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The Role of Central and Eastern Europe in Global Value Chains:

Evidence from Occupation-Level Employment Data

By Gábor Márk Pellényi

Abstract

This paper examines the role of Central Eastern European economies within global value chains. Occupation-level employment data are combined with an input-output model to analyse the types of jobs sustained by exporting industries. Based on its initial comparative advantage of low wages, the region remains specialised in fabrication tasks, which limits the domestic value added content of exports. Functional upgrading – the acquisition of more sophisticated service tasks within firms – could improve value capture, but it progressed slowly between 2011-2018. It could be boosted by raising the supply of high-skilled workers and improving local R&D and innovation capabilities.

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Introduction

The current wave of globalisation, which was ignited in the 1980s by a reduction in coordination costs thanks to information and communications technology, led to the geographical dispersion of production and the emergence of global value chains (GVCs).[1]

Baldwin (2013) argues that this wave of globalisation helps developing countries to industrialise because factory offshoring presents them with ready-made exporting capabilities. In this development model, foreign direct investment brings capital and technology into recipient countries, which accelerates economic convergence. While local affiliates and suppliers of GVCs initially specialise in low-wage, low-value added assembly and processing ("midstream" activities), they may eventually upgrade to more sophisticated upstream (R&D and design, head office activities) and downstream (marketing, distribution, sales and after-sales) tasks. The literature calls this broadening of tasks "functional upgrading".[2]

Upstream and downstream tasks capture more value added from GVCs than midstream assembly tasks; Mudambi (2008) calls it the "smile curve" of value creation.[3] Developing economies may increase the domestic value added content of their exports through functional upgrading, which raises further labour productivity and income per capita. In addition, as the newly acquired service jobs may offer higher wages and better working conditions than assembly-line jobs, economic upgrading can also be accompanied by social upgrading, a related but distinct concept.[4] Essentially, upgrading can ensure that developing economies are not stuck in a middle-income trap[5], but graduate among high-income economies, similar to the example of the Republic of Korea.

However, some limitations of a GVC-led development strategy are also becoming apparent. Rodrik (2018) argues that GVCs use skill-biased technologies, reducing the comparative advantage of developing economies; and they also limit the substitutability between unskilled labour and other production inputs. The automation of production through robots and artificial intelligence makes technology even more skill-biased, and gradually changes the international division of labour. De Backer et al. (2018) present evidence that robotisation is slowing down the offshoring of production from high-income economies.

Numerous case studies among developing economies show that while GVCs indeed contribute to aggregate productivity and wage growth, the development of local suppliers remains a challenge, and that the upgrading of local subsidiaries in GVCs is not guaranteed (Pipkin and Fuentes, 2017). Szalavetz (2017) also warns that relentless competition reduces margins in midstream production activities, and upgrading might only compensate for the resulting loss in profits (Pipkin and Fuentes, 2017, call this "treadmilling"). In this case, economic upgrading – labour productivity growth – is achieved not through innovation and increasing sophistication (the "high road" of development), but through persistently low wages and potentially deteriorating working conditions (the "low road"), as the economy continues to compete mainly on production cost, with low-wage economies. If this is the case, then economic upgrading need not support social upgrading (Barrientos et al., 2011) and the economy could remain entangled in a middle-income trap.[6]

Since the 1990s, GVC became a defining feature of the economic systems of Central Eastern European (CEE) economies (Nölke and Vliegenthart, 2009). So far, GVC integration has served the CEE region well. Foreign direct investment contributed to productivity growth and income convergence to Western Europe (Szabo and Durán, 2020). However, challenges remain: since the global financial crisis, technology generation in lead firms slowed and the pace of GVC integration slowed down, with repercussions for CEE productivity growth (ECB, 2019). In addition, studies focusing on CEE found that firms in these countries have not yet caught up with western counterparts in terms of value added capture; see e.g. Éltető et al. (2015), Pavlinek and Ženka (2010), Demeter and Szász (2016).

Sectoral specialisation patterns in CEE may also affect the scope for upgrading. In the automotive industry, the flagship of CEE manufacturing, low product standardisation raises entry and switching costs for suppliers, which makes upgrading more difficult. Lead companies also maintain tight control over design and R&D (Sturgeon et al. 2009), with some rare exceptions such as Czech Škoda and Romanian Dacia (Pavlínek, 2015). In electronics, another key industry, the competitive pressure on midstream firms is particularly strong because of the high degree of standardisation (Plank and Staritz, 2013). This pressure on margins may not leave sufficient resources for innovation.

