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ORIGINAL PAPER

OUTPUT MULTIPLIERS IN THE ECONOMIES OF GERMANY, POLAND AND SLOVAKIA: A COMPARATIVE INPUT-OUTPUT ANALYSIS

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Abstract

The article presents a comparative analysis of output multipliers in the economies of Germany, Poland and Slovakia for 2022. The study is based on national input-output tables published by the OECD and covers fifty economic activities. The results reveal a clear cross-country gradient in average output multipliers: Germany records the lowest value, Poland an intermediate one and Slovakia the highest. This gradient reflects the higher material intensity of production in Poland and Slovakia and is amplified by the use of the total Leontief inverse, which includes both domestic and imported intermediate consumption. The ranking of economic activities is broadly similar across the three countries: manufacturing and energy occupy the upper part of the distribution, whereas education, public administration and real estate activities are located at the lower end. Slovakia combines the highest average multiplier with the widest dispersion, driven especially by motor vehicles, electronic products and electricity supply. The output multiplier is decomposed into a direct requirements component and a residual requirement component, the latter defined as the remaining output requirement after the first round of direct inputs; this residual component accounts for about 70–85 per cent of the total multiplier in all three economies. A central empirical finding is that selected manufacturing activities in Poland and Slovakia, especially motor vehicles, computers and electronics, electrical equipment and, in Slovakia, electricity supply, generate substantially higher multipliers than their German counterparts.

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MNOŻNIKI PRODUKCJI GLOBALNEJ W GOSPODARKACH NIEMIEC, POLSKI I SŁOWACJI: PORÓWNAWCZA ANALIZA INPUT-OUTPUT

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Słowa kluczowe: mnożnik produkcji globalnej, analiza input-output, macierz odwrotna Leontiefa, dekompozycja wymagań całkowitych, powiązania międzybranżowe.

Abstrakt

W artykule przedstawiono porównawczą analizę mnożników produkcji globalnej w gospodarkach Niemiec, Polski i Słowacji w 2022 roku. Badanie oparto na narodowych tablicach input-output OECD i przeprowadzono w przekroju pięćdziesięciu rodzajów działalności gospodarczej. Wyniki wskazują wyraźny międzykrajowy gradient średnich mnożników produkcji globalnej: najniższą wartość odnotowano w Niemczech, pośrednią w Polsce, a najwyższą na Słowacji. Gradient ten odzwierciedla większą materiałochłonność produkcji w Polsce i na Słowacji oraz znaczenie importowanego zużycia pośredniego w mniejszych gospodarkach otwartych. Ranking działalności według wartości mnożnika jest podobny w trzech krajach: najwyższe pozycje zajmują przetwórstwo przemysłowe i energetyka, a najniższe edukacja, administracja publiczna i obsługa nieruchomości. Mnożnik produkcji rozłożono na komponent bezpośredni oraz komponent rezydualny, przy czym ten drugi zdefiniowano jako pozostałe zapotrzebowanie na produkcję po pierwszej rundzie nakładów bezpośrednich; komponent rezydualny stanowi około 70–85 procent mnożnika całkowitego we wszystkich trzech gospodarkach. Wyniki mogą wspierać analizę powiązań międzybranżowych oraz decyzje w zakresie polityki przemysłowej i strukturalnej. Kluczowym wynikiem jest również to, że wybrane działy przemysłu przetwórczego w Polsce i na Słowacji, zwłaszcza pojazdy samochodowe, komputery i elektronika, urządzenia elektryczne oraz na Słowacji sektor energii elektrycznej, osiągają znacznie wyższe mnożniki niż ich odpowiedniki w Niemczech.

Introduction

Input-output analysis is one of the oldest and at the same time most persistently used tools of applied macroeconomics. The model proposed by Leontief (1936, 1941), which describes the structure of interindustry linkages through a system of linear production equations, has become the standard framework for studying how a unit increase in final demand for the output of a given economic activity spreads through the economy via supply chains. The output multiplier is the aggregate indicator of this propagation: it measures the total response of gross output in all economic activities to a unit increase in final demand for the output of one of them. Despite the long history of the method, comparative empirical studies remain valuable, especially when they are based on harmonised cross-country data that minimise the methodological differences which have traditionally complicated such comparisons (Miller & Blair, 2022; Dietzenbacher *et al.*, 2013b).

The objects of comparison in this article are three European Union economies with different sectoral specialisations and different degrees of openness. Germany is a large EU economy with a developed manufacturing sector and a diversified sectoral structure. Poland is a large post-transition economy with a completed transformation, a strong manufacturing and engineering base, and an expanding service sector. Slovakia is a small open economy specialising in automotive production and performing the function of a regional energy hub: a substantial share of nuclear generation, combined with transit capacities, meets domestic needs and also supports electricity exports to neighbouring countries. Comparing these three cases makes it possible to trace how the depth of interindustry linkages varies with the character of sectoral specialisation and the degree of economic openness.

