. In the Slovak environment, it has been argued that linking companies to education institutions is necessary also due to a declining quality of students over time (Jarosova, 2008), I-11). Additionally, however, interlinking is conditioned on the nature of the IT industry – its fast pace of advancement leads to a fast growing and increasing gap between what is taught in schools, exacerbated by institutional rigidities in the adaptation of education systems and curricula in the two countries (I-2, I-8, I-4, I-16).

Responding to this challenge, several initiatives trying to create business-education clusters have appeared. Examples include the Kosice IT Valley project<sup>33</sup> or what seems to be a more bottom-up created dynamic in “Brno Silicon Hill” where the IT technological park is co-located with the technical high schools and universities (see also Jarosova, 2008). On the negative side, however, the interviews revealed a complicated procedures and legal environment for establishing more durable and formalised cooperation with the university sector in both countries (I-4, I-8, I-9, I-16). In any case, strong ties to universities as a source of human capital for the firms indirectly result in defining an important feature of the software industry, which is locational concentration in urban centres and well developed areas – primarily in Prague, Brno, Bratislava and Kosice. This is related to two factors: concentration of the availability of graduate supply as well as the preferences of foreign managers to reside in attractive and dynamic locations (Micek, 2008). Although locational concentration or clustering is apparent on the outside, it has not evolved into Silicon Valley type features of interaction where a vibrant exchange of ideas and the quest for innovation and breakthrough is interlinked with a sharing of sales and marketing expertise and search for finance. The Brno cluster, however, might be proving to be an exception.

#### *Labour market institutions (labour legislation and labour contracts)*

The crucial importance of the employees to the success of these companies is well understood and for that reason formal labour contracts and access to training is offered to the core employees. Especially the market leading and innovative companies go to

<sup>33</sup> *The Slovak Spectator* (2009).

great lengths to keep employees by providing additional benefits to ensure their loyalty and satisfaction, gaining in return a generally low turnover of key staff (Andacky, 2004). However, a flexible part of the labour market segment coexists with more secure forms of employment. As described by Benner (2002) for the employment dynamics in the US IT labour market, as in the Czech Republic and Slovakia, subcontracting, labour leasing and flexible forms of employment are widespread. While no precise data exists to estimate the scope of flexible and non-standard employment forms, in the Slovak case it has been estimated to range within double-digit figures (I-2). More research is needed to understand clearer motives behind this, which, we believe, are not independent from labour market legislation in these countries.

Our research so far suggests that flexible practices seem to be used primarily at the highest and the lowest end of the employment hierarchy in the sector. The hierarchy has been described as starting from the highest value-added and innovative types of work, such as architecture and system design to the least sophisticated activities related to the coding or testing of software (Figure 4). This technical expertise hierarchy is cut across a second dimension which is the complexity of management tasks and the range of skills portfolio. Flexible work arrangements come into place in situations when either a highly sophisticated and scarce expertise is needed to solve a specific task or – at the other extreme – to hire people with less sophisticated skills to aid implementation of projects and ensure availability of human resources at peak project times. In R&D and innovation segment, long investment in skills and expertise is a key and therefore both the firms and the employees prefer secure types of employment relations. Therefore, after testing the qualities of the workforce (trial periods, internships, involvement in the teaching process etc.), stable and permanent contracts were offered, with subcontracting or leasing seldom used for the core employees (architects, developers, account managers, persons with long-standing experience).

Table B.1, where we analyse ICT employees in 2010 from the EU LFS data support the observations gained from these interviews. Non-standards forms of employment are not widespread in the EU27 and Slovakia (14% of self-employed), but appear to be more widely existing in the Czech Republic (25% of workers are self-employed suggesting work through sub-contracting). This statistic is however likely to be biased by the inclusion of the telecommunications subsector in the data, which is characterised by formal and stable contracts much more than the IT sector. This we see confirmed in data from 2009 (Table B.2) which show the shares of self-employed workers in the IT sector much closer to the Czech values in Table B.1 (about a quarter of IT employees are self-employed).

Slovak ICT firms also typically offer full time permanent contracts, while the Czech Republic and EU27 are somewhat more flexible in this respect (Table B.1). In the Slovak case, employment in the sector is characterised by the emergence of small businesses which specialise in employing IT specialists and then function as subcontractors for multiple specialised projects for various IT companies. The employees are offered full-time regular contracts, but are not directly employed by main IT employers. Statistically this appears as full time and stable (unlimited contract) employment, but

in effect functions as a flexible arrangement.<sup>34</sup> Since companies were typically able to find alternative means of flexibility, e.g. testing skill potential through internships or hiring through subcontracting, labour code rigidity was rarely considered an institutional barrier or a disadvantage in the two countries studied.

Table B.1 Labour contracts and employment relations in ICT sector, 2010

	CZ	SK	EU27
<b>Self-employed (%)</b>	25	14	14
<b>Employee (%)</b>	75	86	86
<i>Full time (%)</i>	93	98	88
<i>Part time (%)</i>	7	2	12
<i>Permanent contract (%)</i>	91	98	91
<i>Temporary contract (%)</i>	9	2	9

Source: EU LFS, own calculations. NACE Rev. 2 (ISIC Rev. 4), Code J: “Information and communication technology”.

