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THE MULTIPLIER EFFECT OF INVESTMENT AND INNOVATION SUPPORT FOR THE DEVELOPMENT OF TRANSPORT AND LOGISTICS SYSTEMS: FOREIGN EXPERIENCE AND PRACTICE FOR UKRAINE

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Abstract

The primary source of development of transport and logistics systems is an investment. In countries with developed economies, investment in the development of transport and logistics systems is one of the most effective tools for influencing economic growth, leveling socio-economic disparities in regional development, and stimulating business activity in priority areas. This research is devoted to theoretical and applied organizational bases to substantiate the use of foreign experience of the multiplier effect of investment development of transport and logistics systems and analysis of sound methodological approaches for Ukraine. The article tests the authors' hypothesis about the adequacy of the proposed methodological approaches, which provide for the definition of the multiplier and accelerator of investment in the development of the transport and logistics system.

To analyze the impact of investments on the economic development of Ukraine's national and regional systems, the authors proposed the calculation of the coefficient of the investment multiplier (Keynes multiplier). Statistical data of the State Statistics Service of Ukraine are used as the basis of the measures. Furthermore, the authors adapted the appropriate calculation method to determine the multiplier of investments in developing regional transport and logistics systems. After all, in economic models, the multiplier is used to determine the amount of investment in year *t*, which must be attracted to increase production (services) in period *t+1*, which is k times less than the increase in this production.

The calculated indicators of the multiplier of investments in the transport and logistics system showed that in terms of regions, the highest multiplier effect of assets in the development of transportation, warehousing, and communications (more than twice) as of the end of 2020 is observed in Volyn, Zakarpattia, Lviv, Mykolaiv, Poltava, and Chernihiv regions. In 2020, the multiplier effect of more than five times the GRP increase in transport investment compared to 2016 was typical for some oblasts whose transport potential is used most intensively due to the geographical location of major transport routes and key transport hubs in the territory. In particular, these are Lviv (growth more than seven times), Chernihiv (6 times), Kyiv (almost five times), Mykolaiv (4 times), Poltava, and Odesa regions. In general, with various deviations in specific periods during 2016 - 2020, the multiplier effect of investing in the development of transport and logistics on GRP and the level of investment activity of economic entities was observed in all regions of Ukraine.

The results of the calculations allow us to assess the extent to which the marginal propensity to save

limits the growth of the volume of logistics services. Accordingly, a change in the component of aggregate costs leads to an even more significant difference in the equilibrium volume of logistics services, which reproduces the multiplier effect. It was determined that achieving the effect of an accelerator and multiplier of investments in the transport and logistics sector requires a comprehensive analysis and rational planning of capital investments in the industry and their compliance with the needs and trends of the development of the regional, national and world economy. In this context, an urgent task at the level of territorial management systems is developing a strategy for the development of warehouse logistics as an integrative component of transport and logistics systems, taking into account the proposed methods of evaluating efficiency.

***Key words**: Foreign experience, Transport and logistics system, Methodological approaches, Multiplier effect, Accelerator, Multiplier, Investment support.*

1. Introduction

The primary source of development of transport and logistics systems is an investment. In countries with developed economies, investment in the development of transport and logistics systems is one of the most effective tools for influencing economic growth, leveling socio-economic disparities in regional development, and stimulating business activity in priority areas [1, 7].

Investments that reduce the cost of moving goods to and from markets (via improvements in reliability, transit times, service levels, etc.) can help increase and sustain economic growth. In effect, the efficiency and reliability of the freight transportation system affect economic productivity, and many economists would argue that productivity is the most critical determinant of financial performance.

Therefore, the study of theoretical and applied organizational bases to justify the use of foreign experience of the multiplier effect of investment support for the development of transport and logistics systems and analysis of the rationale for methodological approaches for Ukraine is quite relevant.

Jereb [2], notes, "The survey of the status of governance of investments in logistics and its analysis revealed a significant degree of accord on the contribution of logistics to business success, the challenges, and opportunities related to logistics. The survey findings lend themselves to various conclusions and issues that can be considered. There are still significant opportunities for many enterprises to transition the logistics role to a more proactive one. This can be done by using an appropriate organizational structure encompassing managing business relationships and standardized processes to effectively bridge the business demand with the logistics supply. Innovations offer ample opportunities for logistics to play a more proactive role".

