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THE ROLE OF THE TRANSPORT SECTOR IN THE POLISH ECONOMY: AN INPUT–OUTPUT APPROACH

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Purpose: The aim of this article is to evaluate the role of the transport sector within the structure of the Polish economy between 2010 and 2020 using input–output analysis tools, with particular emphasis on the exogenous approach.
Design/methodology/approach: The study employs Leontief and Ghosh models to calculate traditional multipliers (output, value added, income) and conducts a simulation of demand shocks based on the exogenous approach. The analysis is based on input–output tables from Statistics Poland for the years 2010, 2015, and 2020.
Findings: The results indicate strong interdependencies between the transport sector and other branches of the national economy, highlighting its dual role as both a supplier and a recipient of intermediate services. The land transport subsector exhibits the highest level of sectoral integration and generates substantial multiplier effects.
Research limitations/implications: The study does not account for employment effects due to the unavailability of satellite data. Future research should consider the use of dynamic models and the integration of environmental and social data.
Practical implications: The results may support investment decisions and transport policy by identifying the sectors most responsive to transport-induced economic stimuli.
Social implications: The analysis highlights the systemic importance of transport as a factor fostering regional development, social cohesion, and national economic competitiveness.
Originality/value: This article contributes new value by applying an exogenous modelling approach to assess the structural role of transport, a perspective rarely explored in the Polish literature.
Keywords: transport, input–output model, economic multipliers, Polish economy, intersectoral analysis.
Category of the paper: Research paper.

1. Introduction

The transport sector plays a vital role in modern economies. There is a strong correlation between the development of the transport system and the overall growth of the national economy. Efficient and well-developed transport serves both as a prerequisite for and a driver of economic growth (Rydzkowski, Wojewódzka-Król, 2000). The literature emphasises its dual role, on the one hand, as a provider of services essential for the smooth functioning of other sectors, and on the other, as a recipient of investment resources, both public and private (Koźlak, 2007).

Transport facilitates the exchange of goods and services by enabling the movement of raw materials, semi-finished products, and final goods, serving both productive and non-productive sectors, such as education and healthcare. It provides communication services to the population, influences the location of production and settlement, and supports administrative cohesion as well as the country's defence functions (Rydzkowski, Wojewódzka-Król, 2000; Koźlak, 2007). It may be stated that transport accompanies virtually all economic and social activities, constituting an indispensable element of development, acting as the "circulatory system" of the national economy (Mindur, 2007). On the other hand, the functioning of the transport system itself depends on supplies of fuel, energy, rolling stock, machinery, infrastructure, and human labour, which underlines the reciprocal interdependence between transport and other sectors of the economy (Rydzkowski, Wojewódzka-Król, 2000; Koźlak, 2007).

The significance of transport is reflected in a range of economic indicators that allow for the assessment of its impact on economic growth and the level of socio-economic development. The most commonly used measures include the value of turnover in the transport sector, the sector's contribution to gross domestic product (GDP), employment levels in the industry, the value of investment outlays, and transport intensity indicators (Butyter, 2015; Fajczak-Kowalska, Kowalska, 2018; Koźlak, 2018; Handayani et al., 2020; Vukić, Mikulić, Keček, 2021).

According to data from Statistics Poland, between 2010 and 2023, revenues from service sales in transport entities increased from PLN 124.9 million to PLN 454.5 billion, while average employment increased from 478.8 thousand to 724.1 thousand persons (GUS, 2011, 2024b). However, these figures refer to entities classified under Section H, "Transportation and Storage", excluding the division "Postal and Courier Activities". Therefore, they encompass more than just transport companies. The share of Section H in GDP increased from 4.77% in 2010 to 6.09% in 2023. Meanwhile, the share of investment outlays for Section H in total investment expenditures was 19.65% and 19.39%, respectively. These indicators confirm the crucial role and growing importance of the transport and storage sector in the Polish national economy.

At the same time, between 2010 and 2023, a noticeable decrease in transport intensity was observed. This indicator reflects the ratio of transport inputs (e.g., freight volumes in tonnes, tonne kilometres, or the value of transport output) to the value of outputs achieved in other sectors of the economy (e.g., GDP). In 2010, these indicators amounted to 1,241 tonnes per million PLN of GDP, 213 tonne-kilometres per thousand PLN of GDP, and PLN 125 per thousand PLN of GDP, respectively, while in 2023, the corresponding figures were 655 tonnes, 145 tonne-kilometres and PLN 105. The evident decline in transport intensity indicates a reduced share of transport costs in total production expenditures. This may result from increasing efficiency in the use of transport resources, modernisation of the transport network, or structural changes in the economy.

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However, indicators based on current-price GDP may be unreliable, as inflation distorts their value, thereby limiting their usefulness as a measure of actual transport intensity (Rydzkowski, Wojewódzka-Król, 2000). Furthermore, while the indicators presented are useful, they are of an aggregate nature and do not allow the identification of indirect and induced effects generated by the transport sector in relation to other branches of the economy. Consequently, there is a growing tendency to employ more detailed analytical tools, such as input–output models. This approach enables the identification of intersectoral linkages and the analysis of multiplier effects resulting from transport activity–effects that cannot be captured by conventional descriptive indicators.

Despite numerous studies on the transport sector in Poland, there remains a lack of analysis based on input–output models that comprehensively capture its direct, indirect and induced effects on the economy. This article seeks to address this gap by applying an extended input-output approach, which includes both traditional multipliers and linkage analysis (backward/forward linkages), as well as exogenous simulations of economic impulses generated by the transport sector. The purpose of the study is to assess the importance of transport within the structure of the Polish economy in the years 2010-2020 by identifying its intersectoral links and its impact on other sectors using both classical and exogenous perspectives.

The remainder of the article is structured into four main sections: Section Two presents a literature review on the application of input–output models in transport sector analysis; Section Three discusses the research methodology and data sources; Section Four provides the analytical results and their interpretation; and Section Five contains conclusions and recommendations.

2. Literature Review

Input–output (I–O) models are among the fundamental tools used in economic analysis and are widely applied in studies of the transport sector. They allow the identification of intersectoral linkages and the assessment of multiplier effects, making them useful in both academic research and the practice of public policy formulation (Yu, 2018). As Chrzanowski (2014) notes, given the current availability of statistical data, input–output models have become an almost indispensable tool for examining the structure of market economies.