Table B.2 Types of labour contracts in Slovakia – different ICT subsectors (2009)

<b>Reported employees as of December 31st 2009</b>	<b>Employment total</b>	<b>Employees</b>	<b>Self-employed</b>	<b>% Self-employed in total</b>
<b>Publishing, audiovisual and radio activities</b>	9950	5721	4229	43%
<b>Telecommunications</b>	9159	9094	65	1%
<b>IT and other information technologies</b>	19375	13707	5668	29%
<b>ICT sector total</b>	38484	28522	9962	26%
<b>Basic ICT sector total</b>	28 534	22 801	5668	20%

Source: Slovak Statistical Office in ITAS (2011).

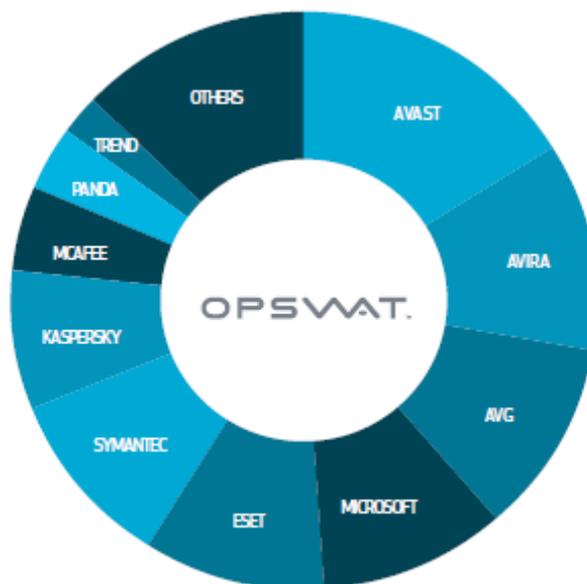
#### IV. Trajectories of antivirus firms

As of March 2012, Avast, AVG and ESET were placed among the five most successful security software vendors in the world with 16%, 11% and 10% of world market share respectively (Figure 5). Their position among the best performing companies has been stable over time. In this section we construct detailed trajectories of the growth of these three companies. We concentrate on identifying breaking points in their development and evaluate the strategy with respect to human capital decisions and the internationalisation of management and research personnel. We pay particular attention to how the process of internationalisation of these firms evolved with respect to the penetration of foreign markets and the professionalisation of management

<sup>34</sup> We would like to follow this up closely with additional interviews with such employers and HR recruiters in the ICT sector.

structures leading to a globalised presence on the market. Three specific and interrelated questions that we address are: *a)* what determines the success of anti-virus companies in the Czech Republic and Slovakia; *b)* to what extent can the success of these companies be attributed to the overall socio-economic model in these countries, and which aspects of it, and *c)* how much have labour market conditions, labour market regulation and skill availability mattered. We begin with short biographies of the three firms, which explain general shifts and key turning points in their developments.

Figure 5. Worldwide antivirus vendor market share, March 2012



Source: OPSWAT (2012).

#### *i. Short company biographies*

**Avast** – originally ALWILL – was established in 1988 by two Czech programming innovators based at Prague's Mathematical Machines Research Institute as a production cooperative to mark cooperation on the writing of first anti-virus able to remove the Vienna virus (Komárek, 2008). The antivirus was initially sold in boxes as a physical product and sales and marketing strategy was oriented towards large firms and the public sector in the Czech Republic. In 1995, firm's antivirus was written to function on the Microsoft platform and in 1996 gained a series of independent awards marking international recognition. A crucial growth factor during the 1990s was the cooperation with McAfee which began using the ALWIL antivirus engine and further licensed it for use in its line of products. Such a partnership was key not only in providing further marketing and evidence of product quality for ALWIL, it also helped to generate finances which helped the company to survive less fortunate years in the sector around the time of dotcom bubble (I-6) and to finance the introduction of the

'freemium' model launched in 2001, following an earlier example of AVG (Grisoft). Free Avast for home end-users, introduced partly due to a lack of capital for international marketing, proved a very successful user community-based model which brought an increase in the visibility of the company on world markets. A further spur to the growth came in the form of a strategic alliance with SanDisc, which offered Avast on its USB sticks. This again served as a way to bring the product to more clients, but its important side effect was the requirement of SanDisc that Avast offers support in multiple languages which spurred the internationalisation of sales staff inside the company.

The company again transformed its legal entity in 2006-2007 when it became a joint stock company, due to better law enforceability and more diverse ownership structure possibilities formally based in the Netherlands. The decision responded to the fact that venture and private equity capital began expressing interest in buying Avast. A minority stake was sold in 2010 to Summit Partners. A major change in the governance of Avast was a professionalisation of its management board, and, especially, the hiring of US-origin CEO in 2009 who agreed to take the position, leaving a competitive firm (Symantec). The management board has since become more internationalised, while Czech-origin managers remain to occupy about half of the management positions. The hiring of an external CEO led to major growth both in employment in Avast and in the consumer base. As of June 2012, it had 150 million active users, and occupied the highest share of the world market (OPSWAT, 2012). This process has been crowned by a decision to file an application for stock market listing in the US (I-6).

