



Quantitative analysis of the multiplier effect and intersectoral influences of the transport and storage sector

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Article info

Original scientific paper

DOI:

<https://doi.org/10.71159/icemit2504T>

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Abstract

This study investigates the economic significance of the Transport and Storage sector using an input–output (IO) framework. The primary objective is to evaluate the sector’s multiplier effect and intersectoral linkages within the domestic economy. The analysis relies on the official 2020 Symmetric Input–Output Tables, aggregated into 16 analytical sectors. A demand-driven IO model was applied to measure direct and indirect impacts, excluding import shares to focus on domestic propagation channels. Results indicate that the total output multiplier for Transport and Storage is 2.807, with nearly two-thirds generated by indirect effects. Strong internal loops are observed within logistics activities, while notable spillovers occur in Manufacturing, Trade, Energy, Construction, and Hospitality. Approximately 19% of the effect translates into Gross Value Added, highlighting its role in income generation. The findings confirm the sector’s systemic importance and suggest that strengthening domestic supplier networks and infrastructure investment can further magnify its developmental contribution.

Keywords: transport and storage, input–output analysis, multiplier effect, intersectoral linkages, economic impact

1. Introduction

Transport and storage connect producers, suppliers, and customers by moving and holding goods when and where they are needed. Changes in the capacity, cost, or reliability of this sector do not stay inside transport firms. Transportation and storage activities are closely related and dependable of other economic divisions like manufacturing, wholesale and retail trade, and other business services, referring to production schedules, inventories, and finally incomes. Identifying and measuring these sectoral relations helps policymakers and business entities to understand where improvements in logistics can contribute to overall positive economic impact.

This paper uses official Symmetric Input–Output Tables as a standard data to identify intersectoral connections. These data are also basic to understand and to measure how one unit increases in final demand for transport and storage translates into total domestic output across all sectors. First, we create aggregated set of sixteen sectors and then we apply the inverse Leontief framework to calculate both the direct effects of the sector on national economy based on the first-round purchases and the indirect effects on the national economy generated through supplier networks. The methodology used in the paper is transparent, replicable, and aligned with international statistical standards.

By calculating the overall output multiplier for transport and storage sector we can also show how the total effect is distributed across supplying industries. The results indicate strong intersectoral connection and strong relations with manufacturing sector, as well as wholesale and retail trade, followed by energy, construction, hospitality, and producer services. We have also identified strong self-feedback inside transport and storage sector which mainly comes through subcontracting, warehousing operations, and fleet maintenance. These results suggest that policy makers should target measures in areas that will support intermodal connectivity, advanced warehousing systems, energy efficient operations, and digital technologies. These measures and investments can contribute to development of transport and storage sector and can also significantly increase its overall economic impact.

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The paper is structured in 5 main parts. The next section reviews the literature on wider economic effects of transport and on input–output applications to transport, logistics and related services, with attention to studies that use official symmetric tables and a demand-driven framework. The methodology section then details the data, aggregation, and model implementation, and explains how we decompose the total response into direct and indirect components by supplying industry. The results section presents the multiplier estimates and sectoral attributions, followed by a discussion of their interpretation and robustness. The concluding section summarizes policy and managerial implications and outlines avenues for future work.

2. Literature review

Research on transport consistently shows that improvements in infrastructure and services generate effects that extend well beyond the directly affected industries. These wider effects arise through lower generalized transport costs, better market access, productivity gains from agglomeration, and reorganization of supply chains. Lakshmanan synthesizes this evidence and explains how transport investment translates into broader economic gains through market expansion, technology diffusion, and urban clustering mechanisms that raise productivity. This perspective helps interpret why a shock in transport demand often produces sizeable responses outside the sector itself. (Lakshmanan, 2011).

For credible measurement, contemporary studies follow international standards for building Supply and Use Tables and Symmetric Input–Output Tables. The United Nations handbook details compilation practices, price concepts, the treatment of taxes and subsidies, and the separation of domestic and imported uses, all of which directly affect multiplier magnitudes and their interpretation as domestic effects. The Eurostat manual provides harmonized methods for European statistical systems and guidance on transforming Supply and Use Tables into symmetric tables under explicit technology assumptions (Eurostat, 2008). Miller and Blair remain the standard reference for the analytical use of these tables, including the demand driven Leontief model, output multipliers, and value-added multipliers (Miller & Blair, 2009). These sources define the data and analytical foundations used in this paper. (United Nations Statistical Division, 2018).