In addition to classical input–output (I–O) models, their extensions are increasingly applied in the literature, offering a more complex representation of economic phenomena. Among the most commonly used are multi-regional input–output (MRIO) models, which allow for the analysis of the spatial effects of infrastructure investments (Marzano, Papola, 2008), and computable general equilibrium (CGE) models, which account for interactions between supply and demand across different markets as well as price variability, making them particularly useful for analysing dynamic macroeconomic processes (Njoya, Ragab, 2022; Rosik, Wójcik, 2023). The choice of a specific model depends on the research objective – classical I–O models are well-suited for multiplier and structural analyses, whereas the CGE approach enables scenario-based simulations that incorporate market mechanisms.

The application of input–output models in transport sector research can be grouped into three main analytical strands, each reflecting different research objectives and perspectives. First, there are studies focusing on multiplier effects and the influence of the transport sector on other parts of the economy. Second, research employing the exogenous approach, in which transport acts as a source of macroeconomic impulses. Third, studies that examine the structural position of transport within the intersectoral system. This classification structures the remainder of the literature review, facilitating the identification of dominant trends and research gaps.

One of the most common applications of I–O models in transport studies is the analysis of multiplier effects, including the impact of the sector on production, value added, and employment in the economy. For example, Lim et al. (2015) examined the effects of road and rail transport on the South Korean economy in the years 2003-2009, showing that despite its relatively low value added, road transport plays a key role as a channel for transmitting economic impulses. Alises and Vassallo (2016) focused on comparing the demand for road freight transport in Spain and the United Kingdom, analysing the relationship between economic structure and the demand for transport services. Using input–output tables, the authors measured the volume of transport associated with domestic production and consumption, emphasising the importance of detailed sectoral modelling in transport analysis. In the Polish context, a notable example of this approach is the study by Lach et al. (2022), who estimated the potential effects of implementing Hyperloop technology, pointing to broad multiplier effects in both industry and the labour market.

There is a growing interest in the literature in the exogenous approach, where the transport sector is not analysed as a passive recipient of final demand but as an active source of impulses stimulating the economy. For example, Lee and Yoo (2016) treated four transport modes, rail, road, water, and air, as exogenous factors and analysed their impact on other sectors of the South Korean economy. Muryani and Swastika (2018) adopted a similar methodology in their study of the Indonesian economy, applying a supply-side approach in which primary inputs were treated as drivers of economic growth. The exogenous model was also used by Vukić et al. (2021) in analysing the Croatian economy, and Daldoul and Dakhlaoui (2025) considered it more accurately reflects the role of transport in developing countries. In Poland, the exogenous model was applied by Białek and Tyc (2025), who studied the impact of public support policies for the land transport sector during and after the COVID-19 pandemic. Their analysis, which combined macroeconomic and microeconomic perspectives, allowed for an assessment of the competitiveness relative to its suppliers and business partners.

The third strand of research focuses on analysing the position of transport within the economic structure, with particular emphasis on its intermediary functions and role in the network of intersectoral linkages. This type of study allows for the assessment of the strategic importance of the transport sector in production, service, and investment flows. For example, Wang and Yan (2023), analyzing the logistics sector in China, emphasised its multidimensional nature, which includes not only transport operations, but also infrastructure, information management, and digital components. In the Polish context, Fura (2017), using data from Statistics Poland, identified transport as one of the key sectors of the national economy. Similarly, Huderek-Glapska et al. (2016) highlighted the importance of regional airports as critical nodes in economic linkages, analysing both operational and investment-related effects of air transport. Such studies point to the central role of the transport sector in the system of economic flows and its potential as a generator of indirect effects.

Input–output models are used in transport analyses in various economic and geographic contexts—including both highly developed countries such as South Korea (Lee, Yoo, 2016), Germany (Koesler, 2013) and Croatia (Vukić, Mikulić, Keček, 2021), and developing economies such as China (Zhao, Ding, 2024), Tunisia (Daldoul, Dakhlaoui, 2025), Indonesia (Muryani, Swastika, 2018), and Nigeria (Ojaleye, Narayanan, 2022). The spatial scope of the analyses includes both national and regional levels. Examples of regionally focused studies include research on interregional trade flows in Poland (Rokicki, Vázquez, Goliszek, 2024) and the impact of regional airports (Huderek-Glapska, Inchausti-Sintes, Njoya, 2016). Furthermore, the study by Handayani et al. (2020) indicates that the transport sector can serve as a foundational sector that effectively stimulates economic growth. Cross-country and multiscalar comparisons help to better understand the conditions under which transport influences the structure of the economy, including variations due to development levels, industrial structure, and spatial policy.

The literature review demonstrates a growing interest in the application of input–output models in transport research, encompassing various methodological approaches (classical and exogenous), different levels of analysis (national and regional), and a wide range of applications–from multiplier effect assessments to structural investigations. Despite this diversity, relatively few studies integrate an analysis of the structural role of the transport sector with an exogenous modelling of economic impulses. In the context of Poland, although input–output models have been applied to study the transport sector, there is a noticeable lack of research adopting an exogenous perspective, where transport is treated as a source of economic stimulus. This study seeks to address this gap by offering an in-depth assessment of the role of the transport sector in the national economic structure, employing both classical multiplier analysis and exogenous modelling.

3. Methodology and Data Sources

3.1. The Leontief Model and Its Application

Leontief's model, commonly referred to as the input–output model, was developed by Wassily Leontief in the 1930s and further elaborated in subsequent decades (Leontief, 1986). It constitutes a mathematical representation of the structure of a national or regional economy, in which each sector (industry) simultaneously acts as a supplier and a recipient of goods or services in relation to other sectors. A key feature of the I-O model is its ability to depict quantitative intersectoral relationships, which allows analysis of the effects of changes in final demand on the entire economy. The starting point is the input–output table, which reflects the production relationships among individual sectors of the economy (see Table 1).

Table 1.
Input–output transaction table

Sector number i	Intermediate inputs x_{ij}				Final demand Y_i	Total output X_i
	1	2	…	n		
1	x_{11}	x_{12}	…	x_{1n}	Y_1	X_1
2	x_{21}	x_{22}	…	x_{2n}	Y_2	X_2
⋮	⋮	⋮	⋱	⋮	⋮	⋮
n	x_{n1}	x_{n2}	…	x_{nn}	Y_n	X_n
Value added D_j	D_1	D_2	…	D_n		
Total output X_j	X_1	X_2	…	X_n		

Source: the author's own work.