**AVG** – originally GRISOFT – was formed in 1989 And the first anti-Virus product was introduced in 1992 to the local market. The company initially generated profit locally from the sales of hardware, which enabled investment into further software improvement. In 1994, a decision was made to specialise in anti-virus software alone and in 1995 the anti-virus began to be offered for free in the English version. This enabled them to enter the market relatively successfully especially the UK. Similarly to Avast, in late 1990s Grisoft offered its licenses abroad – in 1997, the first AVG licenses were sold in Germany and the UK. Further, in 1998 AVG was introduced to the US market by establishing Grisoft Inc. in Delaware. Grisoft then started building an international network of distributors and resellers to provide service worldwide, accompanied by a launch of freemium model (Unknown, 2000). To oversee and manage the sales expansion, a first professional Czech CEO was hired in 2002, by which time the company founder had sold a share to a regional investor company. The investor gradually bought out the company and maximised the investment by selling it to large private equity investors in the mid-2000s. After the entry of larger (and demanding investors) investors, a process of major restructuring of management began, leading to the hiring of a foreign CEO in 2007. Firm's global ambitions materialized in the fact that by 2012, the management of AVG had been fully internationalised and the firm was listed on the New York stock exchange in early 2012 (Orfanus, 2012). AVG keeps its managing headquarters in Prague and technology headquarters in Brno, where it was originally established.

Like the two Czech companies, the beginnings of **ESET** date back to 1987 when two programming engineers discovered one of the first viruses and wrote a program that was able to detect it. Many other discoveries followed and led to the idea to design a

universal solution for viruses. Already in 1990, the firm offered the first version of a program called STOPVIR to the Austrian market. ESET was formally established in 1992. In 1995, a new version of program was created and in the late 1990s, ESET began receiving international recognition for its quality by gaining positive evaluation from Virus Bulletin. In 1999, ESET was established in San Diego in the US with the aim to establish a key sales point, which, however, was brought back to Bratislava in 2009. In the early 2000s, the firm made a technological leap which raised its profile with respect to the quality of its anti-virus product. During the 1990s, the firm targeted domestic corporate customers (mainly small and medium enterprises) and this orientation has remained to date. This has been explained as a key reason why ESET never followed its competitors in the region in using the freemium model, but rather concentrated on self-financed and a well-developed marketing strategy. Also, unlike AVG and Avast, ESET never allowed the entry of private equity capital, or internationalised its management. ESET chose the strategy of penetrating foreign markets through the establishment of sales points, keeping the headquarters and key R&D functions in Slovakia. It was only in the late 2000s that the founders began to seek professionalised management in order to devote more time to strategic thinking and planning (Jarosova, 2008).

#### *ii. Antivirus industry – development and trends*

The antivirus industry belongs to the most sophisticated and technologically demanding segment of the software sector. The architecture of the antivirus software is based on reversed engineering which aims to reconstruct malicious virus codes to disable their functionality. The security software market has followed a similar trajectory to general software internationalisation. Originally, anti-virus programs were sold in national markets and greater internationalisation began towards the end of 1990s, which in the Czech Republic and Slovakia was both a response to a saturation of domestic markets (Unknown, 2000; Koubský, 2000; Andacky, 2004) and a reaction to the wider spread of the internet, which took place earlier abroad than in their home countries. However, the domestic market was important as it provided a space where the products could be tested and developed and from where sufficient income could be generated to enable a process of improvement of the anti-virus software, all the way to gaining international recognition of the quality. The second important feature of the domestic market was the fact that the region was ‘unattractive’ for an earlier entry of private equity and foreign investors while foreign firms on the market were incapable of offering their products in national languages. The combination of these factors provided a period of shielded growth for domestic firms and also relieved the pressure of consolidation, which was taking place in the segment worldwide.<sup>35</sup> The three firms were at the same time able to segment the market (home-end users versus corporate clients), a process which seems to have taken place naturally rather than by agreement.<sup>36</sup> All three companies enriched its product portfolio from antivirus to a full

<sup>35</sup> According to the regional investor in the sector that bought a share in Grisoft in 2001, a merger of the three companies was discussed and suggested by the capital owners, but there was no will on the part of the company founders to pursue it (I-5), or the financial necessity to do so.

<sup>36</sup> For example, Grisoft product was strong in the UK market because it had offered a free version very early on, Avast has a strong presence in France due to the ability to provide its product in French, following the SanDisc alliance.

protection of computers, including malware and spyware detection, as well as the protection of other durables such as mobiles. This, again, reflects a broader trend in the industry of responding to broader and more diversified threats to internet users (both end-consumers and corporate clients) and trends in communication industry generally (e.g. mobile internet) (I-6, I-8).

After a process of relative market consolidation, to which a number of regional companies 'fell victim' (e.g. an acquisition of Romanian GeCad by Microsoft (Microsoft, 2003), the antivirus industry currently consists of 15-20 companies. Among these, Avast, AVG and ESET occupy leading positions in terms of market coverage, which is however still relatively dispersed – in March 2012, the top ten vendors held 87% of the market, with the leading AVG holding 16% (OPSWAT, 2012). Importantly, with the spread of the internet, becoming internationalised in the antivirus sector does not require building physical infrastructure in the target markets, but rather involves sophisticated PR and business strategies that ensure the product is known and purchased by clients. Becoming aware of this, AVG and Avast turned to the freemium business model, and ESET invested heavily in marketing and branding campaigns home and abroad. In sum, in addition to the technological expertise that the companies were able to develop and continuously improve, the ability to market the products was a key to the success of the companies on global markets.