The COVID-19 pandemic raises new questions. It highlighted the vulnerability of GVCs to supply disruptions, including restrictions on workers' presence in factories and transport barriers. Thus, the pandemic might trigger further automation and the reshoring of production near headquarters or key markets (Javorcik, 2020, Seric and Winkler, 2020). This is both an opportunity and a risk for CEE economies. On the one hand, they can benefit from their favourable location, market access and moderate labour cost; on the other, they are still at an early stage of the Industry 4.0 transition compared to global manufacturing powerhouses (Szabo, 2020).

So far, the analysis of GVC upgrading tended to focus on company-level case studies (an overview is presented in Pipkin and Fuentes, 2017). Case studies offer useful insights by revealing the fine details on individual companies, but they have some shortcomings. They are based on a limited sample; they suffer from selection bias because usually the better known, more successful, and most importantly, surviving firms are interviewed. On the other hand, one cannot approach firms that do not exist anymore, so failures tend to remain hidden in these studies. Furthermore, due to their micro perspective, case studies are silent about macroeconomic effects, which also involve feedbacks within and outside the analysed sector.

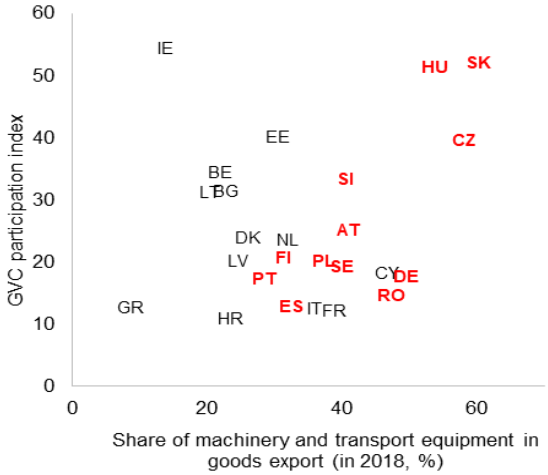
Some recent papers used sector-level data to overcome these limitations. Arto et al. (2018) find that in CEE economies, the share of high-skilled labour embodied in intra-EU exports was considerably lower than the EU average; this specialisation pattern did not seem to change between 2008 and 2014. However, distinguishing workers by skill level does not inform about the actual tasks performed by them. Using occupational data, Timmer et al. (2019) find that between 1999 and 2011, CEE economies reduced their specialisation in fabrication and turned towards other, mostly service activities, although this process was uneven across countries. For example, specialisation in R&D even decreased in Hungary and Slovakia. Marcolin et al. (2016) also find that manufacturing employment in CEE is geared towards highly routinised tasks. Finally, Stöllinger (2019) analyses Greenfield FDI flows and finds evidence that CEE economies are still specialising in assembly, which is associated with their low value creation.

This paper discusses the labour market implications of GVCs from a sectoral perspective between 2011 and 2018. It analyses the evolution of the local labour content of GVC production, both over time and in a regional comparison. This is done by combining input-output models with sector-level data on the occupational mix of employment, building on the work of Timmer et al. (2019). The key finding is that despite some diversification towards service tasks in recent years, CEE economies remain specialised in fabrication tasks within GVCs, which may account for the low domestic value added content of their exports. On the positive side, they participate in the manufacturing of complex goods, and this product mix indicates a high potential income level (Hidalgo and Hausmann, 2009; Felipe et al. 2012). Further investment in high-skilled labour and R&D could help their shift towards more advanced tasks in the value chain, and unlock their development potential.

CEE economies are strongly integrated in global value chains

The analysis focuses on those CEE Member States where internationalised industries dominate manufacturing production (Czechia, Hungary, Poland, Romania, Slovakia and Slovenia). The choice of countries is explained through Graph 1.

Graph 1: **Global value chain participation and export structure in EU Member States**



Note: the GVC participation index is the sum of foreign value added embedded in domestic exports, and exported domestic value added embedded in foreign exports, as a percentage of GDP. Countries analysed in this paper are highlighted with bold, red letters.

Source: Eurostat, OECD.

The degree of GVC participation can be measured by summing foreign value added embedded in exports and the domestic value added that is embedded in other countries' exports, as a share of GDP (OECD, 2012).[7] This measure is analogous to a standard measure of trade openness (the sum of exports and imports as a share of GDP), but it is calculated in value added terms instead of gross trade flows. According to this measure, CEE economies are highly integrated into GVCs.