The country selection follows a purposive comparative design. Germany, Poland and Slovakia are linked by their participation in the EU single market and in Central European production networks, especially in manufacturing, automotive, machinery, electronics and energy-related value chains. At the same time, they occupy three different structural positions along a core, post-transition and small-open gradient. The comparison therefore does not treat the three economies as homogeneous; it uses them as an ordered set of contrasting but economically connected cases. Other EU economies, such as Czechia, Hungary and Austria, could be included in a wider design, but the present selection was chosen to keep the paper focused on a core-post-transition-small-open gradient with identical 2022 OECD input-output coverage.

The purpose of the study is to identify and compare the output multiplier effects of economic activities in Germany, Poland and Slovakia and to reveal the common features, specific characteristics and regularities in their formation. It should be emphasised that all multipliers are calculated on the basis of the total Leontief inverse matrix; hence, they include the contribution not only of domestic but also of imported intermediate consumption. This is crucial for the subsequent interpretation, because the role of imports in intermediate consumption differs substantially across the three economies under study.

The article provides an updated empirical description of the structure of output multipliers in three European economies and systematises their sectoral composition and decomposition into a direct requirements component and a residual requirement component. In this way it offers a comparative empirical basis for subsequent structural and sectoral research. The regularities identified – the cross-country gradient of mean values, the broadly similar ranking of economic activities and the predominance of the residual requirement component over the direct one – are analytically relevant both for researchers of interindustry linkages and structural change and for designers of industrial and structural policy who need empirical reference points for assessing expected output responses to changes in final demand in particular economic activities.

The remainder of the article is organised as follows. The literature review outlines the conceptual and methodological background of output multiplier analysis. The data and methodology section describe the OECD input-output tables used in the study and explains the calculation procedure. The results section presents the comparative empirical findings for Germany, Poland and Slovakia. The conclusions summarise the main regularities identified and discuss their analytical and policy relevance.

Literature review

The conceptual foundations of output multiplier analysis were laid by Leontief (1936, 1941), who formalised the structure of interindustry linkages through a system of linear production equations. The central technical object of this framework is the Leontief inverse matrix; the sum of the elements in each of its columns indicates the total volume of gross output in all economic activities that must be produced to satisfy a unit increase in final demand for the output of a given activity. This indicator, traditionally referred to as the simple output multiplier (Type I multiplier), concisely summarises the depth of interindustry linkages associated with each economic activity and remains a basic tool of input-output analysis (Miller & Blair, 2022; ten Raa, 2005).

The research that developed around the original Leontief model evolved in two directions: substantive applications and methodological refinement. In empirical work, Chenery and Watanabe (1958) initiated comparative studies of interindustry structures, demonstrating the stability of basic patterns of intermediate input use across national economies. Rasmussen (1956) proposed indices of dispersion, which, together with Hirschman's (1958) concepts of backward and forward linkages, became a standard instrument for identifying so-called key economic activities and for discussing strategies of unbalanced growth. The methods developed in this period continue to underpin most modern multiplier-based diagnostics.

Input-output analysis also has a broader theoretical background than the operational calculation of multipliers. Kurz and Salvadori (2006) interpret Leontief's work and Sraffa's early analysis as related attempts to describe the economy as a system of mutually dependent industries, in which outputs of some activities reappear as inputs of others. Opocher and Steedman (2015) extend this perspective to the theory of full industry equilibrium, stressing that long-run industrial adjustment has to be analysed at the level of the complete production system rather than as a collection of isolated industries. Empirical contributions such as Paraskevopoulou *et al.* (2016), which revisit Leontief's paradox using input-output evidence, also show that input-output analysis can reveal structural regularities that are not captured by simpler trade or sectoral models. These works are important for the present article because they support the interpretation of output multipliers as indicators of systemic interindustry dependence, while also reminding the reader that a high multiplier reflects the scale of intermediate requirements rather than welfare, productivity or competitiveness in itself.

At the same time, the standard Leontief multiplier has been subject to important critical reassessments. Dietzenbacher (2002) and Oosterhaven and Stelder (2002) note that the traditional definition tends to overstate the economic importance of activities with exceptionally high intermediate input requirements, because the multiplier mechanically captures the volume of intermediate linkages rather than the value created in the activity concerned. To overcome this limitation, alternative formulations have been proposed, including net multipliers and gross value-added multipliers (Oosterhaven & Stelder, 2002; Dietzenbacher, 2005; Oosterhaven, 2007); a textbook treatment of these issues, together with related decomposition methods, is provided by ten Raa (2005). The methodological debate has therefore enriched the toolkit, while at the same time confirming the relevance of the standard column-sum multiplier as an appropriate indicator for comparative analysis, provided that its results are interpreted carefully.