Halkin *et al.*, [4], studied the investment approach to the cost of transport services: "Transportation services cost formation is advisable to carry out the project analysis methods. The model parameters' variation shows the project's decision efficiency on transportation services cost example. The investment project approach enables the regulation of transportation service's cost value based on investment indicators for transport companies compared with small carriers. Using the suggested approach allows to measurement any cost decrease for compatible service relative with separate's competitors. It provides extra advantages for clients and firms on market".

Dong J. *et al.*, [8], investigated the system of a dynamic approach to the impact of underground logistics on sustainable urban development, namely Beijing (China). The relevant study provides a perspective on the systematic and quantitative analysis of ULS to support sustainable urban development.

Oosterhaven and Stelder [11], believe that: "Such models need to have an inter-industry character to capture forward effects, which mostly stawith transport cost reductions, and to capture backward effects, which mostly start with transport demand effects. Moreover, such models need to have an interregional character, as the same type of infrastructure will have a very different effect depending upon the regions where it is installed. Finally, for small open economies such models also need to incorporate the relevant neighboring countries to capture international (re) location decisions to and from the country at hand. For the time being, however, we anyhow will need net multipliers to give a more balanced evaluation of the regional and national economic importance of transportation, and other economic sectors as such".

According to Sibiryakova [9]: "The theory of the multiplier-accelerator in its original form did not fully correspond to economic reality, but further additions and improvements allow us to describe the real data accurately. But it is necessary to consider the conditions in which each model is implemented: scientific and technological progress, inflation, the availability of free production capacity, and inventories. The theory of the multiplier-accelerator, without taking into account such parameters, loses all practical meaning and turns rather into an educational model that helps to understand macroeconomic principles".

Most scholars consider the investment a driving force in developing transport and logistics systems [5, 10, and 12]. That is why studying the multiplier effect of investment support for developing transport and logistics systems using foreign experience for Ukraine is quite relevant.

This research aimed to theoretical and applied organizational bases to substantiate the use of foreign experience of the multiplier effect of investment development of transport and logistics systems and analysis of sound methodological approaches for Ukraine. The article tests the authors' hypothesis about the adequacy of the proposed methodological approaches, which provide for the definition of the multiplier and accelerator of investment in the development of the transport and logistics system.

2. Materials and Methods

Pantina and Borodulina [3], investigated the methodology for estimating the multiplier effect on the development of water transport infrastructure. The methodology for estimating the multiplier effect of investments in liquidating limiting sites within inland waterways of SDWS is based on the following backgrounds and interrelations. The budget investments in the liquidation of the present sites are aimed at increase of volumes of transportations by inland water transport, i.e. using reallocation of freight traffic between different types of transport, growth of investment activity in the branch, foremost-of the shipping business, and also generate an increase of production in allied branches of economy. As a result of projects' realization, the increase of final demand in the economy is expected, which will positively influence the social and economic parameters of development of population, business and country as a whole.

The development of national and regional programs requires justification of the feasibility and volume of necessary investments in transport and logistics infrastructure development. To this end, it is proposed to determine the multiplier effect of investment in transportation and logistics activities on the region's economy and their impact on attracting investment in other areas of economic activity.

To determine the multiplier of logistics investments, which in work means the gross capital investment in the development of transport and logistics systems in the region, adapted methodological approaches to calculating the multiplier and accelerator of investment.

The results of the calculations will determine how much economic growth and investment activity of the region correlates with the development of transport and logistics systems and the amount of investment in transport and logistics system of each region is necessary to provide a multiplier effect in the context of increasing investment activity and GRP growth on existing trends.

The essence of the multiplier theory is that an increase in investment in a particular area leads to an increase in gross investment in the region and gross regional product by an amount greater than the initial increase in investment.

Mathematically, the calculation of the multiplier of investment in the development of transport and logistics systems is proposed to be carried out according to the formulas:

$$M_{il} = \frac{\Delta GRP}{\Delta IL} \quad (1)$$

Where: M_{il}- Multiplier of investments in the development of transport and logistics systems; ΔGRP - Change in a gross regional product; ΔIL - Change of investments in the development of transport and logistics systems.

$$M_{il} = \frac{\Delta \mathrm{BI}}{\Delta IL} \quad (2)$$

Where: ΔBI - change of capital investments in the development of the region.