The structure of the Leontief model can be described using two fundamental equations. The first one pertains to the production side (rows of the table) and expresses the total output of the *i-th* sector as the sum of intermediate inputs delivered to other sectors and final demand:

$$X_i = \sum_{j=1}^{n} x_{ij} + Y_i \tag{1}$$

where:

X_i – total output of sector i,

x_{ij} – value of the product from sector i used by sector j as an intermediate input,

Y_i – final demand for the output of sector i (final demand for goods and services of sector i).

$$X_j = \sum_{i=1}^{n} x_{ij} + D_j \tag{2}$$

where:

X_j – is the total output of sector j,

x_{ij} – denotes intermediate inputs from sector i used in sector j,

D_j – primary inputs in sector j, ie, value added (wages, indirect taxes, operating surplus).

On the basis of the values of x_{ij}, one can construct the matrix of technical coefficients A, referred to as the cost structure matrix.

$$A = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{bmatrix} \tag{3}$$

The elements of this matrix are nonnegative and represent the cost coefficients (direct input coefficients) of sector j, i.e., the ratio of inputs to outputs in that sector, where:

$$a_{ij} = \frac{x_{ij}}{X_j} \qquad i,j = 1,2 \ldots n \tag{4}$$

This formulation allows the model to be transformed into matrix form:

$$X = AX + Y \Leftrightarrow (I - A)X = Y \Leftrightarrow X = (I - A)^{-1}Y \tag{5}$$

where:

X – total output vector,

A – matrix of technical coefficients,

Y – final demand vector,

I – identity matrix,

$(I - A)$ – Leontief matrix,

$(I - A)^{-1}$ – inverse Leontief matrix, representing the total (direct and indirect) impact of final demand on the output of individual sectors.

In the relevant literature, the Leontief model is typically interpreted as a demand-driven model, in which final demand is treated as an exogenous variable, and sectoral output adjusts to its structure and level. In contrast, the supply-driven model (also known as the Ghosh model) starts from value added, which is considered an impulse affecting a sector's ability to produce and supply goods to other sectors (Dietzenbacher, 1997; Lee, Yoo, 2016; Kim, Tromp, 2022). In macroeconomic analysis, the demand-driven approach is much more commonly used, primarily due to its simplicity and its empirical link to observable demand and consumption variables. This framework helps to understand how increased demand for goods and services in one sector can generate growth impulses throughout the economy. It also enables the identification of sectors that are particularly sensitive to demand-side changes (Fura, 2017), which is crucial for designing regional policies and planning for sustainable development (Chrzanowski, 2014).

The presented structure of the input–output model enables the analysis of the economic structure and the assessment of how changes in final demand affect total sectoral output. Through the technical coefficient matrix, it is possible to trace direct and indirect links between sectors. This model provides a foundation for further analyses of multiplier effects and simulations of changes in the economic structure.

3.2. Indicators of Intersectoral Linkages

To determine the intensity of the transport sector's linkages with other sectors of the economy, backward linkage and forward linkage indicators were used. These are classic measures of sectoral influence in inter-industry analysis. The concepts originate from the work of Rasmussen and Hirschman and are widely applied in studies based on the Leontief model (Miller, Blair, 2009).

Calculations can be performed based on either the matrix of direct technical coefficients A or the full Leontief matrix $L = (I - A)^{-1}$. In this study, the approach based on the matrix L is adopted, as it accounts not only for the direct but also for the indirect effects arising from complex intersectoral linkages. This approach enables a more comprehensive assessment of the structural importance of the analysed sector within the entire production system of the economy.

The backward linkage indicator measures the strength of a given sector's dependence as a recipient of intermediate inputs–specifically, the extent to which the sector relies on products from other sectors in its production process. It is calculated as the sum of values in column j of the Leontief matrix L:

$$BL_j = \sum_{i=1}^{n} l_{ij} \tag{6}$$

where:

BL_j – backward linkage value for sector j,

l_{ij} – element of the Leontief matrix L, representing the total impact of sector i on the unit output of sector j,

n – number of sectors.

The forward linkage indicator determines the extent to which the outputs of a given sector are used by other sectors as intermediate inputs–thereby assessing its importance as a supplier within the economy. It is calculated as the sum of the values in row i of the Leontief matrix L:

$$FL_i = \sum_{i=1}^{n} l_{ij} \tag{6}$$

where:

FL_i – forward linkage value for sector i.

In this analysis, a normalisation approach was applied, where the results are scaled relative to the economy-wide average. According to the framework presented by Miller and Blair (2009), this allows the indicators to be interpreted in the form of indices:

$$BI_j = \frac{BL_j}{\frac{1}{n}\sum_{j=1}^{n} BL_j} \tag{7}$$

$$FI_i = \frac{FL_i}{\frac{1}{n}\sum_{i=1}^{n} FL_i} \tag{8}$$

Values of the indicators above 1 indicate an above-average level of sectoral integration with the economy, whereas values below 1 point to weaker linkages in the respective dimension.

3.3. Multiplier Effects in the Input–Output Model

One of the key applications of the input–output model is the ability to estimate so-called multiplier effects, which reveal the scale of impact that changes in a selected sector have on other parts of the economy. In the context of this study, the goal is to determine the extent to which a change in total output in the transport sector translates into the level of economic activity in other sectors.

According to the classification presented by Miller and Blair (Miller, Blair, 2009), multiplier effects can be divided into:

- Direct effects – the response of the analysed sector to an economic stimulus (e.g., investment).
- Indirect effects – changes in sectors indirectly linked through the supply of intermediate inputs
- Induced effects – further increases in economic activity resulting from higher household incomes and expenditures.

From a mathematical perspective, these multipliers are expressed using the inverse Leontief matrix $(I - A)^{-1}$. The elements of this matrix, denoted as lij, represent the total (direct and indirect) effect of a change in final demand in sector j on the output of sector i. The total output multiplier for sector j is calculated as the sum of the corresponding column in the inverse matrix:

$$m_j^{(X)} = \sum_{i=1}^{n} l_{ij} \tag{6}$$

where:
$m_j^{(X)}$ – total output multiplier for sector j,
l_{ij}– element of the inverse Leontief matrix.

Given the availability of satellite coefficients such as the share of value added (d_i), or income (r_i) in the output of a given sector, the corresponding multipliers can be calculated as follows:

- Value-added multiplier:

$$m_j^{(D)} = \sum_{i=1}^{n} d_i \times l_{ij} \tag{7}$$

- Income multiplier:

$$m_j^{(R)} = \sum_{i=1}^{n} r_i \times l_{ij} \tag{8}$$

In empirical research, such multipliers make it possible to identify which sectors serve as "engines" of development, exerting a strong influence on the entire economy.