Consistent with this, output multipliers, value-added multipliers and employment multipliers are best understood as complementary rather than competing indicators that describe different aspects of the same demand impulse: output multipliers describe the gross production requirements and intersectoral propagation of final demand, while value added and employment multipliers describe net income and labour-market effects. Official statistical and central-bank applications therefore routinely calculate output multipliers together with value added, income and employment multipliers. This applied use is reflected in the United Nations Handbook, the U.S. Bureau of Economic Analysis methodology, the Bank of Greece and Central Bank of Malta studies, and the multiplier tables published by the Scottish Government and Statistics Canada (Australian Bureau of Statistics, 2025; Bureau of Economic Analysis, 2009; United Nations, 2018; Backinezos *et al.*, 2020; Cassar, 2015; Scottish Government, 2025; Statistics Canada, 2026).

A further line of methodological development, summarised in the programmatic essay by Dietzenbacher *et al.* (2013a), concerns the construction of multiregional and global input-output databases. The World Input-Output Database (Dietzenbacher *et al.*, 2013b; Timmer *et al.*, 2015) and, later, the OECD Inter-Country Input-Output tables (Yamano & Webb, 2018) made it possible to move multiplier analysis from a closed national context to a global production network and to account for the cross-border transmission of demand impulses, which now shapes modern manufacturing. The unified classifications of economic activities and harmonised accounting principles on which these databases are based have largely removed the harmonisation problems that once made cross-country comparisons of multipliers highly risky.

Empirical applications of multiplier analysis to European economies have a long tradition. For Germany, multipliers have been used in studies of interindustry structure, technological change, environmental impacts and the effects of fiscal stimulus, often in combination with structural decomposition and integrated environmental-economic accounts such as NAMEA (Schäfer & Stahmer, 1989; Moll *et al.*, 2006). The Polish multiplier school, associated primarily with the University of Lodz, has accumulated a substantial body of work on input-output modelling (Tomaszewicz, 1994; Plich, 2002; Boratyński *et al.*, 2010; Boratyński *et al.*, 2015; Świeczewska, 2014). These studies address, among other issues, the effects of European integration, fiscal and tax effects, the environmental consequences of structural change and the short-term effects of energy price changes. For Slovakia, comparative descriptions of interindustry structure developed in parallel with the country's integration into the European automotive supply chain, while more recent research based on harmonised sources has documented the exceptionally high material intensity of Slovak manufacturing (Grodzicki & Skrzypek, 2020).

Despite this substantial body of research, recent comparative descriptions of output multipliers for the Germany-Poland-Slovakia triangle based on the latest available data remain scarce. The present article is intended to fill this descriptive and analytical gap by systematically presenting the structure of output multipliers and their decomposition into a direct requirements component and a residual requirement component using national OECD input-output tables for the three economies.

Data and methodology

The empirical analysis is based on national input-output tables published by the OECD (2025) for the reporting year 2022. This is the most recent year for which the source currently publishes national tables. The data are compiled at basic prices and are available for fifty economic activities according to ISIC Rev. 4, with a detailed breakdown of selected manufacturing activities that is identical across the three countries. Intermediate consumption in the tables is split into domestic and imported components, which makes the data directly suitable for calculating multipliers that include both domestic and import-induced effects (Yamano & Webb, 2018; OECD, 2025). The advantage of this source over national statistical office data lies in the full harmonisation of activity definitions and accounting principles, so the cross-country differences observed in the multipliers can be attributed to structural rather than methodological factors. The output multiplier of economic activity j is calculated as the sum of the elements of the j-th column of the Leontief inverse matrix, as shown in formula (1):

$$m_j = \sum_i L_{ij} \tag{1}$$

where

$L = (I - A)^{-1}$

In formula (1), A is the matrix of total, that is, domestic and imported, technical coefficients. Each element $a_{ij} = z_{ij}/x_j$ expresses the share of inputs supplied by economic activity i per unit of gross output of economic activity j. The diagonal element of the Leontief inverse matrix reflects the response of the economic activity itself to a unit increase in final demand, while the off-diagonal elements capture the responses transmitted through other economic activities via interindustry linkages (Miller & Blair, 2022).

The calculated multiplier is decomposed according to a two-component, requirements-based convention into the direct intermediate-requirements component d_j and the residual requirement component r_j. The direct component is calculated as the sum of the elements of the j-th column of the matrix of technical coefficients, as shown in formula (2):

$$d_j = \sum_i a_{ij} = \frac{Z_j}{x_j} \tag{2}$$

In formula (2), Z_j is the total intermediate consumption of economic activity j. The direct component is therefore equal to the ratio of intermediate consumption to gross output and reflects the immediate technical input requirements generated by a unit increase in final demand. The residual requirement component is defined as the difference between the total output multiplier and the direct intermediate-requirements component, as shown in formula (3):

$$r_j = m_j - d_j \tag{3}$$

The residual component r_j is thus the remaining output requirement after the first round of direct inputs. Since $L = I + A + A^2 + A^3 + \dots$, subtracting A from L leaves $I + A^2 + A^3 + \dots$; the residual component therefore comprises the initial unit of output associated with final demand together with the higher-order interindustry requirements, and differs from the strict higher-order indirect effect $L - I - A$, in which the identity matrix is separated as an initial effect. This two-component, requirements-based reading is documented in the literature (Parikh, 1975; Coskun & Coskun, 2021; Office for National Statistics, 2017; Thomas *et al.*, 2024).