The indicators that determine the impact of investment on the economic development of national and regional systems include the investment accelerator. In economic models, the accelerator is used to determine the amount of investment in year t, which must be attracted to increase production (services) in period t +1, which is *a k time* less than the increase in this production. To determine the accelerator of investment in the development of transport and logistics systems of the regions, we have adapted the appropriate formula:

$$k_{IL} = \frac{IL_t}{GRP_{t-1} - GRP_{t-2}} \quad (3)$$

Where: k_{IL} - an accelerator of investments in the development of transport and logistics systems of the region; IL - investments in fixed assets of the sector "Transport, warehousing, postal and courier activities of the region for the period *t*.

3. Results and Discussion

Daia and Yanga [6], studied the multiplier effect of the relationship of the logistics pack with related industries. The said: "There are high correlations between Logistics Park and manufacturing, transportation, warehousing, information transmission, and software industry. As the growth pole, the Logistics Park promotes the establishment of other related industries, thus causing

Table 1. Multiplier of transport and logistics investments in the regions of Ukraine

Regions of Ukraine	2016	2017	2018	2019	2020	2020 in% until 2016
Ukraine	0.76	0.68	0.78	1.19	1.31	173
Vinnytsia	1.93	0.49	0.90	0.95	1.39	72
Volyn	0.70	0.77	0.78	0.70	2.06	295
Dnipropetrovsk	0.87	0.48	0.71	0.89	1.35	155
Donetsk	1.91	0.26	0.93	3.16	0.78	41
Zhytomyr	0.85	1.46	0.52	1.59	0.33	39
Zakarpatska	1.17	0.82	1.08	1.16	2.48	212
Zaporizhzhia	0.63	0.65	0.47	0.69	1.25	199
Ivano-Frankivsk	10.71	0.25	1.60	0.80	2.19	20
Kyiv	0.40	0.79	0.76	0.60	1.97	491
Kirovohrad	0.79	0.58	1.19	1.35	0.86	109
Luhansk	1.53	0.40	0.88	0.60	1.52	99
Lviv	0.70	1.01	0.53	1.08	5.14	731
Mykolayiv	1.94	0.60	1.88	0.72	7.51	386
Odesa	0.58	0.97	0.85	1.17	1.26	218
Poltava	0.76	0.67	0.76	0.95	3.04	398
Rivne	0.52	0.78	0.54	1.45	2.55	493
Sumy	0.40	1.18	0.41	2.72	1.37	345
Ternopil	0.81	0.39	0.67	2.40	0.39	48
Kharkiv	2.34	0.53	0.84	0.85	0.99	42
Kherson	0.73	1.03	1.22	0.98	1.76	242
Khmelnytsky	0.57	0.69	1.19	0.77	0.74	130
Cherkasy	1.14	0.24	0.99	1.64	1.29	114
Chernivtsi	0.65	1.04	0.81	1.08	1.33	203
Chernihiv	0.35	0.47	1.08	0.85	2.30	653
Kyiv	0.59	0.70	0.75	1.31	1.16	199

Source: calculated by the authors.

multiplier effect on the increase of employment, production and economic benefits".

The original data calculated by the author for calculating the multiplier of investments in the development of transport and logistics in economic growth regions are given in Table 1.

The table illustrates the growth indices of capital investment in each region's transport and logistics sector, as well as the corresponding GRP growth indices relative to the previous period.

The calculations showed that in Ukraine as a whole, for the period 2016 - 2018, the growth rate of investment in the development of the transport and logistics sector exceeded the rate of GRP, which since 2019 has led to the formation of a multiplier effect. Such tendencies are typical for several oblasts, including: Volyn, Dnipropetrovsk, Zaporizhia, Kyiv, and Odesa. Poltava, Khmelnytsky, Chernihiv and Kyiv. At the same time, the high multiplier effect of investments in 2016-2018, in which their growth rates in the transport sector were significantly higher than GRP growth and did not lead to a corresponding economic effect in the following periods, is observed in Ivano-Frankivsk, Donetsk and Kharkiv regions.

