

Chapter 8

Globalisation, decarbonisation and technological change: challenges for the German and CEE automotive supplier industry

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Introduction

The automotive industry is going through a phase of profound change. On the one hand, we can see the continuing and deepening globalisation of companies and value chains. The global rise of emerging economies as automotive markets and as locations for automobile production is having a strong impact on company strategies. This development requires companies to rebuild their location structures and supply chains, and it also puts pressure on traditional high-wage locations in Europe.

On the other hand, technological change is forcing companies to rethink their business strategies, products and processes. In particular, the increasing demand for clean propulsion technologies – and the emerging transition from the combustion engine to electric mobility – imply significant changes in the automotive industry. At the same time, technological innovation processes in the field of autonomous driving and in the area of advanced manufacturing techniques are becoming increasingly important.

These developments give rise to a number of questions about the future of employment in the German automotive industry. What are the risks of relocation processes and under what conditions can employment be safeguarded at high-wage locations? How are skill requirements changing due to new technologies and what impact will electric mobility and digitalisation have on employment?

From a German perspective, the major concerns are over the future of established high-wage locations, which will have to compete with low-wage alternatives, and the question of how to maintain technological leadership in changing conditions. From the point of view of low-wage countries, in contrast, the major issue is the potential for upgrading. Between Germany and central and eastern Europe (CEE), a closely intertwined production network has emerged. In the process, CEE plants have developed from being mere ‘extended workbenches’ into modern production facilities which are competing with German locations on an increasingly equal footing as far as products and process technologies are concerned. But what opportunities are there for further upgrading and how will technological change affect these locations?

This chapter differs from most existing studies in terms of its focus and approach. First, while a majority of authors focus on automobile manufacturers, here we discuss the development of automotive suppliers in the context of digitalisation processes and technological change. Second, this chapter emphasises the difference between developments at company level and those at plant level. While it is possible that

technologically strong automotive suppliers will benefit from developments in the field of electric mobility or autonomous driving, it is unclear how this will affect plants in different geographical regions. Will future products be produced in high-wage locations or directly in low-wage countries?

Our analysis is based on case studies of automotive supplier companies as well as a survey of employee representatives (works councils in Germany; workplace trade union chairs in CEE).¹ In total, 145 employee representatives from German plants and 125 employee representatives from CEE plants (in Poland, Czechia, Slovakia and Hungary) participated in the survey. With regard to the mixture of plants involved by employment level and product segment, the survey was composed from a representative sample within the automotive supply industry. There is a certain bias with regard to company ownership structure: the plants included in the analysis belong overwhelmingly to multinational supplier corporations. Plants operated by local companies without operations in other countries represent a small minority (five plants in Germany; two in CEE). For more information regarding the data and methodology, see Schwarz-Kocher *et al.* (2019).

This chapter does not aim to develop scenarios or make forecasts. The direction and speed of technological change seems too uncertain to advance this, as do the shifts in automobile demand. Neither does it aim to address all the future changes facing the automobile sector. Instead, it concentrates on analysing the current situation of German and CEE automotive supplier plants, based on empirical data, in order to discuss potential future developments both in Germany and in CEE.

Section 1 discusses the processes of globalisation and technological innovation as major drivers of change in the automotive sector. Section 2 examines changes in the German automotive supply sector. It analyses the strategies of automotive suppliers and the role that German manufacturing facilities play in the introduction of new products and technologies, i.e. their innovation-related role, and discusses the relationship between these roles, skill structures and trends in employment. In Section 3, the analysis turns to developments in central and eastern Europe, which is the central low-wage region for the European automotive industry. The focus is, once again, on the role of sites in introducing new products and technologies, and features a discussion of both the extent and the limits of the upgrading of low-wage locations within Europe. Section 4 comprises the conclusions.

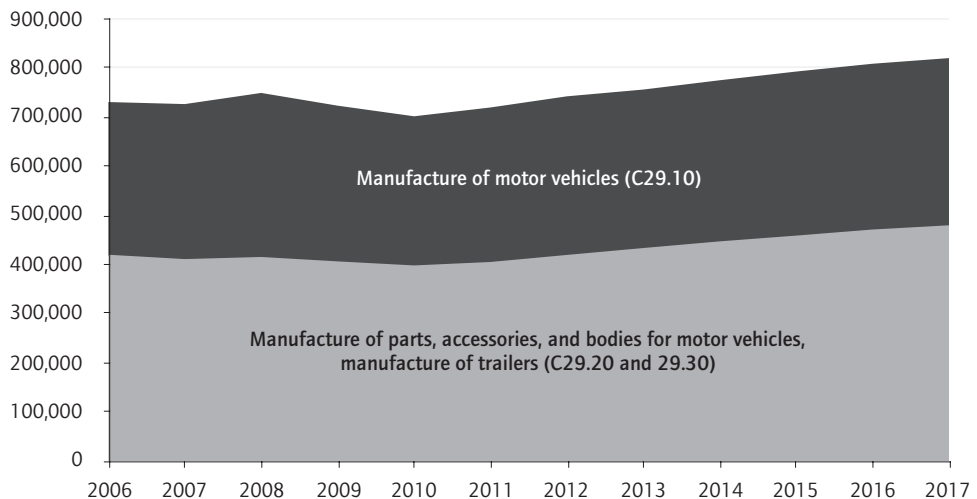
1. The analysis is based on the *Prospects of the Automotive Supply Industry* research project, implemented in 2015 and 2016. The project was conducted by Martin Krzywdzinski and Axel Schröder (WZB) along with Martin Schwarz-Kocher, Heinz Pfäfflin, Hermann Biehler, Yalzin Kutlu and Walter Mugler (IMU Institute); and Inger Korflür, Ralf Löckener and Arne Vorderwülbecke (Sustain Consult). It was funded by the Hans-Böckler-Stiftung.

1. Globalisation and technological change: the major drivers of sectoral transformation

At first glance, it seems the German automotive industry has weathered the collapse of the 2008-9 crisis. Automobile production in Germany plunged from a peak of 5.7 million vehicles in 2007 to 4.9 million in 2009; however, the number of automobiles produced once again reached 5.7 million in 2015, with production stagnating at this level both in 2016 and 2017.

Employment in the automotive industry has also recovered (see Figure 1). From 2010, the peak of the crisis, to 2017, employment in the German automotive industry increased by over 100,000 to 820,000 and has thus clearly exceeded pre-crisis levels. This increase is mainly attributable to the automotive supplier sector; employment in automotive manufacturers has remained stable. Employment trends in the German automotive industry are significantly different to those in many neighbouring countries such as France.

Figure 1 Employment in the German automobile industry (C29*), 2006-2017



Source: Author, based on VDA (German Association of the Automotive Industry) (various volumes).

Note: * C29 stands for 'manufacture of motor vehicles, trailers and semi-trailers' in the NACE sector classification.

However, this positive development should not lead us to overlook the many forces that are significantly changing the structure of the industry. Two important factors are changes in global market structures; and changes in mobility and environmental policies.

1.1 Globalisation

One major characteristic of the ongoing changes in market structures is that growth is slowing in European markets while it is expected to continue in China and in other emerging markets (perhaps even in the USA). The long-term effects of the economic, financial and sovereign debt crisis of 2008 and the applied adjustment policies, both at EU and member state level, have had negative effects on growth in Europe and, above all, in its southern parts.