3.4. The Ghosh Supply Model and Supply Multipliers

An alternative to the Leontief demand model is the so-called supply model, also known as the Ghosh model (Dietzenbacher, 1997; Yu, 2018). In contrast to the demand model, which analyses the impact of increased final demand on the entire economy, the supply model focusses on the effects of an increase in total output (supply) in individual sectors. At the core of the model lies the supply allocation coefficient matrix (matrix B), expressed as:

$$B = [b_{ij}] = \left(\frac{z_{ij}}{X_j}\right) \tag{9}$$

where:
z_{ij} – the flow from sector j to sector i,
X_j – the total output (gross output) of sector j.

The inverse Ghosh matrix $(I - B)^{-1}$ is used to assess the total supply effects, analogously to the Leontief inverse in the demand model (Yu, 2018). The row sum of this matrix for a given sector defines the supply multiplier:

$$m_{s,j} = \sum_{i=1}^{n} (I - B)_{ji}^{-1} \tag{10}$$

The value of the multiplier reflects the increase in total output across the economy in response to a unitary supply-side impulse in sector j, assuming inelastic final demand.

3.5. The Exogenous Leontief Model with Final Demand Shock Simulation

The classical Leontief demand model assumes that final output (final demand) is the exogenous variable, while sectoral output is an endogenous variable–calculated in response to demand shocks. However, as noted by Miller and Blair (2009), in the case of certain sectors–such as transport–not all output changes result from classical final demand. Infrastructure investments, political decisions, or the development of transport networks may serve as exogenous impulses that trigger changes in other sectors of the economy. For this reason, it is more appropriate to treat the transport sector as a source of economic stimulus that affects other branches of the economy, which constitutes the rationale for adopting an exogenous approach in the present analysis.

In this approach, an extension of the classical input–output (I–O) model is applied, in which the transport sector is treated as an exogenous source of disturbance, and its impact on the national economy is calculated using the inverse Leontief matrix. The change in output in the endogenous (remaining) sectors is expressed by the following equation:

$$\Delta X_e = (I - A)^{-1} A_T \Delta X_T \tag{11}$$

where:

ΔX_e – change in output in the endogenous (remaining) sectors,

A – technical coefficients matrix,

A_T – the column of matrix A representing the demand of individual sectors for the output of the transport sector,

ΔX_T – exogenous change in the output of the transport sector.

The multiplier approach was complemented by an exogenous analysis based on the concept of injecting a unit demand shock into selected sectors. This analysis enables the assessment of the structure of production effects in the remaining sectors of the economy by using the inverse Leontief matrix and multiplying it by a shock vector with a value of PLN 1 million for the selected sector.

3.6. Data Sources

The basis of the analysis consists of input–output tables compiled by Statistics Poland (GUS) for the years 2010, 2015, and 2020, which form an integral part of the national accounts system. The tables containing data for 2010 were prepared in accordance with the SNA 1993 (System of National Accounts) and ESA 1995 (European System of Accounts) standards (GUS, 2014), whereas the tables for 2015 and 2020 were compiled according to the European System of National and Regional Accounts (ESA, 2010), introduced by Regulation (EU) No 549/2013 of the European Parliament and of the Council of 21 May 2013 (GUS, 2019, 2024a), ensuring their comparability at the international level. Moreover, GUS publications provide detailed explanations concerning the methods used to estimate missing data and the principles of transforming purchaser prices into basic prices, thereby enhancing the transparency and credibility of the analysis.

The input–output tables present the flows of products and services at basic prices, in a product-by-product format, broken down into 77 positions according to the divisions of the Polish Classification of Products and Services (PKWiU). The PKWiU structure is based on the Statistical Classification of Economic Activities in the European Community (NACE), the Classification of Products by Activity (CPA), and the PRODCOM list. The list of 77 'branches' according to PKWiU divisions is provided in the Appendix.

The structure of the input–output tables published by GUS comprises three main segments: the intermediate consumption matrix (Part I), the final demand matrix (Part II), and the gross value added matrix (Part III). In these tables, the transport sector is classified into two subsectors: (1) Land and pipeline transport services (division 49) and (2) Water and air transport services (combined divisions 50 and 51). This classification determined the analytical framework applied in the present study.

GUS also compiles matrices of direct and total technical coefficients of product intensity. These indicators reflect the intensity of intersectoral dependencies within the economy, enabling the analysis of multiplier effects. The methodology used for their calculation is consistent with classical Leontief theory and adapted to the specific characteristics of the Polish economy and statistical classification system. The use of GUS data ensures methodological consistency over time, enabling structural comparisons within the Polish transport sector.

In the present study, the transport sector was examined in a disaggregated manner–both as a whole (combined divisions 49 and 50-51) and separately, i.e., as land and pipeline transport (division 49) and water and air transport (divisions 50-51). This approach enables not only the assessment of the cumulative impact of the entire transport sector on the national economy, allowing for comparison with macro-level analyses (Daldoul, Dakhlaoui, 2025), but also the identification of differences in the structure of multiplier effects generated by individual divisions. It is similar to the methodology applied in studies concerning the economies of Korea (Lee, Yoo, 2016) and Croatia (Vukić, Mikulić, Keček, 2021). As a result, it is possible to indicate both the general role of the transport sector as a driver of economic development and to identify those subsectors that exhibit the strongest links with other branches of the economy and generate the highest indirect and induced effects.

4. Results and Discussion

4.1. Analysis of Intersectoral Linkages of the Transport Sector

As part of the input–output (I-O) analysis, the intensity of the links between the land and pipeline transport sector (division 49) and the water and air transport sector (divisions 50-51) and other branches of the national economy was evaluated. Standard backward linkage (BL) and forward linkage (FL) indicators were applied, in accordance with the Rasmussen–Hirschman methodology, and their values are presented in Tables 2 and 3.

Table 2.
Backward Linkage Indicators for Divisions 49 and 50-51

	Division 49			Divisions 50-51		
Year	**2010**	**2015**	**2020**	**2010**	**2015**	**2020**
Backward linkage	1,7026	1,6841	1,7879	1,8540	1,9434	2,0883
Average (BL)	1,6917	1,6520	1,6559	1,6917	1,6520	1,6559
Backward index (BI)	1,0065	1,0194	1,0798	1,0960	1,1764	1,2612

Source: the author's own work.