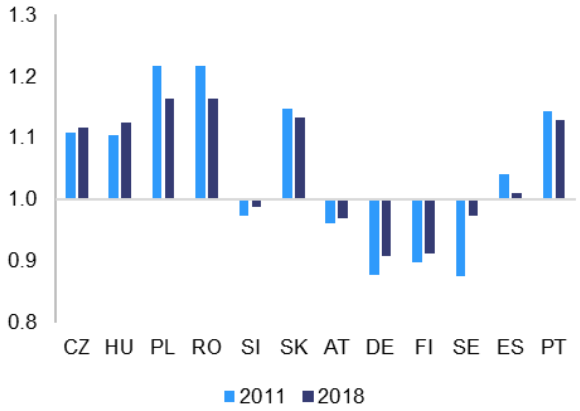
GVC participation is uneven across industries. High and medium-high technology sectors such as machinery, transport and electrical equipment are particularly engaged in GVC activities (Li et al., 2019). The share of these industries is very high in CEE economies. The selected CEE economies will be compared with some Western European peers, which have similar characteristics in terms of GVC participation and industry structure (Austria, Finland, Germany and Sweden). Further insights may be gained from two former "cohesion countries", Portugal and Spain. They have also experienced economic convergence over the past decades, but with different industrial structures. Their current income levels are not very different from the CEE region, thus they may face similar challenges with regard to GVC participation.[8]

They specialise in fabrication activities with low value added content

First, it is useful to simply look at the composition of manufacturing employment. International specialisation patterns are more visible after calculating revealed comparative advantage (Balassa) indexes. This index divides occupational employment shares by the cross-country averages for each occupation type, so values above 1 imply specialisation compared to other countries.[9] CEE countries mainly specialise in fabrication (assembly), while the role of R&D, business support, distribution and sales is usually rather limited. The pattern is mixed for southern Europe but reversed for more developed Western European economies, notably Germany (see Graph 2; methodological details are presented in Annex 1; data are in Annex 2 and 3).

Changes over time in employment shares and specialisation patterns offer a glimpse of functional upgrading in CEE manufacturing (i.e. whether they managed to diversify the job content of their manufacturing). This process is not obvious and not uniform across countries. Employment shares of fabrication typically fell from 2011 to 2018, and shares of R&D and other services activities increased. However, the same process was also apparent in Western Europe, echoing global trends such as the growing role of service activities within manufacturing (Miroudot and Cadestin, 2017). Thus, international specialisation patterns of CEE economies did not change fundamentally from 2011 to 2018 (see Annex 3). Changing specialisation is more visible in Germany and Sweden, where there was indeed a move towards support and distribution. However, at the same time, the R&D specialisation of Germany decreased, in line with evidence on increasing R&D offshoring (UNCTAD, 2005).

Graph 2: **Specialisation of manufacturing employment in fabrication tasks based on the revealed comparative advantage index**



Note: values above 1 reflect specialisation in a certain occupation; See Timmer et al. (2019) for definitions. By definition, the specialisation in non-fabrication tasks is the mirror image of the graph.

Source: Eurostat, Labour Force Survey.

Manufacturing employment is only part of the picture because other domestic industries (e.g. services) can also contribute to their output as suppliers. This is addressed through an input-output model, which takes into account the labour input of supplier industries (see Annex 1 for details). The results of the input-output model confirm the finding: exporting industries, including their domestic suppliers in other sectors, are mainly creating fabrication-type jobs (see Table 1). In the six CEE countries, the average share of fabrication jobs in export-related employment is 60%, while in the four Western European countries it is on average 10 percentage points less. Conversely, manufacturing exports in Western Europe create more jobs in supporting services. Portugal is similar to CEE while Spain is an intermediate case, showing no particular specialisation.

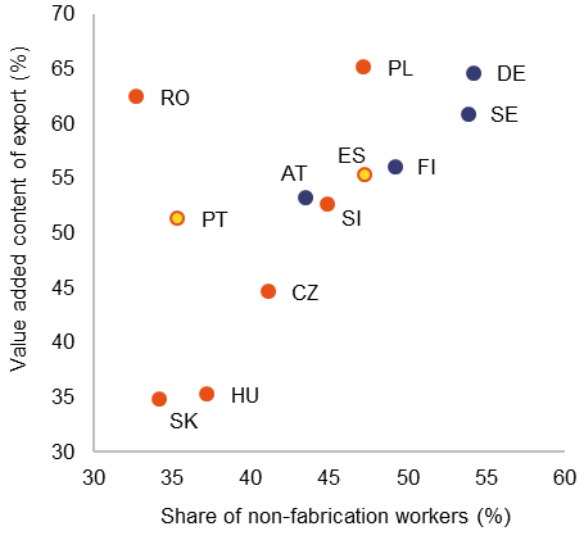
Table 1: **The composition of employment sustained by manufacturing exports**