The shift in growth markets from Europe to Asia, and especially to China, has posed major challenges for the German automotive industry's innovation and export models. Markets outside of Europe may formerly have purchased automobiles produced primarily in Germany; now, a global production and innovation network has developed that supplies regional markets with regionally-produced automobiles (Weber *et al.* 2013; Voskamp and Wittke 2012; Freyssenet *et al.* 2003). From the perspective of the German automotive industry, a shift has occurred from export-dominated vehicle production to a multi-regional network encompassing different regions of the world. This can be illustrated by the development of the German automotive industry's sales and production figures between 2008 and 2016 (VDA 2017). In this period, the total sales of German car manufacturers increased from 10.1 million to 14.7 million passenger cars. This total increase of 4.6 million passenger cars, however, took place nearly exclusively in foreign markets and was boosted by the expansion of production capacities abroad, German domestic production and export figures having remained constant during this period.

These shifts have been accompanied by structural change in the German automotive industry. The production of vehicles in the premium segment has increased significantly while the output of traditional mass producers has decreased (Krzywdzinski 2014a). Of the roughly 6.5 million premium vehicles sold worldwide in 2012, eighty per cent came from German brands, according to the VDA. In the upper class segment, it was nearly 100 per cent in 2010 (see Diez 2015). In the premium sector, there has even been a trend towards more production in German locations (Schade *et al.* 2012: 94). Up to now, products that are largely or exclusively price sensitive have been relocated abroad; high-quality and innovative products tend still to be produced in German locations, in close proximity to company headquarters.

These shifts in the global footprint of the original equipment manufacturers (OEMs) are also affecting suppliers. More than fifteen years ago (in 2003), 34 per cent of German suppliers already had overseas production facilities. There are no directly comparable recent data. This globalisation process has been driven particularly by tier 1 suppliers (see Kinkel *et al.* 2004: 6). In 2012, 65 per cent of the plants of the larger German automotive suppliers (i.e. with more than 1,000 employees in total) were located outside of Germany; in the case of smaller automotive suppliers (fewer than 1,000 employees in total), it was 12 per cent (IWD 2012).

At the same time, the demand from German premium manufacturers remains an important reason for the stability and growth of employment in German automotive

supplier locations. It is also true that, as a result of the strong focus on premium customers, German supplier locations very frequently produce high-end products.

1.2 Environmental regulation and technological change

Technical changes in products that are largely driven by regulatory mechanisms formed from the political environment are having a similarly huge impact on corporate strategies in the automotive industry. Global warming and its potentially catastrophic consequences have put pressure on an international community which has been struggling for years to limit the emission of greenhouse gases. At the UN Climate Change Conference in Paris in 2015, the parties agreed to limit global warming to two degrees centigrade, and preferably to 1.5 degrees. To achieve this, greenhouse gas emissions will have to be reduced to zero between 2045 and 2060. This will only be possible by shifting to renewable energy, achieving greater levels of energy efficiency and making energy savings. The EU wants to reduce CO₂ emissions by at least forty per cent by 2030 compared to 1990 levels. Furthermore, Germany wants to reduce greenhouse gas emissions by forty per cent compared to 1990 by 2020, although the country is likely to miss this target (see Kersting and Stratmann 2018), and then by 55 per cent by 2030, 70 per cent by 2040 and by 80 to 95 per cent by 2050.

The general EU policy also requires the automotive industry to achieve CO₂ savings that, from today's perspective, are very demanding – at least, if we assume the continued use of combustion engine technologies. In 2017, the fleet average of the major German car manufacturers (including Volkswagen, Audi, BMW and Mercedes-Benz) reached 120-130 grams of CO₂ per kilometre. An outlier was Porsche, with 178 grams. By 2021, the allowed fleet average of each automobile manufacturer will be 95 grams per kilometre. The goals for 2030 were subject to a lengthy debate, with the European Parliament proposing a reduction of forty per cent compared to 2021 (i.e. of 38 grams per kilometre) while the European Commission argued for a thirty per cent reduction target. In early 2019, the European institutions finally agreed on a reduction scenario of fifteen per cent by 2025 and 37.5 per cent by 2030 (European Council 2019).

Meanwhile, diesel engines, which are relatively efficient regarding CO₂ emissions and have been preferred by German manufacturers, are facing problems in meeting the increasingly stricter EU regulations on particulate matter pollution and the thresholds for NO_x emissions (see DLR and WI 2015). It seems that diesel technology has peaked and that the previously achieved savings in NO_x emissions were, at least partially, fictitious and based on fraud. The increasing demand for petrol-based combustion engines, however, creates considerable problems for German automotive companies due to the higher CO₂ emissions compared with diesel technology. If the Paris Climate Agreement is to be respected, then the transport sector will have to reduce its CO₂ emissions to around zero by 2050 (EU Commission 2018). From today's perspective, electric vehicles are the only way to achieve this goal – provided that fossil fuels also become a considerably less important component of power supply.

Despite the tightening of the environmental regulations, however, the extent to which the conversion to electric mobility will succeed remains unclear. Public subsidies have been made available to buyers of electric vehicles, yet their sales in Germany are still lower than expected. Commerzbank experts estimate that ‘a significant market for pure electric cars will not develop until 2025’ (Commerzbank 2016: 18).

The introduction of electric mobility is expected to have significant employment effects. However, it is difficult to judge how long this introduction will take and how long internal combustion engines and hybrid solutions will remain dominant. The ELAB study (Bauer *et al.* 2012) used the example of an ideal engine factory to investigate several scenarios of how the transition from combustion engines to electric mobility would affect employment. In the scenario judged most realistic by the study’s authors, hybrid vehicles will play an important role until around 2030, as pure electric mobility will gain in importance only relatively slowly due to limited battery capacity, a lack of charging infrastructure and other factors. In this scenario, employment in engine manufacturing will remain constant since both internal combustion engines and electric motors will be produced in parallel.

The ELAB study is, however, limited to examining the change in engine factories; the impacts of the shift towards electric mobility on engine component suppliers have, so far, not been systematically examined.

Another set of largely unclear consequences relates to the technological changes associated with autonomous driving and how these changes will impact employment in the automotive industry. It should be emphasised that, so far, the only autonomous driving automobiles on the road are prototypes, be they for Audi, BMW, Daimler or Volvo. Nevertheless, innovations in autonomous driving technologies are expected in the coming years (see Commerzbank 2016: 15; Roland Berger and Lazard 2016: 33). On the one hand, autonomous driving is expected to have a significant negative impact on demand for vehicles and thus on employment (Groshen *et al.* 2018); on the other, the technologies used are already well-known (radar systems, sensors, cameras) and are produced not only by the major suppliers (Bosch, Valeo, Delphi, TRW, Magna and others) but also by companies outside the automotive sector. Demand for these components can be expected to increase further and to create growth opportunities for electronics suppliers or software-oriented companies (Roland Berger and Lazard 2016: 34).

2. The automotive supplier sector in Germany: the company and the plant-level perspective

When analysing the automotive supply sector, it is important to distinguish the company level from the plant level. Available analyses of the automotive supply industry mostly use company-level data to conclude that the industry is highly competitive and innovative, with good growth prospects. However, even if companies’ growth strategies are successful overall, they may well lead to problems in certain regions and individual locations – for instance, when all of the growth is taking place in emerging economies

and traditional high-wage locations have stagnated or even lost jobs. High returns and competitiveness at company level are perfectly compatible with low returns and the presence of competitiveness issues in individual plants in different locations.

For this reason, the following analysis begins by describing the general development trends in supplier companies and then turns to the situation in German locations.

2.1 The company perspective: strategies of automotive suppliers regarding globalisation and technological change

The two key challenges for automotive suppliers are to drive innovation and, at the same time, to establish themselves as global players with locations across the world and not just in Europe. For quite some time, the research literature has identified changes in the automotive industry's innovation systems, which can be described as 'The end of OEM-centred development and a shift towards network-based innovation [own translation]' (Blöcker *et al.* 2009).