The results indicate that both division 49 and divisions 50-51 exhibit backward linkage values above the average, confirming their significant role as recipients of intermediate goods and services. In particular, the increase in the indicator for divisions 50-51 between 2010 and 2020 suggests a growing demand for external resources and a deepening integration with the national economy.

Table 3.
Forward Linkage Indicators for Divisions 49 and 50-51

	Division 49			Divisions 50-51		
Year	**2010**	**2015**	**2020**	**2010**	**2015**	**2020**
Forward linkage	3,9259	4,1231	4,2767	1,2480	1,2286	1,1191
Average (FL)	1,6917	1,6520	1,6559	1,6917	1,6520	1,6559
Forward index (FI)	2,3207	2,4958	2,5828	0,7377	0,7437	0,6758

Source: the author's own work.

The analysis of the forward linkage indicator reveals more pronounced differences. Division 49 consistently achieves index values that exceed 2.3, confirming its importance as a key supplier of services to other sectors. In contrast, water and air transport (divisions 50-51) records values below the average and demonstrates a downward trend, which may indicate a more specialized and limited role within the economic structure.

These results are consistent with the findings of B. Fura (2017). The author–based on aggregated data–classified the transport sector among the group of "key sectors" (BI and FI > 1). Similar conclusions were drawn in studies conducted for Indonesia (Handayani et al., 2020) and Nigeria (Ojaleye, Narayanan, 2022), where transport, treated as an aggregate, was likewise identified as a sector with significant influence on the structure of intersectoral linkages. Similar results were also obtained in analyses conducted for other Central and Eastern

European countries. For example, Balla (2014) analysing the economic sectors of Romania, Hungary and Slovakia based on backward and forward linkage indicators pointed out that in the Slovak economy, the transport and postal services sector ranks second in terms of backward linkage strength. This confirms its strategic importance within the intersectoral structure of the region.

In contrast, detailed analyses conducted in Taiwan (Chiu Lin, 2012), South Korea (Lee, Yoo, 2016), and Tunisia (Daldoul, Dakhlaoui, 2025), which considered the division of transport into rail, road, water, and air subsectors, revealed that the values of both BL and FL indicators for most transport subsectors were below 1. This suggests that in the economies analysed, individual branches of transport did not serve as key nodes in the intersectoral network. Against this background, the transport sector in Poland–particularly land transport–stands out with a consistently high level of integration, both as a recipient and as a supplier, which confirms its systemic importance in the national economy.

4.2. Output, Value Added, Income, and Supply Multipliers of the Transport Sector

At this stage of the analysis, the classical Leontief model was employed to estimate the multipliers of effects generated by the transport sectors in the Polish economy. Four types of multipliers were calculated: output, value added, employment, and income multipliers– in accordance with the methodological approach outlined in Section 3.3. These multipliers illustrate the extent to which an increase in final demand by one unit (PLN 1000) translates into effects throughout the economy. In addition, the supply multiplier based on the Ghosh model, as presented in Section 3.4, was included to capture the impact of a unitary increase in the sector's supply on other branches of the economy. The inclusion of both approaches enables an assessment of the sector's influence from both the demand and supply perspectives.

The results are presented in Table 4 for the two analysed subsectors: division 49 (land and pipeline transport) and divisions 50-51 (water and air transport), across three time periods: 2010, 2015, and 2020.

Table 4.
Output, Value Added, Income, and Supply Multipliers for Transport Sectors

	Division 49			Divisions 50-51		
Year	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**
Output multiplier	1,70	1,68	1,79	1,85	1,94	2,09
Value added multiplier	0,85	0,78	0,92	0,74	0,75	0,66
Income multiplier	0,19	0,15	0,18	1,39	1,56	1,20
Supply multiplier	5,74	5,88	6,23	1,71	1,64	1,75

Note. The output, value added, employment, and income multipliers refer to a unit increase in final demand (PLN 1000), while the supply multiplier reflects the effect of a unit increase in sectoral supply (Ghosh model).

Source: the author's own work.

The analysis of the results reveals differences in economic impacts between the examined divisions as well as clear temporal changes. In the case of division 49, an increase in the output multiplier (from 1.70 to 1.79) and the value added multiplier (from 0.85 to 0.92) was observed. This means that each additional PLN 1000 of final demand in this sector generates PLN 1790 in output and PLN 920 in value added within the economy. The increase in these multipliers indicates rising economic efficiency and stronger linkages of land transport with the national production structure. The results are consistent with the high forward linkage values (Table 2), confirming the significant role of division 49 as a supplier of value to other sectors. On the other hand, the relatively low value of the income multiplier (0.19 in 2010) suggests that income growth in this sector translates only to a limited extent into income increases in other parts of the economy.

For divisions 50-51, an increase in the output multiplier was also observed (from 1.85 to 2.09), along with a consistently high income multiplier (1.39 in 2010, 1.56 in 2015, and 1.20 in 2020). The low and declining value added multiplier (falling from 0.75 to 0.66) may suggest a high share of labour costs and relatively low capital productivity in these divisions. Conversely, the high income multipliers indicate that income growth in these sectors generates significant income effects across other branches of the economy.

The results obtained are consistent with the findings of previous studies, which demonstrated that after 2004, road transport in Poland significantly increased its role as a key component of the logistics system, particularly in the area of freight transport. It became one of the main drivers of efficiency growth in the TSL sector (Fajczak-Kowalska, Kowalska, 2018; Koźlak, 2018), which is reflected in the observed values of the output and value added multipliers.

The importance of transport for the growth of gross output and the generation of value added has also been confirmed in analyses for South Korea (Lee, Yoo, 2016), where particular emphasis was placed on the integration of the transport sector with the manufacturing industry. Kim and Tromp (2022) noted that the logistics sector, including land, water, and air transport, is characterised by strong intersectoral linkages and significant potential to generate production and income effects. Similarly, Kim, Lee, and Trimi (2021) emphasised the systemic function of the logistics sector as a channel for the diffusion of economic impulses. Moreover, the analysis conducted by Zhao and Ding (2024) for China demonstrated high multiplier effects for transport (over 4 for output and around 2 for value added), stemming from its broad interconnections with other sectors of the economy.

The strong linkages between the transport sector and the broader economy imply that disruptions in its functioning can lead to substantial losses in output and income across a wide range of interconnected sectors. This is confirmed by the findings of Ali et al. (2021), which demonstrated that a 21-day transport strike triggered significant economic consequences.