The calculations are performed using the total Leontief inverse matrix, which includes inputs of both domestic and imported origin. This methodological choice should be kept in mind when interpreting the cross-country differences, especially for smaller open economies in which imported intermediate consumption is quantitatively significant.

Results

According to the calculations based on national OECD input-output tables (OECD, 2025), output multipliers in the three economies under study form a clear and economically meaningful picture of interindustry linkages. The first notable regularity concerns the average level of multipliers. Calculated as a simple average over forty-nine economic activities (activity T, 'Activities of households as employers', is excluded because it has no intermediate consumption, its multiplier is identically equal to one and it carries no comparative information), the output multiplier is 2.258 in Germany, 2.469 in Poland and 2.618 in Slovakia. This ordering, summarised in the last row of Table 1, is fully consistent with the known structural characteristics of the three economies and admits a twofold interpretation. On the one hand, it shows that production in Poland and Slovakia is on average more material-intensive than in Germany: producing one unit of gross output requires a larger volume of intermediate inputs. By contrast, German production creates more gross value added per unit of output and relies less on assembly-type processes accompanied by high intermediate consumption. On the other hand, the observed gradient also reflects the fact that the multipliers are calculated from the total Leontief inverse matrix and include imported intermediate consumption alongside domestic inputs. In small open economies such as Slovakia and, to a lesser extent, Poland, this imported component is quantitatively important and explains a substantial part of the difference from Germany. Poland's average multiplier lies between the two reference points and reflects the dual nature of a post-transition economy that combines a strong engineering and manufacturing base with a growing service sector.

The aggregate results of the output multiplier calculations and their decomposition into a direct requirements component and a residual requirement component for the three economies are presented in Table 1.

The dispersion of multipliers across economic activities also changes systematically with the country average. In Germany, the range between the highest and the lowest multiplier is 1.83, from 1.27 in coal mining to 3.11 in the manufacture of non-ferrous and precious metals; in Poland, it is 1.95, from 1.23 in coal mining to 3.18 in motor vehicles; and in Slovakia, it reaches 2.31, from 1.57 in education to 3.88 in motor vehicles. The wider dispersion in Slovakia is linked to the concentration of its manufacturing base around a small number of material-intensive activities, above all automotive assembly. The unusually low values for coal mining in Germany and Poland deserve separate attention: they are not caused by a low cost of intermediate inputs in the usual sense, but rather reflect the structural decline of the activity in both countries. The remaining capacities are characterised by an unusually low ratio of intermediate consumption to gross output (around 10–13 per cent), so most of the value structure consists of labour compensation and depreciation, while the scope for backward propagation of a demand impulse is limited.

Table 1

Output multipliers and their decomposition into a direct requirements component and a residual requirement component in Germany, Poland and Slovakia, 2022

Economic activity	Code	Germany			Poland			Slovakia		
		Multiplier	Effect		Multiplier	Effect		Multiplier	Effect	
			Direct	Residual		Direct	Residual		Direct	Residual
1	2	3	4	5	6	7	8	9	10	
Agriculture, hunting and related service activities	A01	2.175	0.522	1.653	2.691	0.645	2.046	2.813	0.680	2.133
Forestry and logging	A02	1.999	0.474	1.526	2.367	0.555	1.811	1.846	0.400	1.445
Fishing and aquaculture	A03	2.064	0.491	1.574	2.148	0.486	1.662	2.162	0.484	1.678
Mining of coal and lignite	B05	1.274	0.130	1.144	1.226	0.100	1.126	2.490	0.563	1.927
Extraction of crude petroleum and natural gas	B06	2.335	0.643	1.692	2.529	0.662	1.868	1.769	0.295	1.475
Mining of metal ores	B07	1.000	—	1.000	2.073	0.469	1.603	2.488	0.556	1.932
Other mining and quarrying	B08	2.239	0.590	1.649	2.542	0.662	1.880	3.122	0.802	2.320
Mining support service activities	B09	1.859	0.421	1.439	2.225	0.538	1.687	2.480	0.597	1.883
Manufacture of food products, beverages and tobacco products	C10T12	2.752	0.787	1.965	3.167	0.827	2.340	3.062	0.771	2.291
Textiles, wearing apparel, leather and related products	C13T15	2.474	0.677	1.797	2.570	0.640	1.930	2.646	0.639	2.006
Manufacture of wood and wood products	C16	2.589	0.705	1.885	2.752	0.688	2.064	2.639	0.705	1.934
Manufacture of paper and paper products; printing	C17_18	2.680	0.739	1.941	2.901	0.735	2.166	3.270	0.805	2.465
Manufacture of coke and refined petroleum products	C19	3.052	0.895	2.157	2.935	0.786	2.149	2.544	0.789	1.755
Manufacture of chemicals and chemical products	C20	2.756	0.742	2.014	3.125	0.801	2.324	3.386	0.839	2.546
Manufacture of basic pharmaceutical products	C21	2.177	0.554	1.623	2.446	0.591	1.855	2.391	0.557	1.833
Manufacture of rubber and plastic products	C22	2.566	0.681	1.885	2.944	0.729	2.215	3.117	0.745	2.372