In order to analyse the role of automotive suppliers in the sector's innovation systems, it is important to differentiate between the different types of innovation and their specific contexts. The OSLO Manual (OECD 2005) distinguishes between product and process innovations as well as between marketing and organisational ones. Kinkel *et al.* (2004) distinguish between product innovation, service innovation, process innovation and organisational innovation (see also Dreher *et al.* 2005; Schwarz-Kocher *et al.* 2011). In doing so, they emphasise the interdependence of the four types of innovation. A new product might require new process technology, a new service might require modifications in the product and organisation of customer service processes, and a new production technique might be better deployed if the product is modified, etc. (Porter 1996; Gerybadze 2004).

The focus of innovation activities among automotive suppliers has long been on process-related issues. The ability to use process innovations in order to capture greater value are decreasing, however, as highly-optimised production processes are now already the basic precondition for any order by an OEM. For this reason, automotive suppliers can use their process expertise to achieve better margins only to a very limited extent. Many studies therefore see the shift towards product innovations and closer links with OEM product development processes as a key success factor for suppliers (Commerzbank 2014; Roland Berger and Lazard 2013). In the case of highly innovative products based on newly-developed manufacturing concepts, suppliers can use their knowledge advantage *vis-à-vis* OEMs to achieve an additional 'innovation margin'.

Schwarz-Kocher *et al.* (2019) argue that this has led to a specific innovation type becoming more and more characteristic of the automotive supply industry: production knowledge-based product innovation. There are several reasons for this. First, innovation often focuses on product ideas that are developed directly, based on suppliers' manufacturing experience. Second, many innovation processes involve the successful integration of production knowledge into product development. These

findings confirm the importance of closely linking development and production, as evidenced in various studies, but they also underline the relevance of linking these two functions with others, such as sales and procurement (Fujimoto 2000; Jürgens 2000; Lazonick 2005; Krzywdzinski 2016). Our interviewees in the automotive supplier case studies pointed out that cooperation between product development and production requires direct (and also informal) communication. Similarly, Voskamp (2005) has pointed out that the ‘interdependencies between individual functions (such as product development and manufacturing)’ cannot be adequately supported simply by exchanging codified knowledge.

Innovative strength is becoming increasingly important for the survival of automotive suppliers due to the increasing importance of electric mobility, autonomous driving and automobile software. In the field of engine components, suppliers are being greatly affected by the impending end of the internal combustion engine: here, jobs relating to injection systems, engine castings and other components are at risk. The diesel crisis has further aggravated this development, especially as far as Bosch is concerned. Bosch is the world’s leading manufacturer of diesel injection systems. Injection systems for diesel engines are significantly more complex than for petrol engines and their production requires significantly higher staffing levels. In this respect, the shift from the diesel to the petrol engine poses a problem, even without taking electric mobility into account. All of this puts suppliers under pressure to develop new products.

However, automotive suppliers not only need to strengthen their innovation capabilities, but also master the OEM-driven globalisation process. It is clear that suppliers can only supply OEMs if they also produce globally. In addition, the emergence of OEM R&D centres outside Europe also means that suppliers have to organise their development processes globally. This is often referred to as ‘following the customer’. However, once OEMs have established foreign locations, they may attract other customers and start to supply other OEMs, including local ones. While all major suppliers are being challenged by this development, smaller suppliers are often barely able to keep up with it.

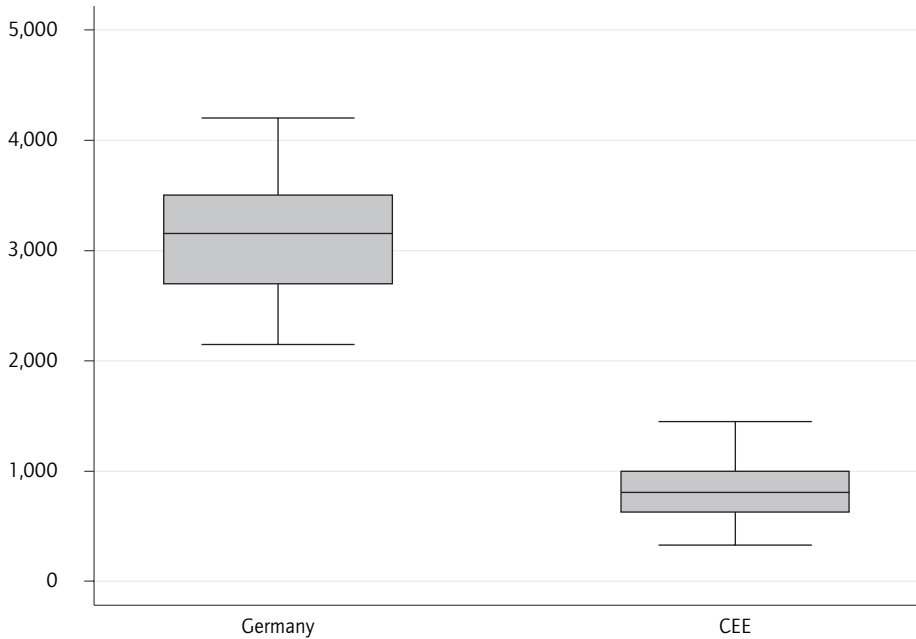
The extra- and intra-European internationalisation of production networks follows different logics. Intra-European internationalisation in the automotive supply industry is mainly driven by labour cost differences and less by ‘following the customer’ and market access motives. As our survey shows, the pure wage gap between Germany and CEE is still substantial today (Figure 2). The median value of wages (illustrated by the black line inside the grey boxes in Figure 2) for production workers in Poland, Slovakia, Czechia and Hungary were around 27 per cent of the German peer group (€835 compared to €3,122).²

There is a large variance within CEE. The lowest wages for production workers are usually paid by electronics and interior parts companies and reach around €300-400 per month. This is just above the minimum wage level in the region and is barely enough to survive on. The wages of production workers in the best-paying companies,

2. We compared gross salaries. We did not take into account differences in productivity or quality but we did allow for differences in working hours and leave entitlements.

however, go up to €1,400 per month. Substantial wage increases took place in CEE in 2017 and 2018 due to labour shortages and increased bargaining power, but the wage gap to Germany remains significant.

Figure 2 Median value and variance of gross wages of production workers in euros in the German and CEE automotive supplier industry, 2016

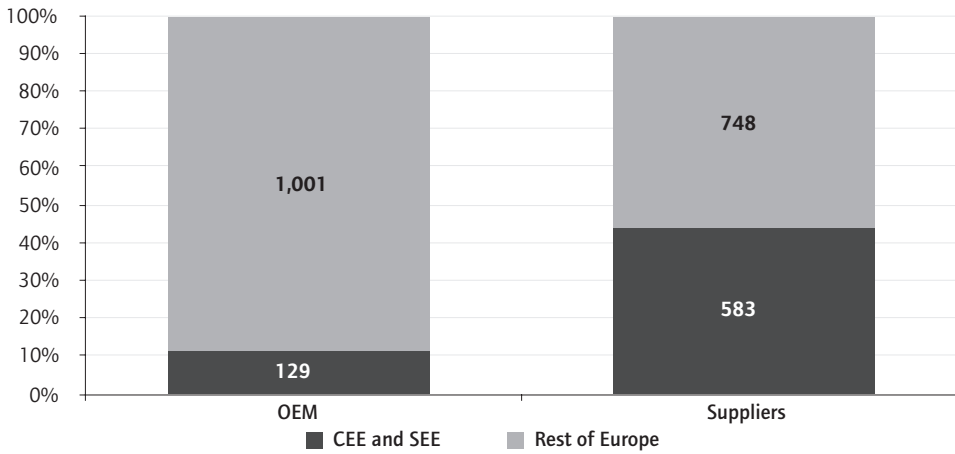


Source: Krzywdzinski *et al.* 2016. Wage levels for production workers with vocational education and five years of job tenure.