This seems to be partly in contrast to the emphasis placed in current efforts to support start-up firms by ensuring capital availability. Finance in the case of software development is important, but not crucial, neither exuberantly high (unlike in more capital-intensive and innovative sectors, such as bio-technology or pharmaceuticals), and an alternative strategy to venture capital entry is an initial diversification of profit generation activities (I-11, I-16, I-8) (Orfanus, 2012; Andacky, 2009). A more important policy tool might be the creation of a somewhat shielded environment where a firm (or a sector) has sufficient time to develop a competitive product (cf. Kurekova, 2012). The importance of capital availability increases at a later stage in the development of a company, for example, at a point when mergers and acquisitions (M&As) are needed to secure new expertise or develop a particular product characteristic (Andacky, 2009; Orfanus, 2012). In the case of AVG and Avast, finance generated by sell-outs or IPO have been used to pay out profit margins to the owners or as personal rewards to the founders rather than for re-investment in further growth or expansion (I-6) (Orfanus, 2012).

### *iii. Three diverse strategies of internationalisation*

While all three companies are successful in the global security software market, the paths of internationalisation have been diverse. A key explanation for the varied trajectories are the ambitions and views of the founders, which affected their decisions to exit or remain involved in the firm, hire professional managers or directors and, most importantly, decisions to sell out parts or the whole of the firm to an outside investor.

In this sense, AVG has gone the furthest when the key founder exited the company in the early 2000s and invited a professional manager to manage the firm with the explicit agenda to expand into global markets. The investor that initially acquired the firm

persistently pushed the ambition to make (the then) Grisoft a global player, and this further intensified with the entry of large private equity funds. The journey to NYSE entailed a hire of an American CEO with a reputation and contacts and a gradual full internationalisation of the management and board of the company to non-Czech staff. This process was further accompanied by an aggressive and proactive strategy of M&As of promising start-ups across the world with the goal of diversifying the firm's portfolio into further niches and tap into new trends, such as a complex protection of security suites, and the protection of mobiles and androids (I-5). AVG has built an image of US company, transforming it from a family-based small firm with informal relations to a profit-oriented international firm with global ambitions. The quotes below highlight some of the ambitions spurring the internationalisation process.

*“Foreign markets will be crucial for our survival in some form. If we want to be competitive in the world, we need to be big.”*

Jan Gritzbach, founder and at that time CEO of Grisoft in (Unknown, 2000), own translation.

*“AVG has 108 million active users and the number is still growing. Our business has changed a lot. But the biggest change is that already for two months, we are on the stock exchange. Taking a small firm from Central and Eastern Europe, letting it grow and placing it on the New York Stock Exchange (NYSE), this has not taken place here for at least 15 years.”*

J.R. Smith, CEO in (Orfanus, 2012), own translation.

So far a less extensive and more gradual process of internationalisation has taken place in Avast. There, however, the founders have to date kept majority ownership and an active role in the board of the company. The offers received to sell the company or open up to external capital investment in the early 2000s were turned down:

*“Even though we were still facing problems with sales back then we did not consider the offer for a moment. The Americans did not understand it much, but for us it was fun, to run the company as we liked, do what we enjoy and what we are good at.”*

Pavel Baudiš, co-founder in Komárek (2008).

Only in the late 2000s was an agreement made for a minority stake investment by US-based private equity fund. Interestingly, the professionalisation of the management took place before the entry of private equity funds. The founders hired a US CEO through a competitive global search which has transformed the way the company has been managed and increased market coverage and profit margins. Management remains mixed – Czech and international - and the company portrays itself as a Czech-

based and Czech-originated firm. Unlike in AVG, the investor does not directly affect the management of the firm, but its role is key with respect to valuable strategic advice and ties to Silicon Valley (I-6). The investors' role will be instrumental in the planned IPO on the US stock market. The rationale for public listing has been the ambition to achieve a corporate high point but was also justified as a natural step in the firm's organic growth. While Avast has also carried out a few M&As abroad, they appear to be responsive rather than proactive, and based mainly on acquiring human capital in competitor firms in the nearby countries (hence branches in Germany and Austria). This is related to a declared strategy of developing products internally in its key R&D base in Prague, rather than 'buying' knowledge through M&As (I-6). Avast intentionally placed a large sales support centre in the Czech Republic where multiple nationalities were hired to serve the international client base, which was not at all difficult, as the quote below demonstrates.

*"We have an international team, we have English, American, Portuguese, French people working with us. There even is one specialist from China and one from Japan. Prague has a great location, it is beautiful, it is not a problem to get people from all over the world to come here. We can easily be sitting in an unremarkable building in Strašnice and update virus detection in our customers' computers every four hours. We do not need Silicon Valley. The quality is the same but people and rents are higher."*

Pavel Baudiš, co-founder in (Komárek, 2008).