cont. Table 1

1	2	3	4	5	6	7	8	9	10	
Manufacture of other non-metallic mineral products	C23	2.457	0.668	1.789	2.756	0.716	2.040	3.030	0.732	2.299
Basic iron and steel	C24A	2.959	0.839	2.120	3.069	0.840	2.229	3.269	0.783	2.486
Manufacture of non-ferrous and precious metals	C24B	3.106	0.867	2.239	3.001	0.817	2.183	3.488	0.834	2.654
Manufacture of fabricated metal products	C25	2.573	0.640	1.932	2.804	0.676	2.129	3.058	0.697	2.360
Manufacture of computers, electronic and optical products	C26	2.155	0.538	1.617	3.084	0.792	2.291	3.770	0.892	2.878
Manufacture of electrical equipment	C27	2.509	0.647	1.862	3.046	0.771	2.275	3.408	0.800	2.608
Manufacture of machinery and equipment n.e.c.	C28	2.479	0.634	1.845	2.763	0.678	2.085	3.324	0.792	2.532
Manufacture of motor vehicles, trailers and semi-trailers	C29	2.615	0.686	1.929	3.175	0.814	2.361	3.882	0.895	2.986
Building of ships and boats	C301	2.916	0.812	2.104	2.965	0.751	2.214	2.955	0.679	2.276
Manufacture of other transport equipment	C302T309	2.547	0.659	1.888	3.023	0.761	2.262	3.266	0.771	2.495
Manufacture of furniture; repair and installation of machinery and equipment	C31T33	2.307	0.588	1.719	2.575	0.629	1.946	2.774	0.652	2.122
Electricity, gas, steam and air conditioning supply	D	2.470	0.650	1.819	2.453	0.643	1.810	3.855	0.969	2.887
Water supply; sewerage; waste management	E	2.261	0.577	1.685	2.298	0.552	1.747	2.400	0.527	1.873
Construction	F	2.327	0.592	1.736	2.842	0.705	2.138	2.578	0.592	1.985
Wholesale and retail trade; repair of motor vehicles	G	1.932	0.460	1.473	1.953	0.422	1.531	2.147	0.456	1.692
Land and pipeline transport	H49	2.203	0.563	1.640	2.466	0.678	1.789	2.324	0.567	1.757
Water transport	H50	2.460	0.615	1.845	2.937	0.748	2.189	1.584	0.251	1.334

cont. Table 1

Air transport	H51	2.815	0.753	2.062	3.055	0.801	2.253	3.148	0.855	2.293
Warehousing and support activities for transportation	H52	2.487	0.682	1.805	2.486	0.641	1.845	2.499	0.618	1.881
Postal and courier activities	H53	2.423	0.633	1.790	2.008	0.469	1.539	2.367	0.578	1.789
Accommodation and food service activities	I	2.146	0.557	1.589	2.301	0.509	1.792	2.109	0.421	1.688
Publishing, audiovisual and broadcasting activities	J58T60	2.189	0.581	1.608	2.196	0.538	1.658	2.378	0.559	1.819
Telecommunications	J61	2.370	0.670	1.700	2.058	0.497	1.561	2.121	0.444	1.677
Computer programming and information services	J62_63	1.900	0.466	1.434	1.852	0.429	1.423	2.069	0.463	1.606
Financial and insurance activities	K	2.141	0.568	1.573	1.633	0.328	1.305	2.139	0.511	1.629
Real estate activities	L	1.561	0.279	1.283	2.139	0.492	1.647	1.645	0.260	1.385
Professional, scientific and technical activities	M	1.962	0.487	1.475	2.030	0.476	1.554	2.184	0.500	1.684
Administrative and support service activities	N	1.903	0.454	1.448	2.077	0.487	1.590	2.394	0.569	1.825
Public administration and defence; compulsory social security	O	1.749	0.373	1.376	1.623	0.276	1.347	1.803	0.328	1.475
Education	P	1.464	0.241	1.224	1.472	0.211	1.260	1.571	0.223	1.348
Human health and social work activities	Q	1.649	0.337	1.312	1.951	0.426	1.526	1.838	0.356	1.481
Arts, sports, entertainment and recreation	R	1.935	0.479	1.456	2.252	0.561	1.692	2.705	0.664	2.041
Other service activities	S	1.698	0.358	1.341	1.988	0.437	1.551	1.994	0.392	1.601
Activities of households as employers	T	1.000	0.000	1.000	1.000	0.000	1.000	1.000	0.000	1.000
Average (excluding activity T)	—	2.258	0.583	1.687	2.469	0.602	1.867	2.618	0.609	2.009

Source: author's calculations based on OECD input-output tables (OECD, 2025) for 2022.