During the first waves of production relocations from Germany to CEE in the 1990s, there were many cases of failure. For instance, in 2008, Kinkel *et al.* concluded that ‘every fourth to sixth offshoring is followed by a re-shoring within four to five years’ (Fraunhofer ISI 2008). However, these negative experiences did not lead to the abandonment of the strategy of offshoring to CEE. Suppliers learned from such experiences and have increasingly transformed their CEE locations from ‘extended workbenches’ into fully-fledged production plants (Jürgens and Krzywdzinski 2010; Krzywdzinski 2016). The earlier east-west differences in product quality and productivity have, for the most part, been fully offset. In fact, CEE locations seem, in many cases, even to be at an advantage when implementing lean production concepts. This advantage is based on new factories being set up for the most part on greenfield sites and recruiting the first levels of shopfloor supervisors from among the pool of local young people with college degrees.

It is striking that automotive suppliers have opted to use the low-cost region of central eastern and south-eastern Europe much more than the car manufacturers. Only 11 per cent of intra-EU OEM employment is located in CEE countries while in the case of automotive suppliers it is 44 per cent (Figure 3).

Figure 3 Automotive original equipment manufacturers (OEM) and supplier employment, by region, in thousands, 2016



Source: Author, based on VDA (2016). 'CEE' includes here Czechia, Hungary, Poland, Romania, Slovakia and Slovenia; 'Rest of Europe' includes western, northern and southern European countries with a relevant automotive industry.

CEE has become the major sourcing region for parts and components for the German automotive industry. For German automotive suppliers, however, there is a tension between globalisation and innovative capability, a factor which has too often been overlooked in previous research studies. The innovative strength of suppliers has largely been based on long, historically emerging network relationships, cooperation and knowledge exchange between R&D sites in Germany, regional universities and research institutes, nearby production equipment manufacturers and suppliers' own production facilities. As production becomes globalised and is relocated from Germany to foreign locations, the question arises as to whether these cooperative relationships are breaking down and, if so, whether the ability of automotive suppliers to innovate is thus being weakened.

2.2 The plant-level perspective: Relocation pressure and the changing roles of manufacturing plants

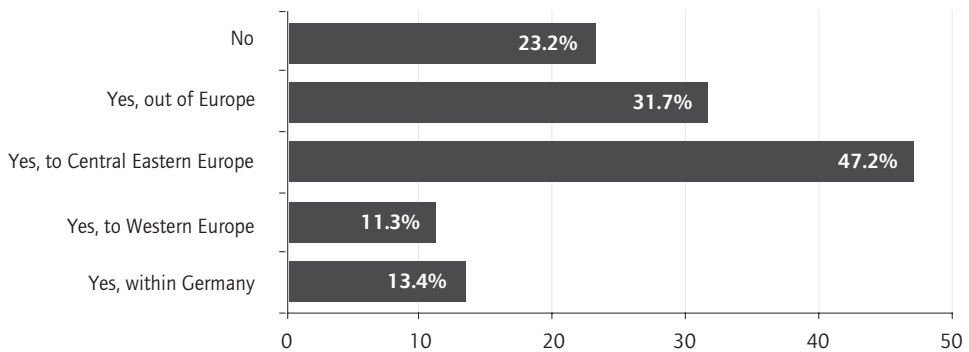
How far does the situation of automotive supplier plants in Germany and CEE correspond to the overall successful development of automotive suppliers? And how are the functional roles of German production plants evolving?

There are several factors which play a role here. On the one hand, strong technological innovation dynamics seem to require the further development of plants' existing production capabilities and knowledge. On the other, the establishment of new plants in CEE countries is putting pressure on production employment in Germany. The expansion of production networks to CEE is often experienced by German production plants as a relocation of jobs even if, strictly speaking, it represents in most cases an expansion of existing production capacities rather than relocation in the narrower

sense. Companies often use products' natural life-cycles to end the production of a particular product at German locations and shift it to CEE.

Nevertheless, relocations in the broader sense remain relevant. In our survey, over 47 per cent of German works councils stated that there had been relocations of production or other functions to CEE from their site in the past five years (Figure 4). Only 23 per cent of plants had not experienced any relocations in the last five years.

Figure 4 Relocations of production from German automotive supplier plants, 2011-2016



Source: Author, based on Krzywdzinski *et al.* 2016.

Of course, relocations do not necessarily have negative consequences for the affected plant; often, old products are relocated to make way for new ones. However, 33 per cent of surveyed works councils in automotive supplier plants in Germany indicated that there had been a reduction in jobs due to relocations.

The strong competitive pressures on German production plants explain why, despite good industry returns, concession bargaining has been evident at many automotive supplier locations. Good returns at company level do not necessarily mean high returns at the level of German production sites. Our survey shows that, over the last five years, in 46 per cent of supplier factories, wage concessions have been agreed to prevent relocations or to gain new products for the plant.

However, there are indications that a manufacturing plant's innovation-related competences have a significant impact on the extent to which it is under relocation pressure and might suffer losses of employment. In this regard, the following competences are particularly important:

- cooperation between manufacturing and R&D in the development of new product ideas;
- industrialisation and the ramping-up of new product generations or completely new product groups;
- testing and implementing new manufacturing processes and automation concepts;

- supporting other plants in the production network when introducing new products and technologies.

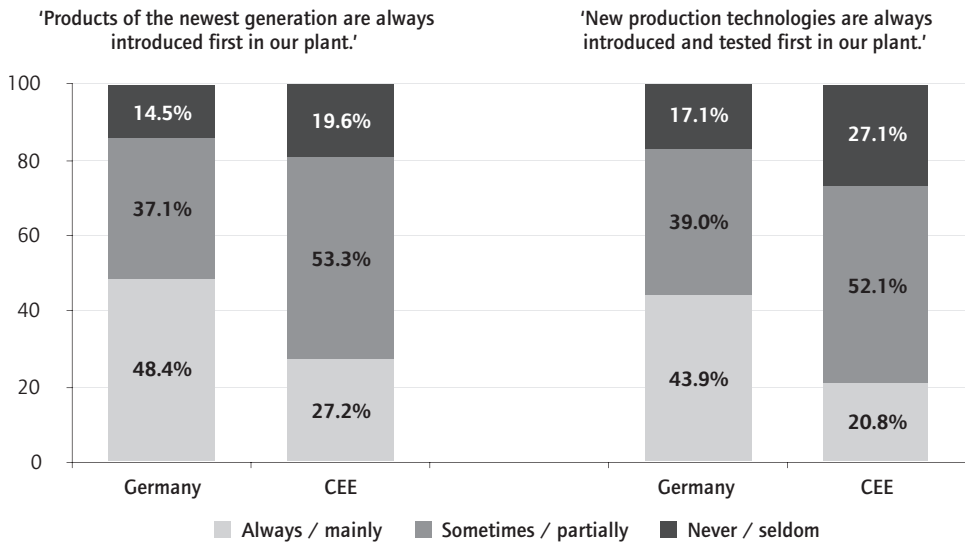
These competences emerge as a consequence of the intensive cooperation between manufacturing departments and R&D, both in formal processes and at the informal level. In some companies, these functions are described as ‘lead factory’ functions, while other firms do not use this term and fulfil this innovation role without any designation as a special location. Schwarz-Kocher *et al.* (2019) show that lead plant roles are associated with better financial performance and higher employment.