Conventional national accounts understate transport because many movements are produced in house by non-transport industries or by households. Transportation Satellite Accounts expand the boundary to include for-hire, own account, and household transport, revealing a larger footprint and richer interindustry connections. This framework reinforces the view of transport and storage as a systemic sector whose improvements propagate widely through supplier and customer networks. (U.S. Bureau of Transportation Statistics, 2025).

In this methodological and measurement context, many researchers use input-output techniques and models to measure economic output of the transport and storage sector. For example, Kim, Lee, and Trimi use national input–output tables to show that the logistics service industry, which includes transport and warehousing, has strong intersectoral linkages and multiplier effects. Their findings highlight that logistics creates a service system that increases activities in manufacturing, packaging, equipment, information services, finance, and professional services. Also, their multiplier results are consistent with the finding that manufacturing and wholesale and retail trade are among the largest beneficiaries of transport and storage sector demand. (Kim et al., 2021).

Some authors work on country case studies referring to the multiplication effect of transport and storage sector. For instance, Daldoul and Dakhlaoui applied input-output analysis to the Tunisian transport sector (including road, air, water, and auxiliary services) to estimate its overall economic impact. Their work, which is consistent with findings from other countries' studies, indicate strong interdependencies between transport and other industries and they also quantify multiplying effects related to the cross sectoral linkages and significant indirect rounds. Such evidence offers a relevant comparator for national studies that use official symmetric tables and a demand driven approach. (Daldoul & Dakhlaoui, 2025).

Work tied to the Macedonian context connects directly with this paper's focus on transport and storage. Trajkov and Biljan show that "volume of international trade of goods has an impact on the volume of trade in logistic services," situating logistics within the country's trade and production system and motivating the sectoral aggregation used here. Their earlier study argues that trade balance indicators for logistics are "worth to realize the potential of logistic sector development," a practical lens for interpreting multiplier results and supplier dependence (Trajkov & Biljan, 2012; Trajkov & Biljan, 2014).

Related work on ports and logistics hubs complements table-based multipliers by showing how logistics capacity expansions trigger regional spillovers consistent with transmission through upstream and downstream links. Studies find that port and logistics development raises regional output and that many ports related effects are traced using input–output tools, again reflecting the central role of logistics in enabling production and distribution. Recent network-based analyses also underscore the criticality of ports for supply chains and trade, reinforcing why shocks in transport and storage are transmitted broadly to other sectors (Han et al., 2019).

These findings motivate the empirical strategy of this paper and frame the expectation that a demand impulse in transport and storage will generate sizeable extra sectoral output and value added, alongside notable feedback within the sector due to subcontracting, warehousing operations, and maintenance chains.

3. Research methodology

The study employs input–output (I–O) analysis to examine the web of inter-industry relationships within the national economy. Using I–O analysis helps in identifying how much input from one sector is required to produce a unit of output in another and these analyze also helps in calculating multiplication (multiplier) coefficients for specific sectors. These coefficients measure the direct and indirect effects of each sector on the national economy as a whole, providing standardized metrics for calculating secondary effects generated by changes in the final demand.

Aligned with the European System of Accounts (ESA) standards, the empirical framework of the data used in the research is constructed using Supply and Use Tables (SUT), which are subsequently transformed into Symmetric Input–Output Tables (SIOT). SIOTs offer a consolidated picture of technological and economic linkages and can be compiled as activity-by-activity or product-by-product matrices. The first highlights dependencies among activities (e.g., how outputs of one activity are used as inputs in another), while the second details interrelations among products (i.e., how much of each product is required to produce other products).

For N. Macedonia, official statistics provide product-by-product SIOTs, which can be integrated into macro analytical settings to study supply use relationships, with emphasis on the structure of final use (final consumption, gross capital formation, exports) and the levels of industrial output. (Trajkov, A., & Biljan, J. 2024). The underlying product detail (≈ 100 CPA items) is aggregated to analytical sectors for tractable analysis, following the National Classification of Activities (NKD Rev. 2) and the Classification of Products by Activity (KPD/CPA 2015). The aggregation used in this paper is shown in Table 1 (retained unchanged for comparability across sectors, including A08 – *Transport and Storage*).