	Export-related employment (% of total)	2018 composition (%)				Composition change between 2011-2018 (pps)			
		R&D	Fabrication	Support	Distribution	R&D	Fabrication	Support	Distribution
Czechia	31.8	4.4	57.2	20.0	18.4	1.7	-3.7	1.1	1.0
Hungary	22.3	7.1	62.7	19.9	10.3	1.5	-2.8	0.8	0.5
Poland	19.6	5.5	63.5	20.5	10.5	1.0	-1.6	1.8	-1.3
Romania	13.0	7.1	67.5	9.6	15.7	0.9	-0.4	-1.0	0.6
Slovenia	24.5	8.7	55.0	26.1	10.2	1.8	-1.7	0.3	-0.4
Slovakia	23.6	3.0	65.9	19.9	11.2	0.5	0.6	1.2	-2.3
Austria	17.2	8.4	55.3	24.5	11.8	4.0	-3.4	1.6	-2.2
Germany	19.6	8.6	44.7	29.7	17.1	0.6	-3.7	2.9	0.2
Finland	15.0	14.4	48.6	23.5	13.5	1.8	-4.6	0.5	2.3
Sweden	12.4	10.4	46.2	29.5	13.9	2.5	-6.0	4.1	-0.5
Spain	10.1	7.6	53.4	25.0	14.0	1.8	-0.7	3.2	-4.3
Portugal	13.0	4.4	64.9	17.6	13.2	1.5	-2.6	1.9	-0.8

Source: calculations based on World Input Output Database and Eurostat, Labour Force Survey.

For R&D the differences are less clear. While these tasks have outstanding shares in Finland and Sweden, their shares in Austria and Germany are much closer to some CEE economies (Slovenia, Hungary, Romania). The overall pattern remains the same if we also consider service exports (see Annex 4). The main difference is a higher share of occupations in distribution and sales in countries with larger tourism industries.

Graph 3: **The share of non-fabrication workers sustained by exports and the domestic value added content of manufacturing exports**



Note: share of non-fabrication workers including supplier linkages through an input-output model.

Source: own calculations based on World Input Output Database and Eurostat, Labour Force Survey.

Why does occupational specialisation matter? The share of non-fabrication workers in these countries is positively associated with the domestic value added content of exports, with a correlation coefficient of 0.59 (see Graph 3).[10] The positive relationship between service workers' share and value added is in line with the predictions of the "smile curve" hypothesis and a related stream of literature that emphasises the role of service activities for manufacturing firms' performance (e.g. Crozet and Millet, 2017).

Finally, the input-output analysis also shows mixed evidence of upgrading in terms of the job composition of manufacturing exports (see Table 1, right panel; and Annex 4 for the total economy). Between 2011 and 2018, the share of fabrication-type jobs tended to decrease. There was an almost unanimous shift towards R&D and administrative support services in the CEE countries, while the employment share of sales and distribution activities often decreased. However, high-income economies saw similar changes in the employment structure. Thus, while the data are consistent with the hypothesis of functional upgrading within countries, they do not suggest changing patterns in the international division of labour. Instead, they could arise from general trends such as automatisation, offshoring and outsourcing, which might affect certain tasks more than the others.

A shift to high-value-added service tasks requires innovation capabilities

Overall, the analysis shows a gap between the job content of exports in Central Eastern Europe and Western Europe. CEE economies contribute mainly with fabrication-type tasks, while R&D and supporting services remain concentrated in the more advanced Western and Nordic countries. Importantly, the fabrication-type activities, which are predominant in Central Eastern Europe, are associated with lower domestic value creation. This is corroborated by product-level studies that show that actual manufacturing costs make up only a small fraction of the value of manufactured goods; see e.g. Ali-Yrkkö and Rouvinen (2015).[11] Functional upgrading – gearing the domestic job content to pre-production, post-production and business support services – can improve the value capture of local subsidiaries and their suppliers, and this could benefit domestic economic performance. However, evidence for such upgrading over time is patchy both in the analysis above and in targeted case studies (see Pipkin and Fuentes, 2017).

Furthermore, even a change in job content may not necessarily improve domestic value capture because it also depends on the internal governance of global supply chains. For example, several R&D tasks can be offshored but headquarters tend to keep strategic R&D close to home (Belderbos et al., 2013). This is especially the case in the automotive and electronic industries (Cohen et al. 2009). Thus, intellectual property rights, the sources of rents, may largely remain in the home economies of multinational firms (Durand and Milberg, 2019). In addition, despite carrying out an increasing range of activities, even with higher skill requirements, the decision autonomy and bargaining power of local subsidiaries does not necessarily increase, especially if they operate as cost centres and not as true profit centres within the global firm.[12]

With these caveats in mind, it can still be argued that the Central Eastern European economies could benefit from functional upgrading in global value chains. So what could be done to foster this process?