Note: mining of metal ores (B07) in Germany in 2022 has zero recorded output and is conventionally reported with a multiplier of 1.000; the direct effect for this activity is not defined. The average in the last row is calculated for forty-nine economic activities, excluding activity T.

The list of activities with the highest multipliers is broadly similar across the three economies. The upper part of the distribution is formed by activities that use intermediate inputs from other manufacturing activities intensively: motor vehicles, coke and refined petroleum products, metallurgy, chemicals, other non-metallic mineral products, rubber and plastics, and food manufacturing. In Poland and Slovakia, the manufacture of computers, electronic and optical products and electrical equipment also occupies a prominent position. The highest individual multiplier in the sample is observed in Slovakia, in the manufacture of motor vehicles (3.88), followed by electricity supply (3.86) and computer products (3.77). In Poland, motor vehicles (3.18) and the food industry (3.17) occupy the leading positions, while computer products and electrical equipment are close to the top. In Germany, the highest values are found in coke and refined petroleum products (3.05) and metallurgy (around 3.0), reflecting the deep integration of the country into heavy-industrial value chains.

Two regularities within the upper part of the distribution deserve particular attention. The first is that a number of manufacturing activities in Poland and Slovakia show much higher multipliers than in Germany. The most striking case is the manufacture of computers, electronic and optical products: the Slovak multiplier (3.77) exceeds the German value (2.16) by more than 1.6 points, while the Polish value (3.08) is almost one point higher than the German one. A similar difference is visible in motor vehicles, where the Slovak multiplier (3.88) is more than one point higher than the German value (2.62), as well as in electrical equipment. This regularity is not a random deviation; it is an empirical manifestation of the assembly-based character of the Slovak manufacturing base and, to a lesser extent, of the Polish one. A large share of gross output value is formed through intermediate linkages rather than created locally, which mechanically inflates the column sums of the Leontief inverse matrix. The second notable feature is the exceptionally high multiplier in electricity, gas and steam supply in Slovakia (3.86), compared with 2.47 in Germany and 2.45 in Poland. This value reflects Slovakia's role as a regional energy hub: the large share of nuclear generation in the energy balance, together with gas and electricity transit capacities, creates a dense chain of intra-sectoral intermediate linkages and, consequently, a high multiplier value.

The lower part of the multiplier distribution mirrors the regularities observed at the top and is also similar across the three countries. The lowest positions are systematically occupied by service activities with a high direct content of gross value added: education, public administration, real estate activities, human health and social work, and other personal services. If the special case of coal mining in Germany and Poland is set aside, education is the activity with the lowest multiplier among substantive activities in all three countries: 1.46 in Germany, 1.47 in Poland and 1.57 in Slovakia. The very high share of labour compensation in this activity and its limited use of intermediate inputs make this result entirely expected from a technological perspective.

The cross-country similarity of activity rankings can be summarised quantitatively using Spearman rank correlations between multiplier values. The pairwise coefficients are 0.85 between Germany and Poland, 0.78 between Poland and Slovakia and 0.73 between Germany and Slovakia. This ordering of coefficients is itself informative: the relatively higher coefficient between Germany and Poland and the lower coefficient between Germany and Slovakia are consistent with the narrow and distinctive industrial profile of the Slovak economy, which generates both higher peaks and a less typical sectoral ordering than in the other two countries.

The percentage decomposition of the output multiplier into a direct requirements component and a residual requirement component for the three economies is presented in Table 2.

Table 2

Shares of the direct and residual requirement components in the output multiplier in Germany, Poland and Slovakia, 2022 (%)

Economic activity	Code	Germany		Poland		Slovakia	
		Direct	Residual	Direct	Residual	Direct	Residual
1	2	3	4	5	6	7	8
Agriculture, hunting and related services	A01	24.0	76.0	24.0	76.0	24.2	75.8
Forestry and logging	A02	23.7	76.3	23.4	76.6	21.7	78.3
Fishing and aquaculture	A03	23.8	76.2	22.6	77.4	22.4	77.6
Mining of coal and lignite	B05	10.2	89.8	8.2	91.8	22.6	77.4
Extraction of crude petroleum and natural gas	B06	27.5	72.5	26.2	73.8	16.7	83.3
Mining of metal ores	B07	—	100.0	22.6	77.4	22.3	77.7
Other mining and quarrying	B08	26.4	73.6	26.0	74.0	25.7	74.3
Mining support service activities	B09	22.6	77.4	24.2	75.8	24.1	75.9
Food products, beverages and tobacco	C10T12	28.6	71.4	26.1	73.9	25.2	74.8
Textiles, apparel, leather and related products	C13T15	27.4	72.6	24.9	75.1	24.1	75.9
Manufacture of wood and wood products	C16	27.2	72.8	25.0	75.0	26.7	73.3
Manufacture of paper and paper products; printing	C17_18	27.6	72.4	25.3	74.7	24.6	75.4
Manufacture of coke and refined petroleum products	C19	29.3	70.7	26.8	73.2	31.0	69.0
Manufacture of chemicals and chemical products	C20	26.9	73.1	25.6	74.4	24.8	75.2
Pharmaceutical products	C21	25.4	74.6	24.2	75.8	23.3	76.7
Rubber and plastic products	C22	26.5	73.5	24.8	75.2	23.9	76.1
Other non-metallic mineral products	C23	27.2	72.8	26.0	74.0	24.2	75.8