Both our survey and our case studies demonstrated that German sites continue to have a particular responsibility for feeding production knowledge into the product development process. There are several reasons for this: first, they are close to automotive suppliers’ R&D sites; second, there is a strong innovation infrastructure in Germany; and third, the skill structures of the plants are also advantageous. The proximity of lead plants to company development centres enables quick accessibility and simple feedback, and gives engineers the opportunity to see and test processes directly (see Dispan and Pfäfflin 2014). Much product development by suppliers (and their customers, OEMs) is, therefore, still based in Germany and is likely to remain so for the foreseeable future. This is also supported by the very good innovation infrastructure, which includes technical support from universities and research institutes, but also direct contact with German production equipment companies. New automation concepts or new production technologies often require the support of equipment builders. The role of these networks in developing and implementing innovation has been widely highlighted in research. Both the industrial districts approach (Piore and Sabel 1984) and Porter’s cluster approach (1985) highlight, among other factors, the importance of corporate networks and of the geographical proximity of upstream and downstream service providers and suppliers. The cluster approach, in particular, points to the significance of skill and research infrastructures, for example, to clusters in the German automotive industry (see Blöcker *et al.* 2009).

These advantages mean that German locations are more likely than CEE plants to produce new product generations and new production technologies. We asked works councils about the extent to which new production technologies and new generations of products are first introduced at their own location; Figure 5 provides the answers.

The results show a clear concentration of innovation activities at German production sites. Forty four per cent of the German works councils surveyed report that product launches are always or mostly done at their own site, while 48 per cent of German works councils report that new technologies are always or mostly implemented first at their site. These figures are around twice as high as the corresponding percentages of respondents from CEE. However, it is noteworthy that at least one-quarter of CEE locations have an innovation role comparable to that of German plants – a considerable degree of upgrading compared to the 1990s.

Figure 5 Lead plant roles in German and CEE automotive supplier plants, 2016 (per cent)



Source: Author, based on Krzywdzinski *et al.* 2016.

German factories are likely to become more specialised in technological lead roles in the future – on the one hand because they will face continuing competition with low-wage countries; and, on the other, because they will play a key role in the introduction of Industry 4.0 concepts. Competition with low-wage countries means that manufacturing plants in high-wage countries that do not have any innovation or lead plant function will experience relocations and job cuts. Yet, factories that play a leading role in the introduction of Industry 4.0 technologies could extend their lead over low-cost locations which, in turn, will help to secure employment. The same might apply to changes related to electrification: in the case of Volkswagen, for instance, German plants will be mainly responsible for producing the future electrical car platform.

This development will have consequences for employment, while we can expect vocational skills to grow in importance. In German plants with a lead role in introducing new products and production technologies, manufacturing employment has been stable in recent years while office employment has been increasing (Figure 6). This means that the employment structure has shifted, but employment has not declined in absolute terms. However, in enterprises without a lead plant role, manufacturing employment has fallen slightly on average while office employment has remained stable. This is an expression of the greater cost pressures, relocations and rationalisation pressures to which pure production plants will be exposed if they do not perform additional innovation-related tasks.

So far, the development of German manufacturing plants can therefore be characterised as one of continuous specialisation in innovation-related tasks and the assumption of lead roles in the introduction of new products and technologies. The consequence of this in terms of skill structures in the German automotive industry is the presence

of an increasing proportion of highly-skilled workers. As Figure 7 shows, lead plants have highly-skilled workforces on their production lines. In an average factory that is responsible for introducing new products and technologies, 60-79 per cent of production workers have completed vocational training; in an average non-lead role plant, it is only 40-59 per cent. If we look at the educational requirements of jobs rather than the education level of workers, the numbers differ to some degree but we can still see clear differences between factories with and without lead plant roles. In an average plant with a lead role in the implementation of technology and products, 40-59 per cent of production jobs require vocational training; in average pure manufacturing operations, this is the case for only 20-39 per cent.

Figure 6 Development of employment in German automotive supplier plants with and without lead plant roles (2011-2016)

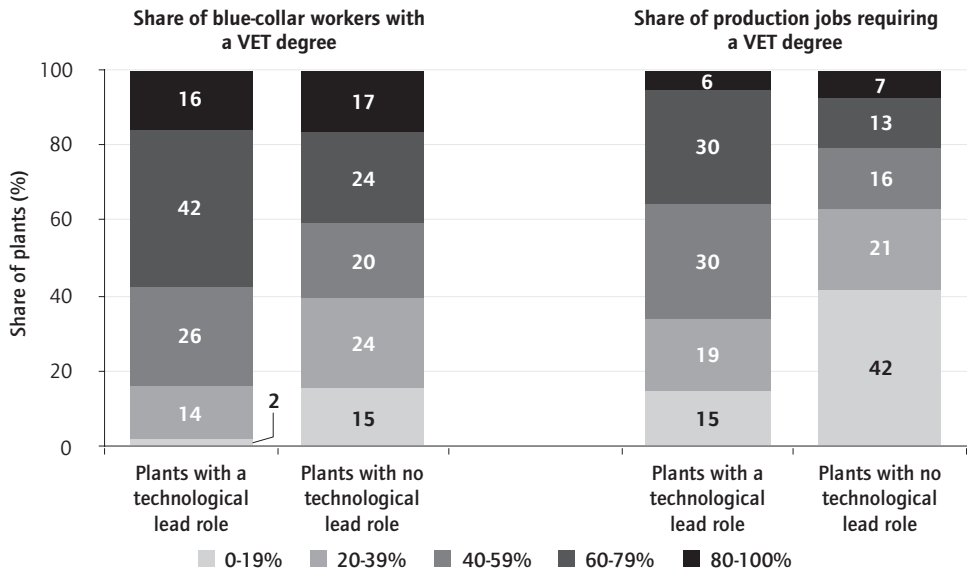


Source: Author, based on Krzywdzinski *et al.* 2016. Mann-Whitney test 0.0923 (production employment); 0.0015 (office employment).

The proportion of workers with vocational training being higher than the proportion of jobs requiring vocational training points to an interesting feature; namely, the presence of ‘excess’ knowledge on the German factory floor. In many German manufacturing plants, we observed a considerable share of workers with vocational education diplomas working in jobs that do not formally require specialist training. This is due to managerial preferences – managers often prefer to hire skilled workers if available on the labour market – as well as pressure from trade unions and works councils to maintain existing levels of vocational training and to hire apprentices after the completion of their training. These skills tend to contribute to the organisation’s problem-solving capabilities often in unnoticed ways. With regard to implementing new production technologies, these ‘excess’ qualifications are an advantage of German plants compared to low-wage regions in which the recruitment of skilled workers

for production is becoming increasingly difficult (Krzywdzinski 2017; Jürgens and Krzywdzinski 2016).

Figure 7 Employment structures in production areas of German automotive supplier plants with and without a lead plant role, 2016



Source: Author, based on Krzywdzinski *et al.* 2016. Mann-Whitney test 0.0316 (share of workers with a vocational training qualification); 0.0023 (share of jobs requiring a vocational education qualification).

All in all, this means that there is a long-term trend towards higher vocational skills and an upskilling of industrial employment. It should be noted, of course, that a large number of pure manufacturing plants without noteworthy innovation functions still exist in Germany. These plants often compete directly with low-wage locations. Where it proves impossible to escape this competition, by developing specific lead and innovation functions, there is pressure to lower wages, increase working hours and both to intensify work processes as well as make them more flexible.