Functional upgrading essentially means that local manufacturing units acquire more service tasks. The literature found that more routine, less complex or less interactive business services are more likely to be outsourced to foreign countries. Production costs, most prominently wages, are the key determinants of offshoring (Liu et al., 2011). Due to the wage cost advantage of CEE countries compared to Western Europe, this process may happen naturally to some extent.[13] However, service offshoring by itself may not necessarily boost value capture because it is a repetition of what has already taken place with fabrication: redirecting the most routinised and cost-sensitive service tasks to cheaper locations.

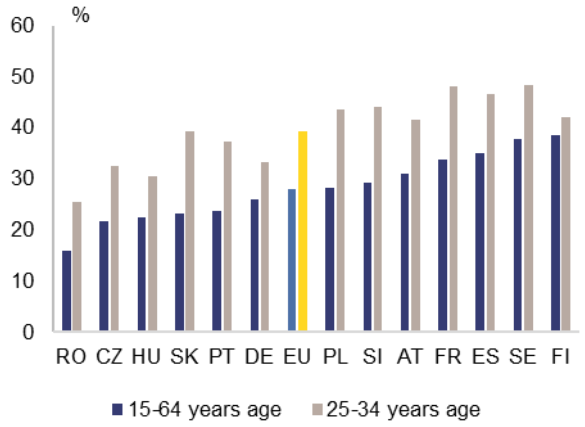
Jensen and Pedersen (2012) argue that the offshoring of more advanced business service tasks[14] is more demanding in terms of management and coordination. The most important driving factor for offshoring them is gaining access to local knowledge resources, such as best practices, new technology, or new competences. For example, R&D offshoring correlates with local innovation capacity and proximity to centres of research excellence (Siedschlag et al., 2013), while the establishment of research labs is associated with stronger intellectual property rights (Ito and Wakasugi, 2007).

CEE countries tend to lag behind Western European peers (and somewhat behind Portugal and Spain) in these dimensions, including tertiary education attainment; R&D expenditure and research outcomes and the protection of intellectual property (see Graph 4). As a result, the 2020 European Innovation Scoreboard ranks CEE countries among moderate or modest innovators while their western peers are all strong innovators or innovation leaders (European Commission, 2020). Thus, strengthening human capital and the local research base could spur upgrading and increase value capture from GVCs. Incidentally, this could also mitigate brain drain, another potential obstacle to economic development (Atoyan et al., 2016).[15] Institutional factors, such as the protection of intellectual property rights, could also support the development of more advanced business tasks.

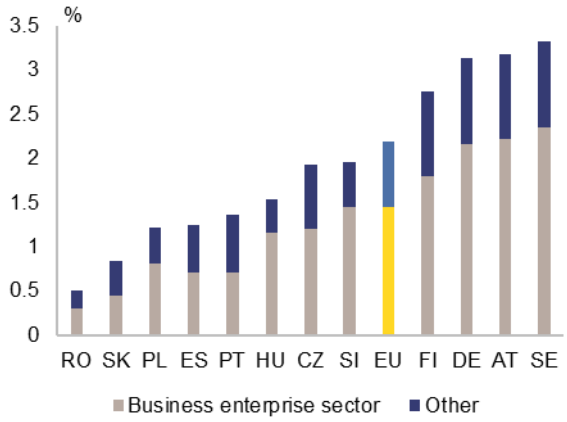
In addition, Pipkin and Fuentes (2017) find that in developing economies, public policies can be an important trigger of upgrading. These policies may include regulations (e.g. more challenging product or environmental standards); more vigorous product market competition; a change in labour relations that forces firms to improve labour productivity; or large macroeconomic shocks such as the COVID-19 pandemic. Indeed, Szalavetz (2016) and Sass and Szalavetz (2013) find that the 2008-2009 global financial crisis not only forced local GVC actors in CEE countries to improve production efficiency, but also created opportunities for functional upgrading by taking over duties from headquarters.