cont. Table 2

1	2	3	4	5	6	7	8
Basic iron and steel	C24A	28.4	71.6	27.4	72.6	24.0	76.0
Non-ferrous and precious metals	C24B	27.9	72.1	27.2	72.8	23.9	76.1
Fabricated metal products	C25	24.9	75.1	24.1	75.9	22.8	77.2
Computer, electronic and optical products	C26	25.0	75.0	25.7	74.3	23.7	76.3
Electrical equipment	C27	25.8	74.2	25.3	74.7	23.5	76.5
Machinery and equipment n.e.c.	C28	25.6	74.4	24.5	75.5	23.8	76.2
Motor vehicles, trailers and semi-trailers	C29	26.2	73.8	25.6	74.4	23.1	76.9
Building of ships and boats	C301	27.8	72.2	25.3	74.7	23.0	77.0
Manufacture of other transport equipment	C302T309	25.9	74.1	25.2	74.8	23.6	76.4
Furniture; repair and installation of machinery	C31T33	25.5	74.5	24.4	75.6	23.5	76.5
Electricity, gas, steam and air conditioning	D	26.3	73.7	26.2	73.8	25.1	74.9
Water supply; sewerage; waste management	E	25.5	74.5	24.0	76.0	22.0	78.0
Construction	F	25.4	74.6	24.8	75.2	23.0	77.0
Wholesale and retail trade; motor vehicle repair	G	23.8	76.2	21.6	78.4	21.2	78.8
Land and pipeline transport	H49	25.6	74.4	27.5	72.5	24.4	75.6
Water transport	H50	25.0	75.0	25.5	74.5	15.8	84.2
Air transport	H51	26.7	73.3	26.2	73.8	27.2	72.8
Warehousing and support for transportation	H52	27.4	72.6	25.8	74.2	24.7	75.3
Postal and courier activities	H53	26.1	73.9	23.4	76.6	24.4	75.6
Accommodation and food service activities	I	26.0	74.0	22.1	77.9	20.0	80.0
Publishing, audiovisual and broadcasting activities	J58T60	26.5	73.5	24.5	75.5	23.5	76.5
Telecommunications	J61	28.3	71.7	24.1	75.9	20.9	79.1
Computer programming and information services	J62_63	24.5	75.5	23.2	76.8	22.4	77.6
Financial and insurance activities	K	26.5	73.5	20.1	79.9	23.9	76.1
Real estate activities	L	17.9	82.1	23.0	77.0	15.8	84.2
Professional, scientific and technical activities	M	24.8	75.2	23.4	76.6	22.9	77.1
Administrative and support service activities	N	23.9	76.1	23.4	76.6	23.8	76.2
Public administration and defence	O	21.3	78.7	17.0	83.0	18.2	81.8
Education	P	16.5	83.5	14.3	85.7	14.2	85.8

cont. Table 2

1	2	3	4	5	6	7	8
Health and social work activities	Q	20.4	79.6	21.8	78.2	19.4	80.6
Arts, entertainment and recreation	R	24.8	75.2	24.9	75.1	24.5	75.5
Other service activities	S	21.1	78.9	22.0	78.0	19.7	80.3
Households as employers	T	0.0	100.0	0.0	100.0	0.0	100.0

Source: author's calculations based on OECD input-output tables (OECD, 2025) for 2022. For mining of metal ores (B07) in Germany, the decomposition is not reported; see the note to Table 1.

In addition to the level and ordering of the multiplier, its two-component decomposition provides further comparative information. Two important regularities emerge. First, in virtually every economic activity and in all three countries, the residual requirement component substantially exceeds the direct intermediate-requirements component: its share usually ranges from 70 to 85 per cent of the total multiplier. Empirically, this shows that most of the total gross-output requirement is not exhausted by the one-round direct input coefficients but is associated with the residual requirement component.

Second, the share of the direct component varies systematically with the technological character of the economic activity. The highest values of this share, from 25 to 31 per cent, are observed in coke and refined petroleum products, food products, metallurgy, paper products, chemicals and motor vehicles, that is, in activities that intensively use intermediate inputs from a relatively narrow circle of suppliers. The lowest shares, from 14 to 22 per cent, are recorded in education, public administration, real estate activities and other personal services, where intermediate inputs play a minor role and most of the value structure consists of labour compensation. This regularity is informative for applied analysis because it shows what part of the total multiplier effect is realised directly in the activity being stimulated and what part is transmitted through its supply chain.