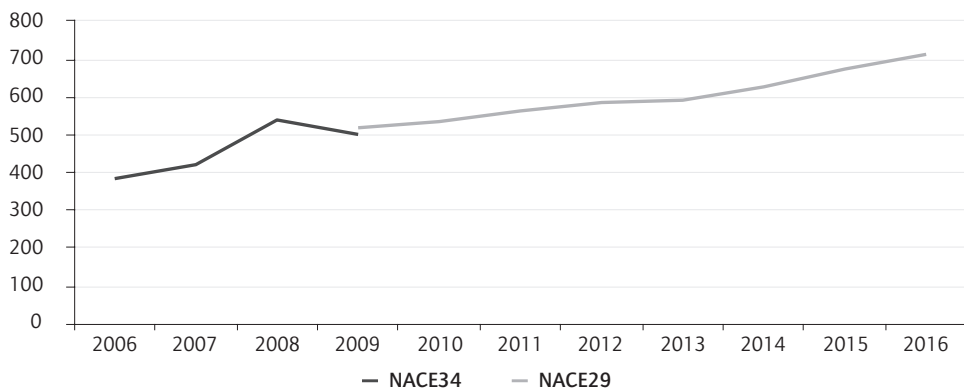
3. Automotive suppliers in CEE: limits to further upgrading?

3.1 Changing roles of manufacturing plants in CEE

For central and eastern Europe, integration into the production networks of the European and, in particular, those of the German automotive industry was a key driver for economic development. In the early 1990s, a wave of relocations and takeovers began, with between forty and seventy factory openings being reported each year by companies in the automotive industry (mainly suppliers) (Jürgens and Krzywdzinski 2010: 48). German companies were pioneers of this development.

Figure 8 clearly shows that employment in the central and east European automotive industry has grown enormously over time. The global economic crisis of 2008-09 led to only a small slowdown in employment growth. Before the crisis, automobile manufacturing employment in the CEE region had risen to around 500,000 people; by 2016, it had reached 712,000. Taking all CEE countries together, employment in the automotive industry roughly corresponds to employment in the German automotive industry – although plants in the CEE region specialise more in the production of parts and components whereas in Germany OEM locations represent a much higher share of automotive employment. This is an unprecedented success story that has contributed significantly to the positive development of the CEE labour market in terms of number of jobs.

Figure 8 Employment in the CEE automotive industry in thousands of employees, 2006-2016



Source: VDA (various volumes). Here, CEE includes Czechia, Hungary, Poland, Romania, Slovakia and Slovenia. Due to a change in statistical methodology, NACE 34 was used until 2009 and NACE 29 in subsequent years.

For CEE, such a development has led to the opportunity to modernise infrastructure, production technologies, products and processes (Jürgens and Krzywdzinski 2008). A number of studies have noted the increasing diversification and upgrading over time of the products of the CEE automotive industry (Domanski *et al.* 2013; Pavlínek and Zenka 2010; Jürgens and Krzywdzinski 2008).

However, the research literature also points to the limits of this process. Pavlínek and Zenka (2010) argue that the upgrading of products and processes remains very selective, affecting only parts of the CEE supplier base. Nölke and Vliegenthart (2009) emphasise that the central and east European automotive industry is largely controlled by foreign companies and is therefore highly dependent on decisions made in corporate headquarters abroad. In addition, there is a lack of local R&D centres in CEE (Pavlínek 2012): despite the massive expansion of the production capacity of the automotive industry in CEE low-wage countries, hardly any R&D facilities have been built there so far (Jürgens and Krzywdzinski 2010; Pavlínek 2012). While the globalisation of automotive companies has prompted the development of regional R&D in Asia (especially in China) and in south America (especially in Brazil), CEE – as a low-income intra-European periphery – has not benefited in the same way.

The extent to which the economic upgrading of the CEE automotive industry is being accompanied by improved working and employment conditions is also a matter for dispute. Among the political and economic elites across CEE, there was an expectation that market forces would ensure improved conditions for employees. The state, therefore, has largely limited itself to providing incentives (especially for foreign capital) and has not pursued an active industrial policy (see Jürgens and Krzywdzinski 2010: 114f). In fact, the state has been careful to keep minimum wages low and give companies far-reaching opportunities to use temporary forms of employment (agency work, fixed-term contracts) (Krzywdzinski 2014b; Maciejewska *et al.* 2016). Unemployment insurance benefits are very low because governments want to encourage jobseekers and employees to seek employment and to strengthen the position of employers in the labour market (Adascalitei 2012; Bohle and Greskovits 2012, Bandelj and Mahutga 2010).

Recent studies argue that, in order to improve working conditions, CEE supplier plants will have to take on more innovation-related functions. Spindelndreier *et al.* (2015) expect that, particularly in Asia and CEE, the number of lead plants responsible for introducing new products and technologies will increase considerably in the next few years, mainly at the expense of German locations (see also Szalavetz 2017).

Our own survey from 2016 shows that 27 per cent of all the CEE plants surveyed were always the first in their companies to introduce the latest products (see Figure 5), and we acknowledge the clear difference here between CEE and German plants. In addition, this does not tell us which product areas are concerned: our case studies show that CEE locations are predominantly responsible for manufacturing well-established products while German locations take on more complex, high-end products. In some cases, however, management stressed that the same technologies are used and the same products are made in both German and CEE locations. Even if management decided to use a particular technology first in Germany, the time advantage over other countries is low:

‘This is always the period of a maximum of one vehicle generation and then the technology advantage is gone. [...] This effect is always less than five, six years.’
(Plant manager, supplier company)

In other case studies, management stressed that new products are always introduced first in German factories:

‘Future products and completely new technologies are implemented first in Germany, while established products are relocated to central eastern Europe.’
(Plant manager, supplier company)

Nonetheless, the findings do point to the existence of an upgrading of products in the CEE automotive supply industry.

Product upgrading is also accompanied by an upgrading of the process technologies in use, where there is only a small difference between German and CEE plants. Looking

at survey data on the level of automation in Germany and CEE, some differences are immediately evident. More than fifty per cent of companies in Germany report having predominantly or highly automated production, whereas in CEE this is only the case in about twenty per cent of companies. The dominant model in CEE is mixed production, with automated and manual production areas existing alongside each other. However, this difference between Germany and CEE is strongly related to the products and production volumes of the plants. Manual operations in the CEE plants are either targeted on the production of small batches that cannot be produced profitably on highly-automated lines due to the interruptions required for setup and refitting; or they manufacture components with lower precision requirements. If we compare the production of the same products at the same volumes, there is no difference between the process technologies in use in Germany and CEE. The chair of a German works council described the technologies used in CEE plants as follows:

‘This is high-tech, these are really greenfield plants with the best machinery, the latest technology.’ (Works council, supplier company)

Various factors influence the dynamics of the technological upgrading of CEE locations. An important driver in the transfer of new products and production technologies to CEE is the interaction between the high cost pressures exerted by automobile manufacturers and, at the same time, their very high demands regarding the quality and stability of manufacturing processes. Due to such cost pressures, automotive suppliers often have little choice where to locate production. In many cases, automobile manufacturers push suppliers to produce in CEE, either to supply the CEE market (on a ‘follow the customer’ basis) or because of lower labour costs. At the same time, they assume that suppliers can also implement standard process technologies in the selected locations. Due to the high quality requirements, suppliers therefore tend to implement the same level of technology in CEE plants as in traditional high-wage locations. In our case studies, none of the suppliers differentiated their process technology according to high-wage and low-wage locations: technology is, first and foremost, based on the customer’s quality specifications. In some cases, even at the tender stage, customers make explicit demands about process technologies. For this reason, the technology gap between German and CEE locations is relatively small.