Table 1. Sectoral aggregation by product

KPD2015 Code	Description
A	A01 Agriculture, hunting, forestry, fishery and pisciculture
B	A02 Mining and quarrying
C	A03 Manufacturing
D	A04 Electricity, gas, steam and air-conditioning supply
E	A05 Water supply and waste management
F	A06 Construction
G	A07 Trade (wholesale and retail)
H	A08 Transport and storage
I	A09 Hotels and restaurants
J	A10 Information and communication
K	A11 Financial intermediations
L	A12 Real estate services
M (69–70)	A13 Legal and accounting
M (71–75)	A14 Professional, scientific and technical activities
N	A15 Administrative and support services
O–U	A16 Other activities of national economy

Source: Authors' processing based on NKD Rev. 2 and KPD2015

The aggregated SIOT provides the key magnitudes required to compute output multipliers by sector. It reports total intermediate consumption at basic prices (sum of intermediate uses across sectors) and total final use at basic prices. Their sum yields the total use of goods and services (basic prices), denoted:

$$X = FU + E + BI + FCE + IC \quad (1)$$

where X is total use; FU total final use; E exports (FOB); BI gross investments (fixed assets plus inventory changes); FCE final consumption expenditure (households, government, non-profit institutions); and IC intermediate consumption. On the supply side, total supply at basic prices consolidates domestic production and imports:

$$Y = P + I \quad (2)$$

with Y total supply, P total production, and I imports.

Total production is decomposed into value added and intermediate consumption (at purchasers' prices):

$$P = VA + IC \quad (3)$$

where VA comprises the standard ESA value added components:

$$VA = CE + T + CFC + NOS \quad (4)$$

with CE compensation of employees, T other net taxes on production, CFC consumption of fixed capital (depreciation), and NOS net operating surplus.

From the aggregated symmetric table, we derive technical (input) coefficients for each sector:

$$a_{ij} = \frac{x_{ij}}{x_j} \quad (5)$$

where x_{ij} is the intermediate input from sector i used by sector j , and x_j is the gross output of sector j . Arranging a_{ij} yields the A-matrix of direct input requirements (rows: supplying sectors; columns: using sectors).

The standard demand driven I–O model links gross output q to final demand f :

$$q = (I - A)^{-1}f \equiv Lf \quad (6)$$

where $L = (I - A)^{-1}$ is the Leontief inverse, summarizing both direct and indirect intersectoral effects. Output multipliers are then obtained as the column sums of L ; these indicate the total economy wide output generated by a unit increase in final demand for the output of a given sector. In extensions, value added multipliers can be computed by premultiplying the Leontief inverse with a diagonal (or vector) of value-added coefficients to scale total output effects into income effects. Application to A08 – Transport and Storage. The same framework is applied by focusing on the A08 column of A and the corresponding column of L . This allows us to (i) compute the total output multiplier for *Transport and Storage*, (ii) decompose the multiplier by supplying sectors (via shares of L_j), and (iii) optionally derive value added multipliers using sector specific value-added coefficients. If imports are to be excluded to emphasize domestic linkages, the analysis is replicated using domestic use SIOTs (or import adjusted coefficients), yielding domestic multipliers that abstract from leakage through trade.

The I–O model assumes fixed technical coefficients, proportionality between inputs and output, and no capacity constraints. Results thus represent a linear, short run propagation benchmark consistent with the SIOT accounting framework, appropriate for comparing sectoral spillovers and identifying key upstream channels relevant to *Transport and Storage*.

4. Research results

The demand driven input–output results shows that the Transport and Storage sector has a total output multiplier of 2.805, decomposed into a direct effect of 1.000 and indirect effects of 1.807. That means, if final demand for Transport and Storage rises by 1 monetary unit, the whole economy’s output rises by 2.805 units. Roughly two-thirds (64.4%) of the overall impact comes from interindustry relations rather than the sector’s own first-round output. The results also indicate that a one unit increase in final demand for transport and storage generates gross value added (GVA) of 0.529 units, which is 18.9% of the total combined impact. It means that transport demand converts not only into intermediate output but also into domestic income referring to wages, operating surplus, consumption of fixed capital, and net production taxes.