A complement to the demand-side analysis is the supply-driven multiplier, which reflects the capacity of a sector to generate output in other sectors of the economy as a supplier. For division 49, the supply multiplier values range from 5.74 to 6.23, indicating its central role in the supply network. In contrast, for divisions 50-51, these values are significantly lower (1.71-1.75), which may suggest a more limited supply function for this segment of the transport sector.

These findings are consistent with the conclusions of Alises and Vassallo (2016), who, based on data from European economies, argued that the structure of the economy influences the strength of supply-side effects generated by the transport sector. In countries with a higher share of industry, land transport maintains an exceptionally strong position as a supplier of goods and services within the intersectoral system.

4.3. Exogenous Sector Analysis

This subsection presents the results of an input–output analysis using the classical Leontief model in its exogenous formulation. The objective of the analysis was to estimate the impact of an additional demand impulse generated in the transport sector on gross output in other sectors of the national economy. The study was conducted for three time points–2010, 2015, and 2020–which allows for the assessment of structural changes over time and the identification of sectors most sensitive to a demand impulse from the transport sector.

The analysis considered three variants of the demand impulse:

- the impact of division 49 (Land and pipeline transport services),
- the impact of divisions 50-51 (Water and air transport services),
- the cumulative effect for the entire transport sector–divisions 49 and 50-51.

In each case, the demand impulse was set at PLN 1 million (in current prices). Variants 1 and 2 involve a disturbance assigned exclusively to the respective divisions, while in variant 3, the impulse of PLN 1 million impulse was simultaneously assigned to both Division 49 and Divisions 50-51. All other divisions were assigned a disturbance value of zero.

The results are presented as rankings of the ten sectors that, in a given year, recorded the highest output effect in response to the impulse. In this way, the TOP 10 divisions most responsive to the exogenous increase in final demand in the analysed transport divisions are identified. Where a given division did not rank among the ten highest effects in a particular year, the symbol '–' was used, indicating its absence from the TOP 10 list for that year.

Table 5.
Effects of Exogenous Impulse from Division 49

No.	Description	Code PKWiU	2010		2015		2020	
			Efect	Rank	Efect	Rank	Efect	Rank
1	Land and pipeline transport services	(49)	1 078 597	1	1 107 871	1	1 154 805	1
2	Coke, refined petroleum products	(19)	127 759	2	84 950	2	83 210	3
3	Warehousing; postal and courier services	(52-53)	51 074	3	71 071	3	104 495	2
4	Retail trade services	(47)	41 636	4	29 711	6	23 540	9
5	Sale and repair services of motor vehicles and motorcycles	(45)	39 536	5	28 763	7	24 891	7
6	Electricity, gas, steam and air conditioning	(35)	33 598	6	32 804	4	24 115	8
7	Wholesale trade services	(46)	31 322	7	21 357	10	–	–
8	Motor vehicles	(29)	31 045	8	30 462	5	25 951	6
9	Rental and leasing services	(77)	25 688	9	28 071	8	42 630	5
10	Constructions and construction works	(41-43)	20 396	10	26 246	9	42 815	4
11	Real estate services	(68)	–	–	–	–	20 433	10

Source: the author's own work.

Table 5 presents 11 divisions that recorded the highest output effects in 2010, 2015, and 2020 in response to an exogenous demand impulse directed at division 49 (Land and pipeline transport services). The highest values were observed in the originating division itself (49), confirming its internal importance and strong feedback linkages (intradivisional effects). High and stable positions are held by the divisions of Coke, refined petroleum products (19), Warehousing; postal and courier services (52-53), Electricity, gas, steam and air conditioning (35), as well as Sale and repair services of motor vehicles and motorcycles (45).

Retail trade services (47) deserve particular attention, as they ranked fourth in 2010 but dropped to ninth in 2020, which may indicate a decreasing sensitivity of this division to demand from Land and pipeline transport services. The upward shift in the ranking in 2015 and 2020 of Constructions and construction works (41-43) and Rental and leasing services (77), as well as the appearance of Real estate services (68) in the ranking, reflect changes in the structure of Division 49's impact on other divisions of the economy and growing sensitivity of these divisions to impulses originating from Land and pipeline transport services.

Table 6.
Effects of Exogenous Impulse from Divisions 50-51

No.	Description	Code PKWiU	2010		2015		2020	
			Efect	Rank	Efect	Rank	Efect	Rank
1	Water and air transport services	(50-51)	1 035 445	1	1 028 194	1	1 044 711	1
2	Warehousing; postal and courier services	(52-53)	263 243	2	302 178	2	271 249	2
3	Rental and leasing services	(77)	54 095	3	63 471	4	85 186	4
4	Coke, refined petroleum products	(19)	54 065	4	34 065	7	48 048	7

Cont. table 6.

5	Repair and installation services of machinery and equipment	(33)	50 974	5	100 828	3	148 231	3
6	Land and pipeline transport services	(49)	46 538	6	54 024	5	58 230	6
7	Constructions and construction works	(41-43)	27 044	7	47 662	6	60 447	5
8	Wholesale trade services	(46)	22 555	8	18 602	8	21 443	9
9	Electricity, gas, steam and air conditioning	(35)	19 654	9	17 605	9	–	–
10	Retail trade services	(47)	18 646	10	–	–	–	–
11	Real estate services	(68)	–	–	17 127	10	24 143	8
12	Food and beverage serving services	(56)	–	–	–	–	21 159	42

Source: the author's own work.

Table 6 presents the ten divisions that recorded the highest output effects in response to an exogenous demand impulse originating from divisions 50-51 (Water and air transport services) in 2010, 2015, and 2020. In all three analysed years, the source division–Water and air transport services (50-51)–consistently ranks first, confirming its high level of self-sufficiency and strong internal feedback effects within the division.

Warehousing; postal and courier services (52–53) consistently hold high positions in the ranking, highlighting their strong operational linkages with transport. Attention should also be drawn to the dynamic increase in the importance of Repair and installation services of machinery and equipment (33), which rose from fifth place in 2010 to third place in 2020, nearly tripling its output effect. Meanwhile, rental and leasing services (77) maintain a stable position (ranked 3rd–4th), which may indicate long-term demand for services supporting transport activities.

Other significant structural changes include the Real Estate Services division (68), which did not appear in the ranking in 2010 but reached tenth and eighth positions in the subsequent years, respectively. In 2020, Food and beverage serving services (56) also appeared in the ranking, which may indicate an increased sensitivity of the food service division to the development of Water and air transport services, particularly in the context of the growing importance of tourism-related linkages with transport.