3.2 The lack of R&D capabilities

One countervailing mechanism and barrier to the diffusion of new production technologies in low-cost locations is the need for exchange and interaction between R&D and manufacturing. In many cases, both the R&D and internal tool-making functions of foreign automotive suppliers are located in their home countries. Given the dominance of German companies in the automotive sector, a major part of R&D in the sector is concentrated in Germany. This is often the main reason why German factories have a lead role in implementing new technologies.

One of the case studies examined in our project has its centralised R&D function located in Germany while, due to their proximity to R&D, prototype construction and in-house

equipment construction are also located in Germany. The company itself builds much of its equipment, such as welding cells and transport systems, in its German location which means that many technologies are tried out there before they go abroad. The presence of prototype and equipment construction at the site also means that a central unit for industrialisation processes has been set up in the German factory; this unit supports the locations outside Germany. The plant manager of the German site expects foreign plants to handle product launches independently in the future, but such a level of independence is not a current reality. The works council describes the level of support for other plants during product launches as a great burden on the German plant, and one which is not appreciated enough by the company:

‘We send our people over months to these locations – welders or operators, electricians and maintenance workers. Even our managing directors are always over there and helping out.’ (Works council, supplier company)

This characterisation of the relationship between the location of product development functions and the lead role of plants in using new process technologies is also supported by data from the survey. We wanted to know whether there was any kind of product development at the location, and regardless of scope. Even though this question does not allow us to distinguish between a large R&D department and a small customisation development unit, it does enable us to examine the connection between the presence of product development tasks and the responsibility for implementing new process technologies.

The data show a clear correlation (Figure 9). Among the German plants with on-site R&D, fifty per cent always or mostly take the lead in implementing new process technologies. Plants without in-house R&D rarely play a lead role. In CEE, too, plants with on-site R&D functions have a greater chance of being the first within the production network to implement new production technologies.

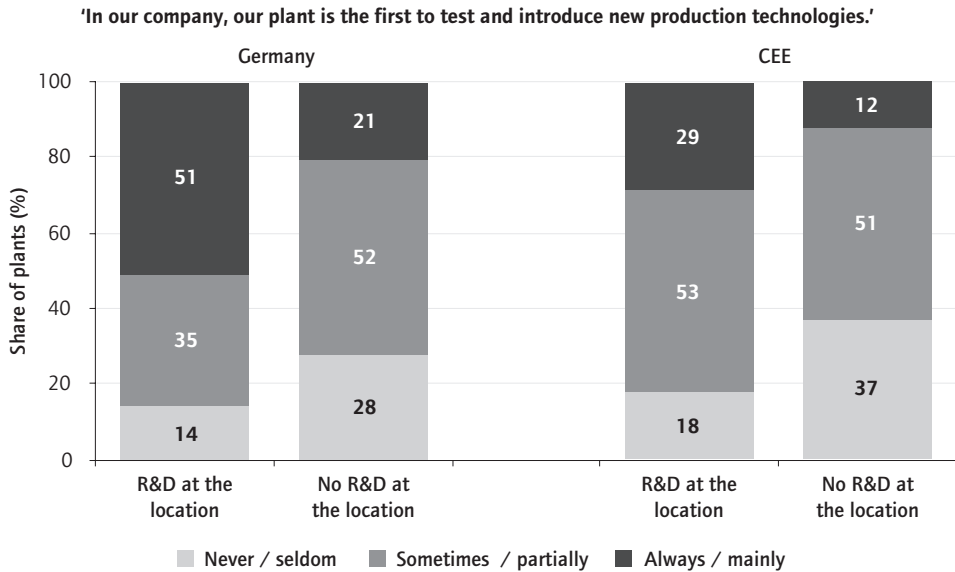
The absence of strong R&D centres in CEE is also likely to have an impact on the region’s opportunities to benefit from new technological developments in electric mobility and autonomous driving. German automobile manufacturers and suppliers are likely to locate the most advanced implementation projects of new technologies in Germany.

Thus, even though the lack of R&D capabilities could hamper the future development of the CEE automotive industry, its current development is relatively robust. Relocations of production to other low-wage countries do happen but are relatively minor. Among the CEE automotive suppliers we surveyed, 63 per cent reported that they had already experienced relocation. However, most of the relocations were within the region, i.e. these were shifts between locations in CEE countries. In addition, only seven per cent of all surveyed CEE plants reported experiencing job losses due to relocation – a figure which is a lot lower than in Germany.

In addition, CEE countries are benefiting from the establishment of the battery plants of Asian manufacturers. With European governments stepping up their efforts to

increase the number of electric vehicles on the roads, Asian battery manufacturers are starting to invest in Europe. In 2018, two large battery factories of the Korean conglomerates Samsung SDI and LG Chem opened in Göd (Hungary) and Wrocław (Poland) respectively; while SK Innovation is planning to open a factory in 2020 for automotive lithium batteries in Komárom, Hungary. Japanese and Chinese companies are also exploring locations for battery plants in central and eastern Europe. However, it should be noted that, in all cases, these are just manufacturing sites: product development remains in Asia and, given the lack of related research and development in CEE, it is highly probable that this will not change in the future.

Figure 9 Lead plant roles and R&D



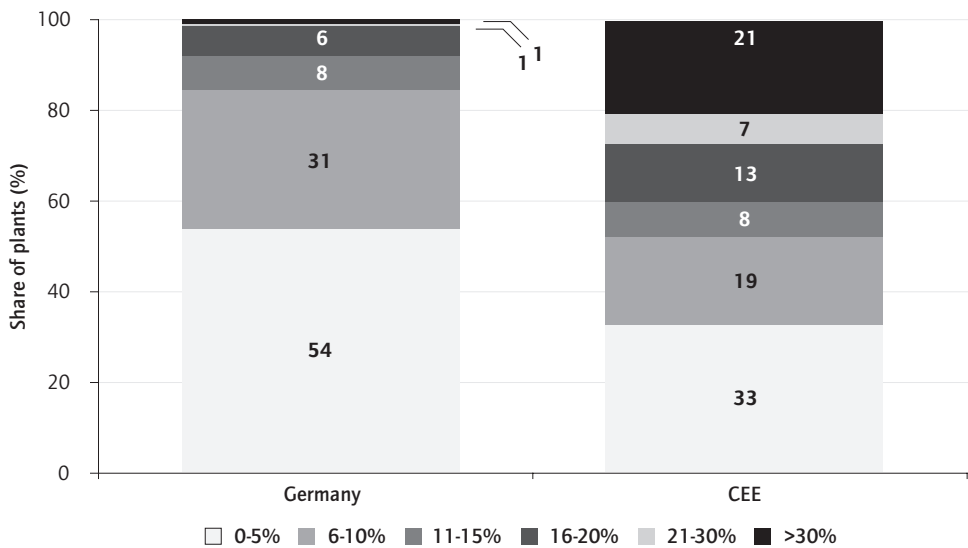
Source: Author, based on Krzywdzinski *et al.* 2016. Mann-Whitney test 0.0038 (Germany); 0.0123 (CEE).