By regions, the highest multiplier effect from investments in the development of transport, warehousing, and communications (more than twice) as of the end of 2020 is observed in: Volyn, Zakarpattia, Lviv, Mykolaiv, Poltava, and Chernihiv regions.

In 2020, the multiplier effect, which was more than five times the increase in GRP relative to transport investment compared to 2016, is typical for many regions whose investment potential is used most intensively due to the geographical location of major transport routes and key transport hubs. In particular, these are Lviv (growth more than seven times), Chernihiv (six times), Kyiv (almost five times), Mykolaiv (four times), and Poltava regions.

If we look at the average value of the multiplier effect (Figure 1) for the period 2016 - 2020, we can conclude that this effect is present in more than half of the regions, despite some fluctuations over the years.

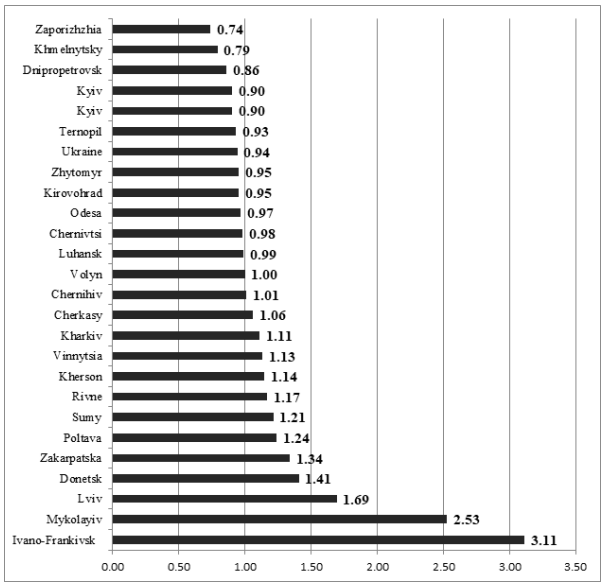

Figure 1. The average indicator of the multiplier of investment in the transport and logistics sector of the regions in the context of economic growth for 2016 - 2020

Ivano-Frankivsk region shows the highest average multiplicative effect (3.11). However, in this case, the average value is due to the high multiplier in 2016 due to a significant reduction in investment in the region's development of transport systems compared to previous periods. This indicates an inevitable imperfection of the multiplier as an independent research tool. That is, the indicators obtained in the calculations determine only approximate trends and require additional clarifications considering the specifics of the region's economy. In some oblasts, including: Luhansk, Chernihiv, Odesa, Kyiv, Zhytomyr, and others, the average multiplier effect is lower than 1. That is, there are currently no stable trends in the efficient use of investment and the transport and logistics potential of the region's logistics infrastructure. Modernization and overhaul to bring fixed assets, in particular in the field of transport, to the level of world standards require significant capital investment, the multiplier effect of which, provided they are involved and used effectively, can be obtained in 10 years.

The multiplier effect of transport and logistics investments does not work by itself. Still, it requires effective management of the region's economy, a high level of business activity in the leading sectors of the regional economy, and successful spatial planning. At the same time, the identified multiplier indicators and their trends in the regions show that investment in the development of transport, and particular infrastructure, is one of the critical stimuli for economic growth in the region (Table 2).

In addition to indirect influence on the formation of GRP, investment in the transport sector of the region

Table 2. Initial data (indices) for calculating the multiplier of investments in the development of the transport and logistics sector in the context of the impact on investment activity in the regions of Ukraine