The ambitions and approach of the founders and key owners of the Slovak ESET towards expansion diverge significantly from the paths of the two Czech firms. In spite of the growth similar to the other two firms, in ESET the internationalisation of management has not taken place, nor has to date a stake been sold out to a foreign investor. ESET remains privately-owned and it was only in late 2000s that the founders began to step down from direct management of the firm and sought professionalized management (Jarosova, 2008). A suspicion about the US model of management and the implications of shared ownership structure on company decisions seemed to deter the founders from such steps, as explained in the quote of the founder below:

*"I would not want ESET to become like Symantec. Although Symantec was able to go through an internal change and they are now doing many things better than earlier. But I have an aversion towards traditional American model of management and towards values which are pushed through there. I find it very short-sighted. I see the work with people and values elsewhere – and I think that most employees of ESET too."*

Miroslav Trnka, co-founder and at the time of the interview CEO in Andacky (2009), own translation.

*"Investors who approached us typically thought of it as a quick business - tap on the boom, buy cheap, sell expensive. They were not interested in long-term horizon." ... "We have structured the firm as a long-distance run, a place, where we and our employees can work until retirement."*

Miroslav Trnka, co-founder and at the time of the interview CEO in Andacky (2004), own translation.

ESET chose a strategy of foreign market penetration through the establishment of sale points in all continents (San Diego, USA; Wexford, Ireland; London, UK; Buenos Aires, Argentina; Prague, Czech Republic; Singapore), accompanied by intensive marketing efforts. The M&A strategy has been modest with self-financed acquisitions of a network security company in 2008 and an anti-spam company in 2010. Product diversification and expansion into complex security suites or diversification into protection of Linux products for corporate clients is based on product development conducted mainly in Bratislava and Kosice based R&D units, and recently also in Krakow, Poland (Jarosova, 2008) (I-16).

*iv. Human capital strategies – ensuring innovative capacity*

In spite of diverse trajectories of internationalisation, what unites the three companies is the fact that the R&D basis for core products and often also their offshoots is kept in the home countries. Given the high level of innovation, human capital is a key element behind their success and growth. It is therefore important to understand how the firms deal with growing needs for different types of workers, to what extent the domestic market is able to supply the type and number of workers needed and which strategies the companies are employing. Here, far fewer differences are found than in the other areas described earlier.

First, in all three companies, employees are highly valued and offered permanent and stable work contracts, high pay and other social benefits and advantages, which has led to a low turnover of technical staff especially. This has been a crucial factor for the sustained development of knowledge and innovation. The success of the companies in global markets has made them attractive for employees and therefore successful in recruitment. The firms have been able to hire a sufficient number of workers and cherry-pick among the best, even at a time of increased shortage. To ensure continued ease of hiring, the companies go to great lengths to develop a specific firm identity. Second, the firms have been very strategic in ensuring consistent inflow to ‘fill the pipeline’ by actively seeking cooperation with universities. Such efforts have intensified with their growing need for workers and globally rising demand in the sector. Involvement in the teaching process and other forms of cooperation with education systems represents one form of recruitment. Other forms include direct hiring, marketing campaigns (ESET), outsourced hiring through recruitment agencies, public advertisements, active headhunting as well as referral processes and hiring through networks and contacts of current employees. Third, the firms hire from Czecho-Slovak labour market where there are in effect no language barriers or other major institutional barriers (e.g. 10-20% of developers in Avast are Slovak by nationality) (I-6). Moreover, the firms are interested in expanding the hiring process to the countries outside the EU, such as Russia. This has been extremely problematic due to a restrictive migration policy and a lack of broad infrastructure for the integration of high-skilled immigrants and other institutional barriers (lack of kinder gardens and crèches, possibility to join health care systems and social insurance, multilingual

schools, etc.). An alternative strategy of accessing expertise have been buy-outs of start-up companies which fit into the firms' portfolio (AVG, ESET) or the establishment of smaller R&D branches elsewhere (ESET, Avast).

*v. Why success?*

What then are the key factors behind the success of three antivirus firms in the former Czechoslovakia and how important have labour regimes been in contributing to the given outcomes? The answer that we propose is complex and highlights the interaction of elements which combine to contribute to the observed outcomes. First, the domestic expertise and technical skills existing in the countries at the end of 1980s – and their sufficient supply since then – have been crucial for the initial establishment and continued growth of the companies. Second, the current existence and dominance of the firms would most likely not have occurred had the 1990s been characterised by open and global competition in the security software market. The hesitation of foreign firms to enter local markets as well the existence of language barriers at that time led to the period of 'shielded growth' in the 1990s, which avoided the need to consolidate and enabled the improvement of products, which was a necessary asset. Third, the domestic market was crucial in providing space for further improvement of the products and the generation of initial capital from other activities. The income was used to cross-subsidise antivirus innovation up to the point when it began generating profit itself. This first happened in the mid-to-late 1990s when foreign antivirus firms began to be interested in buying their antivirus engines through licenses, and then continued in the 2000s by the direct online sale of products. Fourth, by then the firms understood the importance of marketing and applied innovative methods to gain a customer base through a freemium business model (AVG, Avast), intensive marketing campaigns or by the development of partnerships contributing the distribution of the products (Avast-SanDisc alliance). The fact that these marketing and sales decisions worked out was as much a planned activity as chance, as the decisions to introduce freemium business model was made due to a shortage of available finance for paid marketing (I-6) (cf. Bell, 1995).