Graph 4: **Selected indicators of CEE economies and Western European peers**

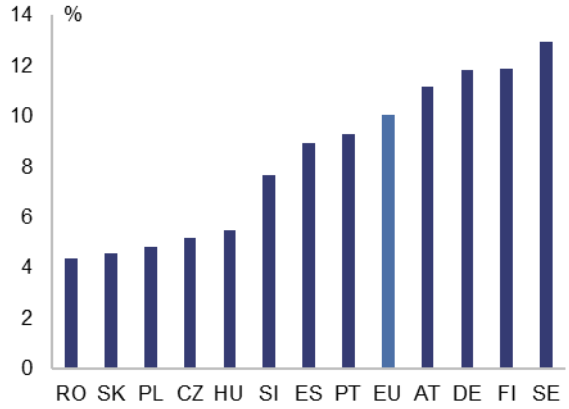
Population with tertiary education (% of total, 2019)



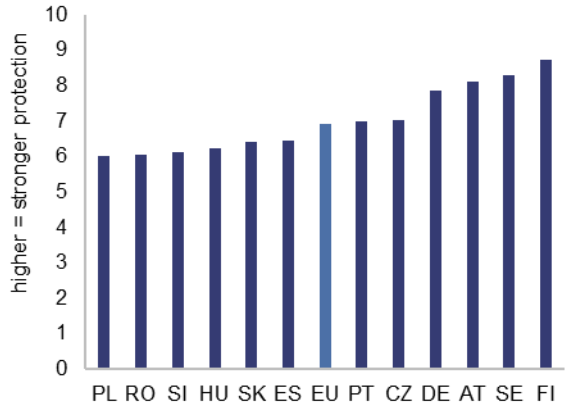
R&D expenditure (% of GDP, 2018)



Scientific publications among the 10% most cited in the world (% of total in country)



Protection of intellectual property rights (2019)



Source: Eurostat, European Commission (2020), International Property Rights Index 2019.

Conclusion

Economic development in the CEE economies since transition has been tightly linked to their participation in GVCs. Their particular development model was based on an initial comparative advantage in relatively skilled but low-wage labour, which allowed specialising in fabrication activities within GVCs. While their specialisation patterns appear similar to former "cohesion economies", their high GVC participation makes them a distinct group.

GVC participation has served the CEE economies well and brought a sustained catch-up in living standards to Western Europe, albeit limited to those regions that could benefit from GVC participation through attracting foreign direct investment (Tondl and Vuksic, 2007). However, this model is facing a challenge because successful income convergence is undermining one of its foundations, low wage costs. This necessitates a move up the value chain, to activities that capture more value added in GVCs.

At the establishment level, functional upgrading takes place by acquiring internal business services in addition to standardised manufacturing tasks. However, these services are also undergoing a transformation. Routinised service tasks are increasingly outsourced to take advantage of lower wages, while core service activities that capture most economic value only move if new locations offer strategic benefits, such as access to cutting-edge technology and know-how.

This paper confirms earlier findings that upgrading within GVCs has been progressing, although the process is gradual, uneven, and disparities with Western Europe remain large. All this calls for policy efforts in CEE countries to support upgrading, especially through investment in quality education and R&D and innovation capabilities.

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Annex 1: Methodology and data

This paper combines input-output data with labour market microdata for the analysis, similar to the approach of de Vries et al. (2019) which builds on earlier work by Timmer et al. (2019). Assume that there are *n* sectors in the economy, each of which have four main business functions (indexed with *b*: fabrication; research and development; management and business support activities; sales and distribution). Sector may purchase intermediate inputs from each other and from abroad to create final products, which are used for consumption, investment or export. The composition of inputs purchased from other sectors is assumed to be fixed; it is represented by matrix **A** (sized *n* x *n*). The number of workers per unit of output in each sector for business function *b* is collected in the diagonalised vector $\mathbf{J_b}$ (sized *n* x *n*). The focus of this analysis is the job content of exports, therefore sectoral exports are collected in vector **f** (sized *1* x *n*). The total number of jobs sustained (directly or indirectly) in each business function can be calculated as

$$jobs_{i,b} = \mathbf{u}_i \mathbf{J}_b (\mathbf{I} - \mathbf{A})^{-1} \mathbf{f}$$

Where *jobs* is the total number of jobs in country *i* in business function *b*; *u* is an appropriately sized vector of ones; **I** is an identity matrix (*n* x *n*). The matrix $(\mathbf{I} - \mathbf{A})^{-1}$captures the multiplier effect – including supplier linkages across all sectors – from increasing final demand (**f**). Vector $\mathbf{J_b}$ can be thought of as a short-run labour demand function that is linear in output and inelastic to wages.