Regions of Ukraine	*ΔBI*					*ΔIL*				
	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020
Ukraine	1.32	1.25	1.29	1.08	0.81	1.35	1.52	1.32	0.87	0.73
Vinnytsia	1.13	1.41	1.50	0.89	0.86	0.55	2.06	1.17	1.14	0.68
Volyn	1.04	1.10	1.23	1.46	0.72	1.55	1.37	1.33	1.35	0.47
Dnipropetrovsk	1.28	1.29	1.41	1.11	0.88	1.13	2.12	1.44	1.17	0.67
Donetsk	1.43	1.45	1.56	1.13	0.87	0.52	3.70	1.08	0.32	1.24
Zhytomyr	1.38	1.39	1.13	0.97	1.09	1.23	0.72	2.00	0.63	2.85
Zakarpatska	1.23	1.21	1.33	1.24	0.54	0.83	1.26	0.96	0.87	0.38
Zaporizhzhia	1.42	1.44	0.99	0.95	1.04	1.58	1.59	2.12	1.49	0.75
Ivano-Frankivsk	0.83	1.22	0.97	0.99	0.68	0.09	4.21	0.66	1.33	0.43
Kyiv	1.37	1.03	1.18	1.24	0.65	2.64	1.32	1.40	1.72	0.49
Kirovohrad	1.57	1.15	0.98	1.09	0.87	1.33	1.70	0.90	0.78	1.04
Luhansk	2.00	0.81	0.97	1.04	0.97	0.77	2.10	1.12	1.74	0.66
Lviv	1.39	1.30	1.20	1.07	0.76	1.41	1.02	1.99	0.97	0.20
Mykolayiv	1.62	1.15	0.90	1.24	0.76	0.54	1.66	0.55	1.48	0.12
Odesa	1.68	1.33	1.07	0.89	1.02	1.80	1.07	1.20	0.88	0.76
Poltava	1.83	1.04	1.18	1.23	1.09	1.28	1.43	1.36	1.07	0.32
Rivne	1.00	1.42	1.18	0.93	0.84	1.94	1.33	1.86	0.74	0.39
Sumy	1.57	1.21	1.12	1.00	0.93	2.43	0.85	2.60	0.37	0.75
Ternopil	1.28	1.46	1.17	1.10	0.79	1.22	2.72	1.53	0.43	2.46
Kharkiv	1.47	1.17	1.22	0.97	0.89	0.44	1.90	1.22	1.20	0.97
Kherson	1.48	1.60	1.20	1.40	0.58	1.41	0.98	0.82	1.07	0.54
Khmelnytsky	1.34	1.15	1.07	0.93	1.01	1.83	1.55	0.86	1.30	1.34
Cherkasy	1.45	1.25	1.36	1.02	0.80	0.90	4.05	1.10	0.63	0.72
Chernivtsi	0.96	1.12	1.24	1.10	0.81	1.52	1.00	1.30	0.97	0.70
Chernihiv	1.50	1.38	1.22	0.97	0.91	2.86	2.17	0.96	1.20	0.43
Kyiv	1.21	1.28	1.47	1.06	0.76	1.80	1.52	1.38	0.78	0.83

Source: calculated by the authors.

and the building of efficient logistics centers stimulate investment activity in related sectors of the economy, including construction, industrial production, trade, and agriculture. The impact of investment in the studied area of economic activity on the growth of investment activity in the economy of the regions will be determined based on the appropriate multiplier (Formula 2).

The dynamics of capital investment indices in the regions show that in 2020 there will be a reduction in economic investment in most regions of Ukraine except: Volyn, Zhytomyr, Zaporizhia, Odesa, and Khmelnytsky compared to the previous period. This is primarily due to a significant decline in business activity due to quarantine restrictions caused by the Covid 19 pandemic. At the same time, despite temporary difficulties and uncertainty, the transport and logistics industry is the main economic artery for regional development. Therefore, in any case, investments in its development are economically justified and profitable.

The multiplier of investments in the development of the transport and logistics sector in the context of the impact on investment activity in the regions of Ukraine is calculated. The results of the calculations are shown in Table 3.

Analyzing the results obtained, it should be noted that in 2020 the highest multiplier effect of investing in the region's transport systems in the context of increasing its investment activity is observed in: Mykolaiv, Lviv, Poltava, and Chernihiv regions. There is no multiplier effect in: Donetsk, Khmelnytsky, Ternopil, and Zhytomyr regions. It should be noted that the calculations taken into account the specifics of transport infrastructure cannot be considered correct, as there is a certain time lag, which may exceed one year, after which the effect of the investment may lead to increased investment in other sectors. Therefore, the multiplier effect of investment in transport and warehousing of the region depends on the structure of its economy, namely the availability and physical condition of transport and logistics systems, the predominance of specific industries, the level of the consumer market, foreign economic activity, its remoteness from the capital or important transport hubs, etc.