Fifth, the entry of private equity investors into the firms shaped their trajectories with respect to the internationalisation of management expertise, but not necessarily the final outcomes with respect to how successful the firms currently are. More than a source of capital, investors' contribution lies in providing strategic support, especially at a point of international public offering. Sixth, labour regimes have been crucial and beneficial in a number of forms. Labour regulation in its current form is satisfactory and provides a framework that is both flexible and secure. In addition, firms have developed functional alternatives that substitute flexibility (such as internships). The provision of skilled and educated human capital is the key to explaining the success of the three companies. Their supply to date seems sufficient but many indications suggest that much more needs to be done to make the 'knowledge advantage' sustainable. Institutional changes should target the quality of education systems and changes to the migration framework, which are both likely to intensify incoming investment in the IT industry, encourage the growth of existing firms, the location of their key R&D activities in the region, and the emergence of new genuine start-up initiatives.

*vi. Why not elsewhere in the region and why not in other sectors?*

A brief question in the context of our argument is explaining why the antivirus industry did not grow in a similar way elsewhere, and why it is in the east of former Czechoslovakia that it took a rather darker route of virus creation and criminal activity. One possible explanation relates to a combination of locational factors and the level of development in Central and Eastern Europe. Markets in nearby Austria or Germany in the 1990s provided opportunities for the legal employment of IT capacity. In addition a somewhat higher purchasing power enabled the creation of markets for software which further encouraged legal activities rather than illegal endeavours.

A related question that could be posed is why other sectors were not able to emulate the example of the security software industry of domestically-based innovation and global success. We argue that this can be explained by the fact that no other sector was able to combine the presence of home-existent top-notch know-how with being able to gain protection that would allow shielded growth delaying scaling to global markets. Businesses were therefore able to generate sufficient sources for product development internally without external capital injections (cf. Kurekova, 2012).

This still begs the question why similar globally successful firms did not develop in neighbouring Hungary and Poland, which share many of the characteristics of Czechoslovakia. Our study cannot give a definitive answer to this question since no detailed analysis of developments in these two countries took place. However, we can surmise, in addition to individual idiosyncrasies, about two factors. In Poland, the internal market was sufficiently large not to push local firms into a full-scale internationalisation strategy early on (similar factors seem to apply to some firms in Germany or the UK). In Hungary, country's greater openness to FDI affected also the IT sector and early on led to the acquisition of a domestic champion.

## **V. Conclusion and summary**

This paper analysed developments in the IT industry generally and studied factors underlying the global success of the security software industry in the Czech Republic and Slovakia. By gathering rich empirical data through semi-structured interviews with various stakeholders, we were able to see different perspectives on the sector, including those of venture capital investors, public officials, CEOs of successful domestic and foreign companies, or HR heads. Our findings move the existing works in this area forward both empirically and conceptually.

Our empirical contribution lies in identifying recent trends in the IT sector, which suggest that it has become more sophisticated. In particular, a trend towards higher value-added services in the companies established by foreign investors and a continued inflow of firms establishing high valued added units is accompanied by a growing number of domestic start-up firms in the IT industry. Our conceptual contribution lies in linking gradual increase in the sophistication of ICT industry to a model of skill and product/service hierarchy. and to the proposition of a fractal nature of R&D in the IT sector. We tie the skill and task hierarchy to a number of issues, including employment relations dynamics in the sector, upgrading patterns and factors likely to be conducive to further growth of the industry.

The key question we addressed relates to the role of labour regime – defined broadly to include education and skill provision systems as well as labour market regulation - as a factor contributing to the success of three antivirus companies. We find that the contribution of human capital, and forms of its availability stemming from labour market regulation and skill formation regimes was a key and necessary condition in the success of the security software firms. Human capital has also been a key factor in the moving up of foreign-established firms on the ladder of sophistication.

However, while human capital quality and innovation capacity were crucial, other factors were of importance in the growth trajectories of the specific antivirus firms. Firstly, contrary to other sectors in CEE where FDI proved to be crucial to bringing expertise and capital (Bohle & Greskovits, 2006; Kurekova, 2012b) (Bohle & Greskovits, 2006; Kurekova, 2012), the fact that foreign investments in IT sector lagged behind for most of 1990s created a period of shielded growth for domestic companies and prevented them from aggressive competitive pressure. FDI was not necessary because the security software firms had their own expertise that matched or exceeded foreign knowledge, which could be developed due to a lesser need for large amounts of capital. Moreover, the firms were initially able to cross-subsidise anti-virus improvement by retained earnings from other activities and soon after generate profit from licensing their antivirus engines to other companies. The second factor that contributed to the especially fast growth in the previous decade was the timing of the spread of internet in the early 2000s, which spurred online sales, further decreasing the costs of marketing and sales, and enabling the rapid expansion to world markets.