Table 7.
Effects of Exogenous Impulse from Divisions 49 and 50-51

No.	Description	Code PKWiU	2010		2015		2020	
			Efect	Rank	Efect	Rank	Efect	Rank
1	Land and pipeline transport services	(49)	1125135	1	1161895	1	1213035	1
2	Water and air transport services	(50-51)	1037119	2	1030182	2	1046320	2
3	Warehousing; postal and courier services	(52-53)	314317	3	373249	3	375744	3
4	Coke, refined petroleum products	(19)	181824	4	11915	4	131258	5
5	Rental and leasing services	(77)	79783	5	91542	6	127816	6

Cont. table 7.

6	Repair and installation services of machinery and equipment	(33)	64609	6	113267	5	163203	4
7	Retail trade services	(47)	60282	7	45763	9	39669	10
8	Wholesale trade services	(46)	53877	8	39959	10	39895	9
9	Electricity, gas, steam and air conditioning	(35)	53252	9	50409	8	–	–
10	Sale and repair services of motor vehicles and motorcycles	(45)	48747	10	–	–	–	–
11	Constructions and construction works	(41-43)	–	–	73908	7	103262	7
12	Real estate services	(68)					44617	8

Source: the author's own work.

Table 7 presents the ten divisions that recorded the highest output effects in response to demand impulses introduced jointly to Divisions 49, 50, and 51, treated as a single aggregated transport division. These results extend the analyses presented in Tables 5 and 6, highlighting the synergistic impact of the combined demand impulse on the structure of the national economy.

The source divisions–Land and pipeline transport services (49) and Water and air transport services (50-51)–maintain leading positions in the ranking, confirming the dominant role of transport in the structure of inter-industry linkages. Warehousing; postal and courier services (52-53) consistently holds third place regardless of the year analyzed, underscoring its enduring operational importance for transport activities.

The results presented in Table 7 also reveal the overlapping effects of impulses from both divisions: the Repair and installation services of machinery and equipment division (33), previously present only in the ranking for the impulse in divisions 50-51 (Table 6), rises to fourth place in 2020. Similarly, the Rental and leasing services division (77) maintains a strong position, confirming its universal importance for the operational activities of both branches of transport.

It is also noteworthy that the importance of the Electricity, Gas, Steam and Air Conditioning division (35) and the Retail Trade Services division (47) systematically declined, eventually dropping out of the ranking in 2020. In contrast, the Real estate services division (68), absent in previous years, reached eighth place in 2020, which may indicate increasing sensitivity of this division to demand impulses from the transport sector. It should be noted that this study does not aim to identify the macroeconomic or institutional factors behind the changing sensitivity of individual sectors to transport-induced impulses. Such causal analysis–e.g. related to digitalisation, structural change or urbanization–would require a separate research framework.

The results indicate that exogenous demand impulses generate the strongest output effects within the transport divisions themselves and in directly related divisions, particularly in Warehousing; postal and courier services (52-53). This means that the most substantial effects are observed within Section H "Transportation and Storage," confirming the existence of strong intrasectoral linkages in this area. According to the findings of Kim, Lee, and Trimi (2021), transport services, warehousing, and support activities for transportation do not operate as separate units, but rather form a coherent service ecosystem. The results of this study empirically confirm this thesis, indicating systemic interdependencies within Section H.

Studies by Lee and Yoo (2016) and Kim and Tromp (2022) on the South Korean economy demonstrated that demand impulses generated by the transport sector stimulate a range of key economic sectors. In particular, they emphasised the importance of production effects in petroleum and coal refining, the manufacturing of transport equipment, and financial and insurance services. Furthermore, Kim and Tromp (2022) pointed to significant links between road transport and the chemical industry, as well as wholesale and retail trade. In the case of water and air transport, significant interactions are observed in the business support services sector and in the finance and insurance sector. Meanwhile, Daldoul and Dakhlaoui (2025), analysing the effects of transport supply shortages in the Tunisian economy, pointed to the particular vulnerability of sectors such as petroleum refining, the mechanical and electrical industries, and the textile industry. Similar patterns were also noted in the Indonesian economy–Handayani et al. (2020) demonstrated that demand impulses in road and rail transport generate strong production effects in, among others, petroleum refining, retail trade, and warehousing sectors, confirming the international relevance of the phenomenon under study.

Although the structure of secondary effects differs in part from the results observed for Poland, studies conducted in other countries confirm that demand impulses in the transport sector stimulate activity in closely linked sectors. Alises and Vassallo (2016), analysing the cases of Spain and the United Kingdom, demonstrated that the economy's response to transport-related stimuli depends on the sectoral structure, particularly the share of material-intensive industries that heavily rely on transport services. Similar patterns, though on a smaller scale, were confirmed in a study by Ojaleye and Narayanan (2022) in Nigeria, where transport–although not classified as a key sector, played an important role in transmitting impulses to industries such as trade and construction. The convergence of findings from various countries points to the recurring nature of this mechanism and confirms the importance of transport as a driver of activity in key industrial and service segments.

5. Conclusions, Research Limitations, and Directions for Further Studies

The analysis conducted revealed the complex and dynamic links between the transport sector and other divisions of the national economy. The use of the input–output model enabled the identification of both the structural importance of individual transport subsectors and the directions of their impact on the interindustry system.

Based on the analysis, the following conclusions have been drawn:

- Transport is one of the divisions with a high level of integration with the national economy. It functions both as a significant supplier (forward linkage) and as a recipient (backward linkage) of goods and services, classifying it as a key division in the interindustry framework. Land and pipeline transport services (division 49) are characterised by consistently high backward and forward linkages, confirming their role as a fundamental component of supply chains and a primary provider of logistics services in the Polish economy. In contrast, Water and air transport services (divisions 50-51) demonstrate a lower level of integration with other divisions.
- Both land and pipeline transport services and Water and air transport services exhibited relatively high multiplier effects. This confirms the importance of the transport division as one of the key sources of economic impulses within the inter-industry structure. Furthermore, multiplier effects reveal the growing importance of the transport division as a generator of economic stimuli, particularly in the case of Division 49, whose impact on other divisions has intensified during the period from 2010 to 2020.
- The results of the exogenous effects analysis indicate that demand impulses in the transport division generate intrasectoral effects within the transport divisions themselves and stimulate economic activity primarily in the following divisions: Coke and refined petroleum products (19), Motor vehicles, trailers and semi-trailers (29), Repair and installation services of machinery and equipment (33), Electricity, gas, steam and hot water (35), Constructions and construction works (41-43), Sale and repair services of motor vehicles and motorcycles (45), Wholesale trade services (46), Retail trade services (47), Warehousing; postal and courier services (52–53), Food and beverage serving services (56), Real estate services (68), and Rental and leasing services (77). These effects are comparable to findings from studies conducted in other countries (e.g., South Korea, the United Kingdom, Slovakia, Nigeria), indicating the recurring nature of the transmission mechanism of demand impulses from the transport sector. The shifting positions of specific divisions in the rankings (e.g., the declining importance of energy or retail trade) reflect structural changes in the economy, including digitalisation, the development of integrated services, and changing patterns of transport consumption.
- The Polish economy exhibits structural characteristics similar to those of other industrialised economies, in which transport serves as a catalyst for economic activity.