Table 3. Multiplier of investments in the development of the transport and logistics sector in the context of the impact on investment activity in the regions of Ukraine

Regions of Ukraine	2016	2017	2018	2019	2020	2020 in% until 2016
Ukraine	0.92	0.82	0.98	1.24	1.11	120
Vinnytsia	2.57	0.69	1.28	0.78	1.28	50
Volyn	0.71	0.81	0.93	1.08	1.53	215
Dnipropetrovsk	1.15	0.61	0.97	0.95	1.30	113
Donetsk	2.80	0.39	1.45	3.53	0.70	25
Zhytomyr	1.13	1.92	0.57	1.53	0.38	34
Zakarpatska	1.45	0.95	1.38	1.42	1.43	99
Zaporizhzhia	0.91	0.90	0.47	0.63	1.39	153
Ivano-Frankivsk	13.22	0.29	1.47	0.75	1.58	12
Kyiv	0.39	0.78	0.84	0.72	1.33	339
Kirovohrad	0.86	0.68	1.09	1.38	0.83	96
Luhansk	1.05	0.38	0.87	0.60	1.47	140
Lviv	0.92	1.27	0.60	1.11	3.84	419
Mykolayiv	2.11	0.69	1.64	0.84	6.21	294
Odesa	0.74	1.24	0.89	1.01	1.34	181
Poltava	0.81	0.72	0.87	1.16	3.41	421
Rivne	0.73	1.06	0.63	1.26	2.17	296
Sumy	0.50	1.42	0.43	2.67	1.24	249
Ternopil	1.20	0.54	0.76	2.55	0.32	27
Kharkiv	2.68	0.62	1.00	0.81	0.91	34
Kherson	1.14	1.64	1.47	1.31	1.08	95
Khmelnytsky	0.63	0.74	1.25	0.72	0.75	119
Cherkasy	1.40	0.31	1.24	1.62	1.11	79
Chernivtsi	0.74	1.13	0.96	1.14	1.16	157
Chernihiv	0.48	0.64	1.27	0.81	2.13	441
Kyiv	0.71	0.84	1.07	1.36	0.92	129

Source: calculated by the authors.

Table 4. Accelerator of investments in the transport and logistics sphere in the context of economic development of regions

Ukraine	2016	2017	2018	2019	2020
Vinnytsia	0.063	0.096	0.084	0.075	0.008
Volyn	0.012	0.026	0.025	0.026	0.003
Dnipropetrovsk	0.018	0.045	0.015	0.039	0.002
Donetsk	0.019	0.053	0.032	0.047	0.005
Zhytomyr	-0.091	0.074	0.064	0.022	0.004
Zakarpatska	0.016	0.011	0.015	0.008	0.004
Zaporizhzhia	0.060	0.106	0.033	0.033	0.002
Ivano-Frankivsk	0.009	0.022	0.027	0.063	0.005
Kyiv	0.019	0.121	0.036	0.040	0.003
Kirovohrad	0.034	0.045	0.055	0.065	0.006
Luhansk	0.026	0.057	0.056	0.027	0.005
Lviv	-0.003	0.006	-0.044	0.017	0.001
Mykolayiv	0.053	0.059	0.072	0.076	0.002
Odesa	0.063	0.139	0.064	0.103	0.002
Poltava	0.145	0.193	0.157	0.172	0.016
Rivne	0.025	0.045	0.036	0.057	0.002
Sumy	0.022	0.045	0.038	0.033	0.002
Ternopil	0.018	0.035	0.043	0.014	0.002
Kharkiv	0.021	0.063	0.044	0.022	0.008
Kherson	0.009	0.017	0.019	0.016	0.003
Khmelnytsky	0.021	0.028	0.017	0.022	0.001
Cherkasy	0.027	0.047	0.021	0.035	0.007
Chernivtsi	0.007	0.040	0.028	0.012	0.002
Chernihiv	0.021	0.026	0.013	0.017	0.002
Kyiv	0.013	0.038	0.018	0.020	0.002

Source: calculated by the authors.