Table 2. Output multipliers of the sector transport and storage

Economic sector	Sector transport and storage					
	Direct effect	Indirect effects	Combined impact	Share of Total (combined)	Share of Total (Direct)	Share of Total (Indirect)
Transport and storage	0.182	1.233	1.415	50.4%	18.2%	68.2%
Manufacturing	0.135	0.262	0.398	14.2%	13.5%	14.5%
Trade (wholesale and retail)	0.043	0.082	0.125	4.5%	4.3%	4.5%
Hotels and restaurants	0.024	0.035	0.059	2.1%	2.4%	1.9%
Electricity, gas, steam and air-conditioning supply	0.014	0.032	0.046	1.6%	1.4%	1.8%
Construction	0.015	0.023	0.038	1.4%	1.5%	1.3%
Financial intermediations	0.014	0.024	0.038	1.4%	1.4%	1.3%
Legal and accounting	0.011	0.022	0.033	1.2%	1.1%	1.2%
Professional, scientific and technical activities	0.009	0.019	0.028	1.0%	0.9%	1.1%
Information and communication	0.007	0.016	0.023	0.8%	0.7%	0.9%
Administrative and support services	0.007	0.014	0.021	0.7%	0.7%	0.8%
Agriculture, hunting, forestry, fishery and pisciculture	0.001	0.018	0.018	0.6%	0.1%	1.0%

Table 2. Continued

Economic sector	Sector transport and storage					
	Direct effect	Indirect effects	Combined impact	Share of Total (combined)	Share of Total (Direct)	Share of Total (Indirect)
Other activities of national economy	0.006	0.013	0.018	0.6%	0.6%	0.7%
Real estate services	0.001	0.006	0.007	0.2%	0.1%	0.3%
Water supply and waste management	0.001	0.004	0.005	0.2%	0.1%	0.2%
Mining and quarrying	0	0.004	0.004	0.1%	0.0%	0.2%
Gross Value Added	0.529		0.529	18.9%	52.9%	
Output multiplier	1	1.807	2.805	100%	100.0%	100.0%

Source: Author's calculation

The research data shows a characteristic intra-sectoral cycle as a key element of the multiplier structure. It is notable that Transport and Storage itself account for a combined effect of 1.415 units, or 50.4% of the total multiplier with 0.182 units as direct effect (18.2% share in total direct effects) and 1.233 units as indirect effect (68.2% share in total indirect effects). This dominance is reasonable because of the way the logistics system is structured, containing a lot of subcontracting, transfers between modes, and repeated transport tasks. It means that the sector must repeatedly purchase services from itself. This makes the sector most depend on its own activities and any increase in transport activity quickly generates a lot more demand *within* the sector across many subsequent transactions.

Outside of the sector's own feedback effects, Manufacturing emerges as the most significant external recipient of the transport multiplier, which receives a combined effect of 0.398 (14.2%), comprising 0.135 direct and 0.262 indirect units of output per unit of final demand for transport services. This aligns with the material intensity of logistics: fuels and refined petroleum products, vehicle/parts maintenance, fabricated metals and equipment, packaging materials, and other manufactured inputs that are normally required to keep goods moving.

If we exclude the transport and storage sector's own feedback effects, then we have Manufacturing as the most significant external beneficiary of the transport multiplier. This sector receives a combined effect of 0.398 units, which is 14.2% of the total multiplier, consisting of 0.135 direct and 0.262 indirect units of output for every unit of final demand for transport services. This strong connection is realistic given the material requirements of logistics as physical distribution of goods needs fuels, maintenance of vehicles, equipment, packaging materials and other manufactured inputs.

Following manufacturing, Trade (wholesale and retail) represents the next significant external linkage to the transport and storage sector. This linkage accounts for 0.125 units or 4.5% share of the combined impact, with 0.043 units as a direct impact and 0.082 units as an indirect impact. These values indicate the important role that wholesale and retail activities have in the supply chain helping the goods to transit from producer to consumer.