The conclusions of the analysis confirm the validity of using the input–output approach to assess the role of the transport division, as well as the appropriateness of treating it as a strategic division from a structural perspective. They affirm the systemic role of the transport division in the Polish economy and its importance as a carrier of transformational impulses. This means that the findings of the study are not only of theoretical relevance but also of practical significance. They may serve as a basis for designing measures to support the transport division as a tool for stimulating economic growth. Especially in the context of investment policy, infrastructure development planning and sectoral programs, it is crucial to treat transport as a systemically important division.

The author acknowledges that the study has certain limitations, which at the same time create opportunities for further analysis. First, due to the lack of complete statistical data, the employment multiplier was not included. Second, the aggregation of applied data into two broad transport categories (Land and Pipeline Transport Services and Water and Air Transport Services) limits the precision in identifying the secondary effects of individual transport branches. Third, the I–O model is static in nature and does not reflect technological, temporal, or price response changes. Fourth, the effects of imports were not considered, which can lead to an overestimation of the secondary effects in the closed model.

Further research should focus on employing a more detailed sectoral classification of transport (e.g., rail, road, air, maritime), applying dynamic models (such as dynamic I–O or CGE models), and incorporating regional differentiation, which may reveal new dependencies in the spatial distribution of secondary effects. It is also worth considering the extension of the analysis to include environmental and social aspects, which are increasingly important in the assessment of transport policies. The use of scenario-based approaches and dynamic models may allow for a more precise evaluation of future development paths for the transport division and its impact on the structure of the national economy. Furthermore, future studies could explore the macroeconomic drivers behind the observed differentiation in sectoral responses to transport-related demand impulses. Analyses linking these variations to broader structural trends—such as digitalisation, urban concentration, or the evolution of service systems—may provide valuable insights into the mechanisms of intersectoral transmission.

In addition, future studies may benefit from the use of modern data sources, including big data (e.g., mobility records, logistics systems, digital platforms), which allow for a more detailed and dynamic assessment of economic responses to transport-related impulses. For studies with a regional focus, spatial analysis tools such as Geographic Information Systems (GIS) could also be applied, particularly in the context of depopulation, transport accessibility, and the territorial variation in the socio-economic effects of transport activity.

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Appendix

Table 8.
List of 77 Divisions According to PKWiU Classification

No.	CODE PKWiU 2008	Description	No.	CODE PKWiU 2008	Description
1	(01)	Products of agriculture and hunting	40	(52-53)	Warehousing; postal and courier services
2	(02)	Products of forestry	41	(55)	Accommodation services
3	(03)	Fish and other fishing products	42	(56)	Food and beverage serving services
4	(05)	Coal and lignite	43	(58)	Publishing services
5	(06-09)	Crude petroleum and natural gas; metal ores; other mining and quarrying products	44	(59)	Motion picture, video and television production, sound recording and music publishing
6	(10)	Food products	45	(60)	Programming and broadcasting services
7	(11)	Beverages	46	(61)	Telecommunications services
8	(12)	Tobacco products	47	(62)	Computer programming, consultancy services
9	(13)	Textilies	48	(63)	Information services
10	(14)	Wearing apparel	49	(64)	Financial services
11	(15)	Leather and related products	50	(65)	Insurance services
12	(16)	Wood and products of wood	51	(66)	Services auxiliary to financ. services and insurance services
13	(17)	Paper and paper products	52	(68)	Real estate services
14	(18)	Printing and recording services	53	(69)	Legal and accounting services
15	(19)	Coke, refined petroleum products	54	(70)	Management consulting services
16	(20)	Chemicals and chemical products	55	(71)	Architectural and engineering services; technical testing and analysis services
17	(21)	Pharmaceutical products	56	(72)	Scientific research and development services
18	(22)	Rubber and plastic products	57	(73)	Advertising and market research services
19	(23)	Other non-metallic mineral products	58	(74)	Other professional, scientific and technical services
20	(24)	Basic metals	59	(75)	Veterinary services
21	(25)	Fabricated metal products	60	(77)	Rental and leasing services
22	(26)	Computer, electronic and optical products	61	(78)	Employment services
23	(27)	Electrical equipment	62	(79)	Travel agency, tour operator and other reservation services and related services
24	(28)	Machinery and equipment n.e.c.	63	(80)	Security and investigation services
25	(29)	Motor vehicles	64	(81)	Services to buildings and landscape
26	(30)	Other transport equipment	65	(82)	Office administrative, office support and other business support services
27	(31)	Furniture	66	(84)	Public administration services
28	(32)	Other manufactured goods	67	(85)	Education services

Cont. table 8.

29	(33)	Repair and installation services of machinery and equipment	68	(86)	Human health services
30	(35)	Electricity, gas, steam and air conditioning	69	(87-88)	Social works services
31	(36)	Natural water; water treatment and supply services	70	(90)	Creative, arts and entertainment services
32	(38)	Waste collection., treatment and disposal services; materials recovery services	71	(91)	Library, archive, museum services
33	(37,39)	Sewerage; remediation services	72	(92)	Gambling and betting services
34	(41-43)	Constructions and construction works	73	(93)	Sporting services and amusement and recreation services
35	(45)	Sale and repair services of motor vehicles and motorcycles	74	(94)	Services furnished by membership organisations
36	(46)	Wholesale trade services	75	(95)	Repair servic. of comput. and personal and household goods
37	(47)	Retail trade services	76	(96)	Other personal services
38	(49)	Land and pipeline transport services	77	(97-98)	Private households with employed persons
39	(50-51)	Water and air transport services			

Source: the author’s own work.