In 2020, the most significant increase in the multiplier compared to 2016 is typical for Lviv (400%), Mykolaiv (+ 294%) and Chernihiv (+ 441%) regions. Multiplier growth is also observed in most other regions.

They are comparing the average indicators of the multiplier of transport and logistics investments in terms of their impact on economic growth and investment activity. It can be concluded that their influence is interrelated.

The obtained indicators show that in most regions, investments in transport and logistics development primarily stimulate investments in the region's development as a whole and increase business activity, which together leads to an increase in GRP. It should be noted that there is a specific time interval for a multiplier effect. This interval can last more than one year and depends on the structure of investments by type of economic activity, "transport, warehousing, postal and courier activities" namely the share of investments in infrastructure development, which can give a longer-term and delayed multiplier effect. However, the implementation of large infrastructure projects in the region, especially in the transport field, contributes to the growth of investment activity in the short term, as the region becomes more promising in business and, accordingly, investment-attractive.

Based on the collected statistical data [13], with the use of file 3 the accelerator of investments in transport and logistics systems of the regions of Ukraine for 2016 - 2020 was calculated. The results of the calculations are illustrated in Table 4.

The investment accelerator shows how much the growth of the region's economy in previous years affects the growth of investment in transport and logistics activities. In general, the indicators of the accelerator of investment in the development of vehicles and logistics are insignificant in the regions due to the small share of this type of economic activity in the economy's structure. The highest and relatively stable indicators are observed in Poltava, Odesa, and Kyiv regions. At the same time, the dynamics of the arrows show a declining trend in all regions, which indicates an insufficient level of funding for transport and logistics support against the background of the gradual growth of the regional economy.

According to Figure 2, the multiplier effect of investments in the transport and logistics systems of the regions in the context of their impact on GRP is divided into high dependence, medium, and low.

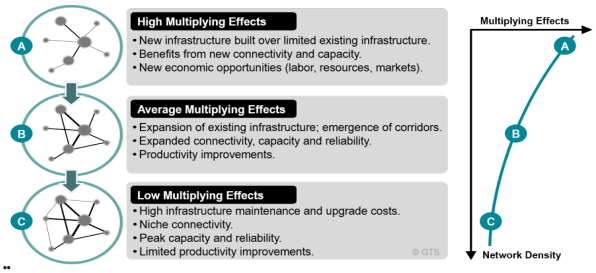

Figure 2. Interdependence of the multiplier effect of investments in the transport and logistics systems of the regions in the context of their impact on GRP

Therefore, the appropriate distribution should be used for the regions of Ukraine. The multiplier effect of transport and logistics investments does not work by itself. Still, it requires effective management of the region's economy, a high level of business activity in the leading sectors of the regional economy, and successful spatial planning. The identified indicators of the multiplier and their trends in the regions show that investment in the development of transport, and particular infrastructure, is one of the important stimuli for the economic development of the regions. At the same time, the indicators of the accelerator of investment in the dynamics show a declining trend in all regions, which indicates an insufficient level of funding for transport and logistics support against the background of the gradual growth of the regional economy.

4. Conclusions

- The calculated indicators of the multiplier of investments in the transport and logistics system showed that in terms of regions, the highest multiplier effect of assets in the development of transportation, warehousing, and communications (more than twice) as of the end of 2020 is observed in: Volyn, Zakarpattia, Lviv, Mykolaiv, Poltava, and Chernihiv regions. In 2020, the multiplier effect of more than five times the GRP increase in transport investment compared to 2016 was typical for some oblasts whose transport potential is used most intensively due to the geographical location of major transport routes and key transport hubs in the territory. In particular, these are Lviv (growth more than seven times), Chernihiv (6 times), Kyiv (almost five times), Mykolaiv (4 times), Poltava, and Odesa regions. In general, with various deviations in specific periods during 2016-2020, the multiplier effect of investing in the development of transport and logistics on GRP and the level of investment activity of economic entities was observed in all regions of Ukraine.