The results also show that a group of important infrastructure and business service activities have a significant contribution to the Transportation and Storage multiplier. Electricity, gas, steam and air-conditioning supply contributes 0.046 unites (1.6%), primary through indirect needs of the sector linked to energy intensive operations like cold chains, terminals, and cargo handling. Both, Construction and Financial intermediation each contribute 0.038 unites in total output (1.4%), which highlights the importance of facility development, renewing transport fleets, and ensuring access to capital for straightening the multiplier effect. The institutional and digital support of transport and storage sector, like Legal and accounting services (0.033; 1.2%), Professional, scientific and technical activities (0.028; 1.0%), Information and communication (0.023; 0.8%), and Administrative and support services (0.021; 0.7%) is very important for the contemporary logistics giving contracting, certification, routing, and back-office support. While their share individually is small, taken together, they represent significant multiplier which also has an impact of the performance and efficiency of entire system.

Finally, another set of sectors record smaller, but still important contributions to the multiplier. Agriculture, forestry, and fishing contributed 0.018 units or 0.6% of total output. Other activities of the national economy also have the same contribution of 0.018 units or 0.6% of total output, than there are Real estate services (0.007; 0.2%), Water supply and waste management (0.005; 0.2%), and Mining and quarrying (0.004; 0.1%).

Given the results, we can conclude that the fundamental structure of the multiplier is generally determined by (1) the large intra-sector loop, (2) strong manufacturing linkages, (3) the trade interface, and (4) an enabling set of utilities and business services.

Finally, the gross value added (GVA) component, amounting to 0.529 or 18.9% of the total multiplier, demonstrates that the effect of transport demand is not restricted to intermediate inputs alone. A considerable share is transformed into domestic income, encompassing wages and salaries, consumption of fixed capital (depreciation), and operating surplus. This value-added portion indicates that the Transport and Storage sector contributes directly to the generation of national income, with benefits accruing to employees, fleet and infrastructure owners, and the wider network of supporting

services such as terminals, warehousing, and auxiliary logistics providers. In this sense, the multiplier effect extends beyond stimulation of supplier industries to strengthening household income and capital returns, linking transport and storage activities more directly with economic welfare.

5. Conclusions

The research results indicate that Transport and Storage sector acts as a powerful engine for the wider economy. A one unit increase in final demand for transport and storage services lifts total output by 2.805 units. Reasonably, 1 unit of the total effect is generated in the first round of the demand of transportation services as a direct effect. The other 1.807 unites calculated as indirect effect comes from additional rounds of purchases among suppliers, which means that about two-thirds (64.4%) of the total impact are created through interindustry linkages. Additionally, the gross value-added component, amounting to 0.529 or 18.9% of the total multiplier, demonstrates that the effect of transport demand is not restricted to intermediate inputs alone. A considerable share is transformed into domestic income, encompassing wages and salaries, consumption of fixed capital (depreciation), and operating surplus.

Research results allow us to understand the structure of intersectoral connection of Transport and storage with other sectors in the national economy. The analysis clearly shows that the largest share of the multiplier occurs within the sector itself. Transport and Storage accounts for a combined 1.415 units of the total, representing over half of all effects. It means that the sector purchase services from itself, which makes it most depend on its own activities and any increase in transport activity quickly generates a lot more demand within the sector across many subsequent transactions. The highest external gains appear in Manufacturing (0.398; 14.2%). The connection between these two sectors is very important given the materials, fuel products, equipment, maintenance, and packaging that logistics activity requires. Trade contributes another 0.125 unites (4.5%), which indicates the important role that wholesale and retail activities have in the supply chain helping the goods to transit from producer to consumer. A set of infrastructure and business support activities (0.046), construction (0.038), financial intermediation (0.038), together with legal/accounting, professional/technical services, ICT, and administrative support generate smaller but essential shares that keep the performance and efficiency of the system on a high level.

Taken together, these results can point out too few practical measures that policymakers can consider to improve Transport and Storage sector and its impact on national economy. First, they can focus on improvements within the logistics chain, through better intermodal connectivity, advanced warehousing systems, energy efficient operations, and digital technologies, because the sector itself accounts for roughly half of the total effect; Then, creating deeper domestic manufacturing linkages that refer to maintenance and repair operations, components, specialized equipment, energy products, packaging by stimulating domestic production and reducing import of these products; At the end, it is also important to focus on improvement of the modern warehousing (including cold chains), energy efficient operations, access to finance for fleet and facility renewal, and robust compliance/data services. In short, transport demand does not only refer to physical movement of goods as it multiplies output across the economy and converts a meaningful share into income, linking logistics performance directly to economic benefits.

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