With respect to institutional frameworks, labour market regulation in its current form seems satisfactory and provides a framework that is both flexible and secure. In addition, firms have developed functional alternatives that substitute flexibility, such as the testing of skills through internships or using networks of subcontractors of smaller firms which employ IT specialists on multiple projects at once. Although labour supply to date seems sufficient, more needs to be done to make the ‘knowledge advantage’ sustainable. The current model might be reaching its limits, especially for innovative companies with the ambition to globalise. These need to draw on international expertise and face many barriers that disable it.

Overall, several tentative policy recommendations emerge. First of all, while the development of a competitive advantage in a particular area is not accidental, it is a result of many uncoordinated factors that are impossible to predict in advance. This points to the unfeasibility of narrowly targeted industrial policy.

On the other hand, changes should definitely target the quality of the education system in three ways. One is the general quality of primary and secondary education, with an emphasis on mathematics and other natural sciences. Additionally, the provision of ‘unstructured’ environments and networks for primary and secondary education pupils that are supportive of IT skills development (e.g. computer ‘clubs’, competitions) and can also act as talent-spotting devices should not be underestimated. Thirdly, the relative scarcity of positions in Slovakia at the top of the pyramid in Figure 4 points to the fact that not only quantity, but also the quality of IT graduates is important.

To broaden the talent pool, changes to the migration framework to enable recruitment outside the EU is also important. The European Union has created the Blue Card program (equivalent to US Green Card), which has recently been transposed to member states' legislation. Through easing and fast-tracking entry conditions for – *inter alia* – knowledge workers, it appears to be ideally suited to assist on this front. Its application should be evaluated and built upon.

These steps, we believe, are likely to intensify a further inflow of FDI into IT industry; support shifts further up the R&D hierarchy that exists in the sector; encourage the growth of existing firms and location of their key R&D activities in the region (rather than abroad); and support the emergence of new genuine start-ups.

## Joint conclusions and findings

This report studied the link between labour regime and technological innovation in Central and Eastern Europe, analysing in considerable detail two key sectors which differ in a number of respects but have gained important positions in the economies of Central and Eastern Europe – the automotive and software industries. Defining success as a move up-market in the complexity of a given production and/or gaining of a dominant and stable share in the world markets, both sectors have been successful regionally and in selected aspects also in global terms, although the character and level of innovation and R&D within them differs. Human capital represents a key input in these skills-intensive industries, which warrants our focus on labour regimes.

Our general finding is that for both types of innovation – ‘imported’ which prevailed in the automotive sector and ‘indigenous’ that was shown to exist relatively widely in the software industry – the availability of human capital, its structure and skill-sets have been crucial for the higher-end activities to be localised or generated in Central and Eastern Europe. Many aspects of labour regime as it has existed have been decisive, while strategies that firms resorted to highlight potential limits of the existing institutional framework.

Generally speaking, labour market regulation, but even more so its amenability, in various ways seems in these two particular sectors to be adequate: in the automotive industry, functional industrial relations and in most cases balanced positions of management and unions lead to broadly acceptable outcomes, which during the crisis provided a necessary combination of flexibility and labour force stability. For the software industry, existing alternatives of various forms of employment (subcontracting, labour leasing) ensure flexibility in the necessary types of work (high-end and low-end) and in adequate points of product or service cycle, contributing to the vibrant and dynamic functioning of the sector. In both sectors, various forms of labour market flexibility and labour pool flexibility have been important factors in explaining sectoral success and growth, leading to an improved position in the global division of tasks. To date, however, the region still falls short of competing with the leaders in innovation.

On the other hand, education and skill provisions systems are becoming weak points in the institutional design of CEE economies. As companies in the two sectors upgrade and attempt to move up in the value chains, they increasingly face limitations on the recruitment of adequate number of workers with sufficient levels of skill, and even more so, with a sufficient *variety and combination* of skills. Companies across two sectors have adopted a set of strategies to ensure the adequate provision of skills. All major and successful firms have already initiated a direct connection with education and skill formation systems. The automotive companies where resources in one company are generally more sizeable have established their own educational institutions or become affiliated with secondary and tertiary programmes, albeit on scales required primarily for production purposes and not for elevating their status into leaders in R&D. IT firms and employees are actively involved in teaching or curricula formation at adjacent universities or even make efforts to reach out to students abroad. Software firms

employ a ‘regionally international’ labour force: this is less important in the automotive sector and occurs only within companies. Up to now, the fact that recruitment in both sectors crosses the country borders and is regional has contributed to the growth of these industries in the individual countries as it effectively enlarges the available and accessible labour pool, creating regional competitive advantage.

Both sectors already rely on foreign labour outside the region, but the education and skill levels of imported workers in the two industries differ markedly. In the automotive sector, there is a clear hierarchy, with foreign workers being overrepresented at the bottom of the skills pyramid, which is also linked with higher incidence of agency work or non-standard contracts. There does not appear to be any clear trend towards the localisation of top management and one could even argue in the opposite direction. To use an example of Skoda, early on after the privatisation the top management team was predominantly Czech working with German advisers. The top team now seems to be global and predominantly German. Top managers seem to be part of an inner core that moves around the world. If they are of local origin, that may be little more than coincidence.