Input-output data come from the World Input Output Database (WIOD), which covers 56 sectors (according to the ISIC Rev. 4 classification) in 43 countries for the 2000-2014 period. For this analysis, only national input-output tables are used because they are sufficient to uncover the composition of domestic labour input. Employment data come from the Labour Force Survey, where sectoral employment is broken down into four business functions following Timmer et al. (2019), and aggregated from two-digit ISCO-08 occupational categories. Because of a change in ISCO classifications before 2011, the analysis covers the period 2011-2018. For 2018, the input-output tables of the last available year (2014) are used.

Annex 2: Manufacturing employment shares by occupation type (%)

	2011				2018			
	R&D	Fabrication	Support	Distribution	R&D	Fabrication	Support	Distribution
Czechia	2.1	77.5	18.2	2.2	4.3	74.4	19.5	1.8
Hungary	5.1	78.1	14.8	2.1	6.6	74.1	16.2	3.0
Poland	4.5	74.2	19.9	1.5	5.3	72.6	20.6	1.6
Romania	6.4	80.7	10.8	2.1	7.6	81.8	8.8	1.9
Slovenia	6.6	68.5	22.6	2.3	8.2	65.4	24.3	2.2
Slovakia	2.2	78.6	17.6	1.6	2.3	77.1	17.9	2.7
Austria	4.7	67.3	22.8	5.3	7.9	64.6	22.2	5.3
Germany	8.6	63.0	22.9	5.5	9.1	59.0	26.0	5.9
Finland	14.3	63.3	20.8	1.6	17.0	60.3	20.9	1.9
Sweden	7.2	67.5	21.9	3.4	10.2	58.8	28.2	2.8
Spain	5.5	70.0	20.5	3.9	6.4	69.9	20.0	3.8
Portugal	3.0	78.3	16.1	2.6	4.6	76.8	16.5	2.0
MS average*	5.8	70.0	20.4	3.8	7.4	67.8	21.2	3.6

Note: * average of individual EU Member States. Occupation types are based on the definitions of Timmer et al. (2019).

Source: Eurostat, Labour Force Survey.

Annex 3: Specialisation of manufacturing employment by occupation type (%)

	2011				2018			
	R&D	Fabrication	Support	Distribution	R&D	Fabrication	Support	Distribution
Czechia	0.36	1.11	0.89	0.59	0.59	1.10	0.92	0.49
Hungary	0.88	1.12	0.72	0.54	0.90	1.09	0.76	0.84
Poland	0.77	1.06	0.97	0.40	0.71	1.07	0.97	0.44
Romania	1.10	1.15	0.53	0.56	1.02	1.21	0.41	0.51
Slovenia	1.13	0.98	1.11	0.60	1.10	0.96	1.14	0.61
Slovakia	0.38	1.12	0.86	0.43	0.31	1.14	0.85	0.74
Austria	0.80	0.96	1.12	1.39	1.07	0.95	1.05	1.47
Germany	1.48	0.90	1.12	1.44	1.24	0.87	1.23	1.65
Finland	2.47	0.90	1.02	0.43	2.30	0.89	0.98	0.51
Sweden	1.24	0.96	1.08	0.89	1.38	0.87	1.33	0.78
Spain	0.95	1.00	1.01	1.03	0.86	1.03	0.94	1.05
Portugal	0.52	1.12	0.79	0.68	0.62	1.13	0.78	0.57

Note: specialisation is measured throught the Balassa index of revealed comparative advantage. Values above 1 reflect specialisation in a certain occupation. Occupation types are based on the definitions of Timmer et al. (2019).

Source: Eurostat, Labour Force Survey.

Annex 4: The composition of employment sustained by goods and services exports

	2018 shares (%)				Change between 2011-2018 (pps)			
	R&D	Fabrication	Support	Distribution	R&D	Fabrication	Support	Distribution
Czechia	5.9	53.0	23.5	17.5	2.2	-2.7	1.5	-1.0
Hungary	7.9	50.5	23.8	17.7	1.8	-3.2	1.0	0.4
Poland	6.3	52.8	20.0	20.9	1.4	-1.6	2.0	-1.8
Romania	6.1	57.2	11.0	25.7	1.0	-4.2	0.8	2.3
Slovenia	9.2	48.3	27.6	14.9	1.9	-1.8	0.2	-0.3
Slovakia	4.4	50.2	23.0	22.4	1.4	-6.4	3.6	1.5
Austria	8.0	45.7	25.3	21.0	2.8	-3.3	0.2	0.3
Germany	8.8	39.6	30.5	21.1	0.5	-2.8	1.9	0.4
Finland	15.5	44.4	24.8	15.3	2.2	-2.9	0.0	0.8
Sweden	12.5	33.6	30.9	23.0	3.2	-5.7	4.1	-1.7
Spain	6.6	44.3	23.0	26.1	0.8	-1.2	0.6	-0.2
Portugal	5.0	51.9	19.8	23.3	1.8	-3.6	2.7	-0.9

Source: calculations based on World Input Output Database and Eurostat, Labour Force Survey.