Two sectoral features in the decomposition of shares deserve particular attention. In coal mining in Germany and Poland, the share of the direct component falls to 10–13 per cent, while the share of the residual component rises to almost 90 per cent. As noted above, this profile results from a structurally low ratio of intermediate consumption to gross output in the remaining capacities of the activity. In Slovakia, the corresponding activity has a much more conventional decomposition, with a direct share of 23 per cent, reflecting a different value structure of the local mining base. The second notable case is water transport in Slovakia, where the share of the direct component is unusually low (16 per cent) and the multiplier itself is the lowest among non-trivial activities in the country (1.58). The explanation lies in Slovakia's geography as a landlocked country: water transport is limited to inland waterways and requires very little intermediate input.

Conclusions

The comparative analysis carried out in this article has identified several stable regularities in the structure of output multipliers in Germany, Poland and Slovakia. The most visible regularity is the cross-country gradient of average multipliers: the lowest value is observed in Germany, an intermediate value in Poland and the highest value in Slovakia. This gradient allows two complementary interpretations, which do not exclude one another. The first is that production in Poland and, especially, Slovakia is more material-intensive than German production: one unit of gross output requires a larger volume of intermediate inputs. The second is that the multipliers are calculated on the basis of the total Leontief inverse matrix and therefore include not only domestic but also imported intermediate consumption. The greater openness of the Slovak and Polish economies and the important role of imports in their assembly-type activities explain a substantial part of the observed difference from Germany. The gradient identified should not be interpreted as evidence that one economy is more productive or competitive than another; it only indicates that its production structure relies more heavily on intermediate consumption of both domestic and imported origin.

Another stable feature of the results is the similarity of sectoral rankings across the three countries. Despite substantial differences in absolute multiplier levels, the ordering of activities by multiplier size is broadly stable: manufacturing and energy systematically occupy the upper part of the distribution, whereas service activities are concentrated at the lower end. Spearman rank correlation coefficients ranging from 0.73 to 0.85 quantitatively confirm this regularity. The stability of the ranking shows that the basic technological structure of interindustry linkages creates a common profile across the three economies, while specific deviations from it - such as the peak in motor vehicles and electronic products in Slovakia or the peak in petroleum refining in Germany – can be linked to identifiable structural specialisations rather than idiosyncratic measurement effects. A separate and theoretically interesting case is the exceptionally high multiplier in electricity supply in Slovakia, which reflects the country's function as a regional energy hub: nuclear generation, together with transit capacities, forms a dense chain of intra-sectoral intermediate linkages.

The most important sector-specific result is the stronger multiplier response of several Polish and Slovak manufacturing activities relative to Germany. This is particularly visible in computers, electronic and optical products (2.16 in Germany, 3.08 in Poland and 3.77 in Slovakia), motor vehicles (2.62, 3.18 and 3.88 respectively) and electrical equipment (2.51, 3.05 and 3.41 respectively). In Slovakia, electricity, gas, steam and air conditioning supply also stands out, with a multiplier of 3.86 compared with about 2.45–2.47 in Germany and Poland. These differences confirm that Poland and especially Slovakia contain activities in which a unit increase in final demand generates a larger gross-output response than in Germany, mainly because of higher material intensity, stronger assembly-type linkages and the larger role of intermediate inputs.

A separate comment should be made on a warning long emphasised in the literature (Dietzenbacher, 2002; Oosterhaven & Stelder, 2002; Oosterhaven, 2007). High output multipliers do not necessarily indicate high economic importance in terms of value added or income; they only indicate a high requirement for intermediate inputs. The exceptional multiplier of 3.88 in motor vehicles in Slovakia is therefore a telling illustration: it reflects the assembly character of the activity rather than a large domestic contribution to value. For applied purposes, output multipliers should therefore be used together with complementary indicators, such as value added or employment multipliers, to avoid overstating the economic weight of material-intensive activities.

The two-component, requirements-based decomposition of output multipliers provides an additional layer of comparative information. The residual requirement component substantially exceeds the direct intermediate-requirements component in all three economies, accounting on average for 70–85 per cent of the total multiplier, while the direct component increases systematically with the material and technological intensity of the activity. This confirms that a large part of the total gross-output requirement lies beyond the one-round direct input coefficients, and that the relative weight of the two components can be measured in a way suitable for cross-country comparison.

The regularities identified in the article are analytically valuable for researchers of interindustry linkages and structural change, and may also serve as empirical reference points for industrial and structural policy makers who need a balanced tool for assessing expected output responses to changes in final demand in particular economic activities. Further research can naturally develop in two directions. The first is the analysis of the time path of multipliers, which would make it possible to trace empirically the speed and character of structural changes in the Polish and Slovak economies. The second is a systematic comparison of output multipliers with value added, income and employment multipliers, which would enrich the applied interpretation of the gross-output results presented here. Both directions can build directly on the harmonised information infrastructure provided by the OECD, while the descriptive basis established in this article offers a convenient starting point for them.

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