3.3 The social effects of economic upgrading

The last question to be discussed here is whether economic upgrading in central and eastern Europe has been accompanied by social upgrading. Barrientos *et al.* (2011) define the social upgrading of enterprises as a process of improving the rights, resources and working conditions of workers in enterprises. The most commonly used indicators of social upgrading relate to forms of employment (regular/temporary), wage levels, social protection, working hours, trade union rights and advocacy, the absence of discrimination, occupational safety and healthy working conditions (Barrientos *et al.* 2011; Rossi 2013). In the following, we look at the share taken by precarious forms of employment (fixed-term/temporary work) in total employment as an indicator of the presence of social upgrading.

As shown in Figure 10, CEE automotive supplier plants use significantly more fixed-term employment contracts than their counterparts in Germany. The average proportion (median) of such forms of employment is up to five per cent in German plants and six to ten per cent in CEE plants. In Germany, only 15 per cent of plants have more than ten per cent of employees on fixed-term contracts, but this is the case for 49 per cent of CEE plants. In 21 per cent of the CEE automotive suppliers surveyed, the share of fixed-term contracts even exceeded thirty per cent (compared to less than one per cent of suppliers based in Germany).

Figure 10 Fixed-term contracts in German and CEE automotive supplier plants, 2015 (percentage of total employment)

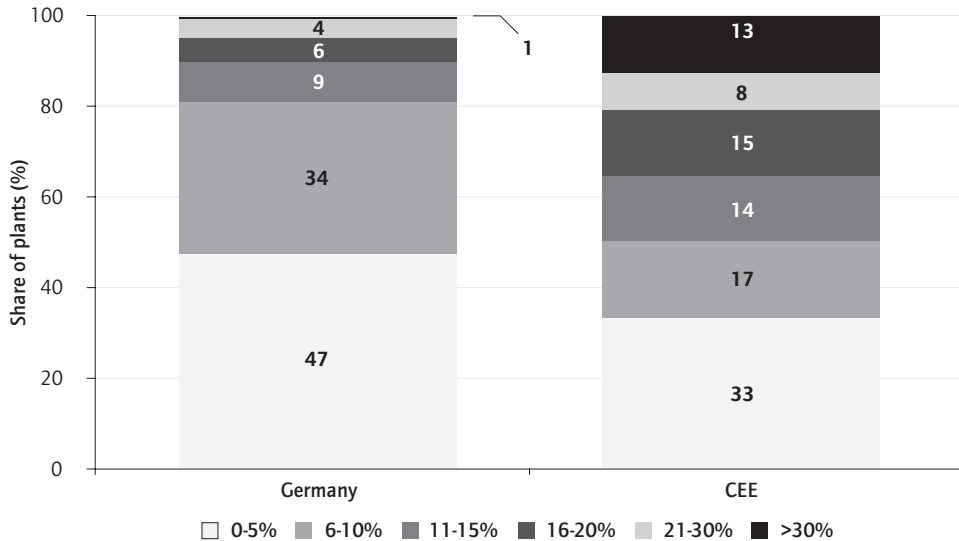


Source: Author, based on Krzywdzinski *et al.* 2016.

A similar pattern can be seen regarding the use of agency work (Figure 11). The share of agency workers in total employment exceeded ten per cent in only twenty per cent of the German plants surveyed – in central and eastern Europe, this was the case in fifty per cent of plants. In 21 per cent of CEE automotive supply plants, the share of agency workers in total employment was even over twenty per cent.

The extensive use of precarious forms of employment in CEE indicates that social upgrading in the region has, so far, been very slow. As Krzywdzinski (2017) shows, there is a connection between process upgrading and the use of precarious forms of employment in the CEE automotive supply industry. Where manufacturing is more automated and where higher skill requirements prevail, the proportion of precarious forms of employment is lower. However, this effect is relatively weak and does little to alter that the precariousness of employment in CEE is, overall, much greater than in Germany.

Figure 11 Agency workers in German and CEE automotive supplier plants, 2015 (percentage of total employment)



Source: Author, based on Krzywdzinski *et al.* 2016.

There are also persistent wage differences between CEE and Germany, in the light of which it is worth noting that the catching-up of wages in CEE compared to Germany came to a standstill for almost a decade in the wake of the economic crisis of 2008. Strong wage increases in CEE characterised the period from the mid-1990s to the mid-2000s (see also Onaran and Stockhammer 2006). Wages in the CEE automotive industry rose during this period from about 8-10 per cent of the German level to about 20-25 per cent (for national average wages, see Galgóczi 2017). Between 2008 and 2016, this catching-up movement stalled with wage increases in Czechia, Hungary and Poland remaining below the increases in Germany, at least if one calculates labour costs in euros. Renewed wage dynamism in CEE after 2016 has not, as yet, restored the pre-crisis levels of wage catch-up.

One reason has certainly been developments in exchange rates – as nominal wage increases have been compensated for by a devaluation of the currency. Only Slovakia has deviated somewhat from this pattern, because the country has introduced the euro and cannot respond by devaluing in response to changes in labour costs (Pavlínek 2015). In addition to the currency effects, weak wage developments in CEE countries also reflect weak unions, decentralised collective bargaining systems (Bohle and Greskovits 2012) and locational competition within CEE (Bernaciak 2010; Meardi *et al.* 2013).

4. Conclusions

The automotive industry is undergoing profound change. The globalisation of sectoral value chains is progressing while major technological changes are on the horizon in the area of powertrains (electric mobility) and autonomous driving.

The impact on employment in Germany is uncertain. Much will depend on the pace of change. How much time will factories have for transformation? What skills will be needed in the future? How will the demand for automobiles develop? A number of studies have attempted to identify what kind of transformation of skill requirements and employment will occur by assessing these technologies. However, there is great uncertainty about the validity of the scenarios used in such studies due to the complexity of the change process.

This chapter adopted a different approach. I did not seek to analyse individual technologies, but to look generally at how competencies concerning the introduction of new products and technologies are distributed in the global production networks of automotive suppliers. This question was discussed with a focus on the division of labour between German and CEE locations in the automotive supply industry.

The analysis clearly shows that German locations are under great competitive pressure. Shifts in jobs to low-wage countries are currently a bigger and more tangible threat to German plants than technological change. This is clearly illustrated by the large number of cases of concession bargaining in the German automotive supply industry.

There is, however, a clear difference between two types of plants in Germany. The pressure of cost is faced mainly by pure manufacturing plants, which have to compete with low-cost countries. Locations with lead roles in introducing new products and technologies have, in contrast, special expertise that enables them partially to escape cost competition. In these locations, we are seeing positive employment development and less concessional pressure. This process of the growth of lead plants and the shrinking of pure manufacturing plants in Germany is leading to a gradual specialisation of the German automotive supply industry. Given this specialisation, we can expect that new technologies for electric mobility and autonomous driving will be implemented first in Germany.

For central and eastern Europe, the picture is mixed. On the one hand, we are seeing very good developments in terms of jobs, with the focus of investors on intra-European low-cost locations continuing. However, the region remains mainly specialised in pure manufacturing functions. Only about one-quarter of plants perform innovation tasks such as the introduction of new products and technologies.

Nevertheless, this constellation seems to be stable. Relocations from central and eastern Europe have thus far been limited and have occurred mainly within the region rather than out of it. CEE is strongly dependent on the internal combustion engine but, at the same time, it is also the preferred investment region for Asian manufacturers when it comes to new battery plants.

On the other hand, wage differentials with Germany – in spite of recent wage dynamism – remain significant and automotive suppliers have particularly high levels of precarious employment. It seems difficult to translate positive economic growth into the improvement of wages and employment conditions. Given severe labour shortages and signs of growing bargaining power at CEE locations, however, this pattern might change in the future. Government policies that have sought to maintain comparative advantage by being a low-cost location cannot therefore offer a sustainable perspective.

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