In the IT sector, especially in the globalised indigenous antivirus firms, foreign labour is hired for more varied tasks (customer support, sales), including the key management positions. Indeed, for firms with foreign investors and / or IPOs, the ‘Americanisation’ of management appears to be a part of the overall ‘standardisation’ process. Moreover, there are growing efforts to import foreign engineers into the R&D segment where IT firms face great barriers and have to contend with a poor institutional framework that would enable smooth employment and the integration of families of employed highly-qualified workers. For the automotive sector, migration policy is less of a pressing issue. Much evidence was gathered that for the IT industry, restrictive immigration policies from outside the EU represent a major constraint.

With respect to clusters we found that while the geographical concentration of firms takes place in both sectors, it falls short of bringing ‘clustering’ benefits, such as pooling or sharing of knowledge and growth of start-up companies. In the automotive sector, intensive links exist between the car assembly and the network of supplies, related largely to the lean production and just-in-time delivery systems of production and process organisation. Outside these networks, communication between different car producers remains limited and they compete for similar type of workers. Geographical concentration creates competition between the companies for a suitable labour force. IT firms cluster in urban areas – in close vicinity to the universities which serve as a key source of stable workforce. Again, cooperation and the exchange of ideas is limited. The globalised firms, however, establish a direct connection to the Silicon Valley in search of clustering benefits, such as a source of financial capital, non-technical knowledge or investment opportunities in companies that complement their portfolios.

With respect to numerical and functional flexibility, these take a different form in the two sectors. In the automotive industry continual fluctuations in demand for individual products require continual adjustments in labour input. This is not related to the innovation process as such, but stems from the nature of mass production. Flexibility has been achieved by creating dual labour markets – with a stable core and a

less secure periphery – but the forms vary between countries, firms and even branches of the same firm. Flexibility is also achieved by varying hours worked and that too requires navigation through legal and institutional environments. The experience of the post-2008 economic crisis illustrates the practical scope for flexibility, showing that constraints on German MNCs were significant but ultimately surmountable in ways that were judged satisfactory enough for firms to continue with their investment plans. Thus the inflow of technology, still dependent on R&D undertaken elsewhere in the world, could continue, albeit without an upgrading that would be necessary to make the region a significant innovation centre in the sector.

## Annex 1 Part B. List of interviews and codes

Code	Interviewee
I-1	Angel investor and private entrepreneur in web and communication field, Slovakia
I-2	IT Association, Slovakia, Director
I-3	Microsoft, Head of Human Resources
I-4	ASSECO, Former Head of Human Resource
I-5	Venture Capital Fund Owner and Regional Private Equity Investor
I-6	AVAST, Chief Technology Offices
I-7	IKT Union Czech Republic, Vice-Chairman and Former CEO of Oracle
I-8	AVG, Former CEO and Chief Technology Officer
I-9	RedHat, CEO and former CEO in AVG
I-10	CzechInvest, Former Director
I-11	ESET, Former director for Sales and Marketing
I-12	Web business entrepreneur
I-13	SARIO, Project manager for research and development
I-14	SARIO, Marketing and communications director
I-15	Venture Capital Investor
I-16	ESET, Founder

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# ABOUT NEUJOBS

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## “Creating and adapting jobs in Europe in the context of a socio-ecological transition”

NEUJOBS is a research project financed by the European Commission under the 7th Framework Programme. Its objective is to analyse likely future developments in the European labour market(s), in view of four major transitions that will impact employment - particularly certain sectors of the labour force and the economy - and European societies in general. What are these transitions? The first is the **socio-ecological transition**: a comprehensive change in the patterns of social organisation and culture, production and consumption that will drive humanity beyond the current industrial model towards a more sustainable future. The second is the **societal transition**, produced by a combination of population ageing, low fertility rates, changing family structures, urbanisation and growing female employment. The third transition concerns **new territorial dynamics** and the balance between agglomeration and dispersion forces. The fourth is a **skills (upgrading)** transition and its likely consequences for employment and (in)equality.

### Research Areas

NEUJOBS consists of 23 work packages organised in six groups:

- **Group 1** provides a conceptualisation of the **socio-ecological transition** that constitutes the basis for the other work-packages.
- **Group 2** considers in detail the main drivers for change and the resulting relevant policies. Regarding the drivers we analyse the discourse on **job quality**, **educational** needs, changes in the organisation of production and in the employment structure. Regarding relevant policies, research in this group assesses the impact of changes in **family composition**, the effect of **labour relations** and the issue of financing transition in an era of budget constraints. The regional dimension is taken into account, also in relation to **migration** flows.
- **Group 3** models economic and employment development on the basis of the inputs provided in the previous work packages.
- **Group 4** examines possible employment trends in key sectors of the economy in the light of the transition processes: energy, health care and goods/services for the **ageing** population, **care services**, housing and transport.
- **Group 5** focuses on impact groups, namely those vital for employment growth in the EU: **women**, the **elderly**, immigrants and **Roma**.
- **Group 6** is composed of transversal work packages: implications NEUJOBS findings for EU policy-making, dissemination, management and coordination.

For more information, visit: [www.neujobs.eu](http://www.neujobs.eu)

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