- Achieving the effect of accelerator and multiplier of investment in the transport and logistics sector requires a comprehensive analysis and rational planning of capital investment in the industry and their compliance with the needs and trends of regional, national and global economies. In this context, the urgent task at the level of provincial and territorial administrative bodies is to develop strategies for the development of warehousing logistics as an integrative component of transport and logistics systems. To clarify the nature, main tasks, and role in the development of transport and logistics structures of the region, a structural model of warehousing logistics development strategy are proposed, which systematizes: the conditions necessary for building warehousing infrastructure and organization of logistics activities in the region; identified alternatives to the required scale, location of technologies and communications of warehousing systems, as well as the types and forms of organizational links between market participants, directly or indirectly related to this type of activity. It is proved that the multiplier effect of investments in the transport and logistics systems of the regions in the context of their impact on GRP is divided into high dependence, medium, and low. Therefore, the appropriate distribution should be used for the regions of Ukraine.

5. References

[1] US Department of Transportation. (2002). *Economic Effects of Transportation: The Freight Story Final Report*. <URL:https://ops.fhwa.dot.gov/freight/freight_analysis/improve_econ/appa.htm. Accessed 12 Jun 2022.

[2] Jereb B. (2017). *Mastering Logistics Investment Management*. Transformations in Business and Economics, 16, 1, (40), pp. 100-120.

[3] Pantina T. A., Borodulina S. A. (2015). *Methods for Estimation of Multiplier Effect of Investments in Development of Infrastructure of Inland Water Transport in the Russian Federation in the Frameworks of Federal Target*. Programs Review of European Studies, 7, 9, pp. 83-96.

[4] Halkin A., Skrypin V., Kush E., Vakulenko K., Dolia V. (2017). *Invest Approach to the Transportation Services Cost Formation*. Procedia Engineering, 178, pp. 435-444.

[5] Popadynets N. Irtyshcheva I., Shymanovska-Dianych L., Diugowanets O., Hryhoruk I., Kramarenko I., Husakovska T., Boiko Y., Hryshyna N., Ishchenko O., Tubaltseva, N., Archybisova, D. (2021). *Evaluation of Domestic Market Development in Ukraine*. In: Russo D., Ahram T., Karwowski W., Di Bucchianico G., Taiar R. (Eds.), Intelligent Human Systems Integration 2021. Advances in Intelligent Systems and Computing, Springer, Cham., New York, USA.

[6] Daia Q., Yanga J. (2013). *Analysis on the Contribution of Logistics Park Construction to Regional Economic Development*. Procedia - Social and Behavioral Sciences, 96, pp. 599-608.

[7] Rodrigue J. P. (2020). *The Geography of Transport Systems: Diminishing Returns of Transport Investments*. <URL:https://transportgeography.org/contents/chapter3/transportation-and-economic-development/transport-investments-diminishing-returns/. Accessed 20 June 2022.

[8] Dong J., Xu Y., Hwang B., Ren R., Chen Z. (2019). *The Impact of Underground Logistics System on Urban Sustainable Development: A System Dynamics Approach*. Sustainability, 11, pp. 1-21.

[9] Sibiryakova O. O. (2017). *The concept of multiplier and multiplicative connection in economic and social theories*. Bulletin of the KhDAK, 50, pp. 296-307.

[10] Pryshchepa O., Kardash O., Yakymchuk A., Shvec M., Pavlov K., Pavlova O., Irtyshcheva I., Popadynets N., Boiko Y., Kramarenko I. (2020). *Optimization of multi-channel queuing systems with a single retail attempt: Economic approach*. Decision Science Letters, 4, 5, pp. 559-564.

[11] Oosterhaven J., Stelder D. (2000). *On the Use of Gross versus Net Multipliers, with a bi-regional application on Dutch transportation*. <URL:https://www.iioa.org/conferences/13th/files/Oosterhaven&Stelder_GrossvsNet%20Multipliers.pdf. Accessed 20 June 2022.

[12] Voit S., Irtyshcheva I., Nosar A. (2021). *Strategy for the development of warehouse logistics as a component of transport and logistics systems in the focus of economic transformation*. Baltic Journal of Economic Studies, 7, (5), pp. 49-58.

[13] State Statistics Service of Ukraine. (2022). *Statistical data collection* (in Ukrainian). <URL:http://www.ukrstat.gov.ua/ Accessed 20 June 2022