[1] Before the 1980s, globalisation was mainly driven by decreasing international trade costs. In contrast, globalisation since the 1980s is driven by falling coordination costs, whereas trade costs have remained broadly stable. See e.g. Baldwin (2012).

[2] Humphrey and Schmitz (2002) distinguish four main types of upgrading in GVCs: *process* (higher efficiency), *product* (more sophisticated product lines), *functional* (new business functions) and *inter-sectoral* (moving into new productive activities). Blažek (2015) offers a richer typology with more types of upgrading and even the possibility of downgrading.

[3] The name is due to the U-shaped relationship between the "downstreamness" and the value added of activities along a supply chain. Econometric evidence for the positive effect of functional upgrading on value capture is presented in Burger et al. (2018).

[4] See e.g. Milberg and Winkler (2011) for definitons and indicators of economic and social upgrading.

[5] Garrett (2004) proposed that middle-income countries can get stuck in their development because they cannot compete yet with high-income countries on skills and sophistication, but cannot compete any longer with low-wage economies on production cost alone. See Gill and Kharas (2015) for a review of the literature on the middle income trap.

[6] For example, Pahl and Timmer (2019) found that over 1970-2008 GVC participation led to manufacturing productivity growth in developing economies, but it did not have a positive effect on employment. Rodrik's (2018) hypothesis offers one possible explanation: GVC technology appears to be biased against unskilled labour, which is relatively abundant in developing economies. Thus, GVCs can only benefit a limited number of firms and employees in these countries.

[7] The first term measures a country's openness to foreign inputs, while the second term captures how much of its exports are used by other countries for producing their own exports. If a value chain is more fragmented across countries, both terms increase. OECD (2012) normalises value added trade flows with gross exports, which does not take into account openness (i.e. it can show the same level of GVC participation with very high or very low gross trade flows). To remedy this, the variable is normalised with GDP.

[8] Graph 1 shows that while some other countries (i.e. BE, IE) would be natural candidates for comparison based on the GVC participation index, their export structure is very different from CEE economies. Their inclusion could distort the input-output analysis because the occupational breakdown of employment is only available at the manufacturing level, not for subsectors.

[9] While the indicator of revealed comparative advantage is traditionally calculated using export data, the following analysis will map exports to employment in different occupations. Therefore, the employment-based indicator is actually not far from traditional concept.

[10] Romania and Portugal appear to be outliers, possibly due to their export mix: they have a higher share of non-GVC exports with a potentially higher domestic value added content (e.g. food, textiles, wood products). Excluding Portugal and Romania from the sample would increase the correlation coefficient to 0.92.

[11] Ali-Yrkkö and Rouvinen (2015) find in a sample of 45 products that on average, the headquarters of the lead firm capture 27% of the product's sales price; logistics and distribution account for 26%; while the direct costs of assembly inside the firm account for 16%. The remaining 30% is attributed to vendors of raw materials and intermediate inputs. To assess the distribution of value added among the entire value chain, the 30% share of outside suppliers should be further split between their various activity types. Assuming the same breakdown among activities as in the lead firm, fabrication may capture less than one quarter of total value added.

[12] Cost centres are business departments that are only responsible for their operating costs, but not for their revenues (e.g. they have no sales activity and collect no revenue from outside the GVC). Therefore they do not directly add to profits at the GVC level. In contrast, profit centres have autonomous revenue sources, thus their actions directly affect GVC profitability.

[13] Sass and Szalavetz (2013) report that by 2007 most GVC actors in Hungary which had started with a narrow production mandate already performed a wide range of services to support local operations, although R&D and sales were less frequently delegated to them.

[14] Some examples for more vs less advanced service tasks: in the domain of IT, architecture and program design vs coding and testing; in the field of finance, financial management vs bookkeeping and reporting; in the area of R&D, user needs assessment and basic research vs patenting and testing.

[15] The CEE region has experienced a significant outflow of highly educated individuals since the fall of the Iron Curtain, largely driven by the income difference between Eastern and Western Europe. At first sight, the expansion of higher education might stimulate brain drain by increasing the pool of potential migrants. However, not all graduates end up migrating, thus the domestic pool of graduates also increases. Furthermore, countries with top-notch scientific and research facilities and with better governance quality tend to experience less brain drain. See e.g. Atoyan et al. (2016) and the literature review of Docquier and Rapoport (2012).

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