A Logistics Approach to the Effective Use of the Trans-Caspian International Transport Route: A Perspective from Poland

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Abstract. The Middle Corridor's transport potential is influenced by various factors, with cost considerations being a primary concern. However, cost isn't the sole factor determining the specific route's utilization. Achieving various objectives (financial, political, efficiency-related, etc.) requires accounting for variables that differ by region, country, and market. This article addresses the issue of optimizing the route to and from eastern Eurasia via Georgia and Azerbaijan from Poland's perspective. Poland has access to efficient logistics channels, but for geopolitical reasons, it is interested in strengthening and intensifying operations in this important alternative transport corridor. The article is based on research questions, and the answers are presented on the basis of a literature review.

Keywords: The Caspian-Caucasus Corridor from Poland's perspective; Logistics support for trans-Eurasian transport; Geopolitical factors influencing logistics processes

1 Introduction

The issue of transport corridors is extensively covered in the literature, addressing various aspects—economic, political, and technical—as well as a range of different perspectives. Numerous empirical studies indicate that investments in corridors boost economic activity and trade, improve regional productivity, and stimulate private investment [1-4], and their importance stems from the concentration of economic activity, economies of scale, and transport-location interactions [5-7] reinforce the processes of agglomeration and dispersion of economic activity and influence the spatial structure of the economy. Corridors as a tool for regional development and reducing inequality an reduce poverty and inequality, improve access to labor markets, and support the development of peripheral areas [8-10]. In a global context, transport corridors strengthen regional integration, influence trade flows, and are a key element of infrastructure geopolitics. As has been emphasized in many sources, corridors are therefore a key tool for the development of national economies and logistics systems [11-13].

The literature contains the latest research focusing on the decarbonization of transportation, "green corridors," and multimodal management [14]. In the context of the

considerations outlined in the title, the discussion focuses on the macroeconomic perspective and concentrates on the logistical aspect of assessing a corridor's utility.

A transport corridor is a stretch of transport infrastructure of international significance along which at least two different transport routes with appropriate technical and operational parameters run, with transport hubs (intermodal terminals, seaports, logistics centers) located along them. The main characteristics of a transport corridor include [15]:

- the international nature of transport connections,
- the adequate socio-economic potential of the regions located within the corridor, generating demand for transport services,
- ensuring convenient transport connections between the regions through which the corridor runs, primarily in terms of distance, travel time, and cost,
- the ability to handle large, sustained traffic flows,
- the creation of integrated transport systems and chains at the technical-technological, organizational-legal, and economic levels, etc.,
- the potential for the use of intermodal technologies,
- non-transport significance, including, above all, the impact on the spatial and economic structure of countries and regions and their international connections.

Another important issue in this regard is the boundaries—both physical and socio-political and cultural—that any transport corridor crosses, thereby creating a new framework for effective cooperation.

Modern transportation systems are one of the fundamental pillars of the global economy, shaping both the dynamics of trade flows and the geopolitical landscape of relations between countries and regions. The literature on the subject emphasizes that transport infrastructure and the associated logistics corridors not only enable the efficient flow of goods but also play a key role in processes of economic integration, the diffusion of innovation, and the building of economic security for nations [16]. In this context, international transport corridors take on particular significance, as they—as integrated infrastructure corridors—create a space for supra-regional and intercontinental flows.

2 Problem statement

An analysis of the significance of any transport or logistics corridor will always be shaped by the perspective of the person or location making the assessment. This is primarily a result of the fields and disciplines of knowledge represented by the researcher, the scope of their assessment, and their understanding of the "spatial scope" on which is focused. The literature contains many different references that confirm the diversity of approaches. As such, Mullen and Marsden point to the existence of "divergent views on the role of transportation" and emphasize that different research approaches lead to differing interpretations of the significance of transportation infrastructure [17]. Luo et al. explicitly emphasize that the study of corridors is conducted "from the perspective of urban agglomerations" and that the choice of this perspective constitutes a deliberate research assumption. They point out also that different approaches (e.g., "narrow" vs. "generalized accessibility") yield different insights into the significance of corridors [18]. Beifert et al. in turn analyze the Trans-Caspian International Transport Route

"from the perspective of logistics stakeholders" [19], while Rosik and Wójcik show that studies of the impact of infrastructure depend on the methods used and the contexts (economic vs. spatial), therefore the results of the analysis are determined by the methodological framework and the researcher's perspective [20]. Tassadiq et al. explain that corridors can and should be analyzed as products of infrastructure and governance (i.e., policy and regulation) as well as elements of global economic processes, leading to the conclusion that their "significance" is not objective and depends on the political context and interpretation [21]. That is precisely why the analysis of transport and logistics corridors is relative and forward-looking; it depends on the spatial scale adopted, is shaped by the interests and perceptions of various stakeholders, results from the choice of analytical methods and indicators, and addresses various dimensions of outcomes. This, of course, does not affect the validity and relevance of assessing the corridor's utility in every possible aspect, nor does it detract from the essence of its multifaceted functions, which are discussed at great length in the literature [4, 7, 13, 22-23].

Since the area between the Black Sea and the Caspian Sea is one of the most functionally complex regions in the global transport system, serving simultaneously as a geographical, civilizational, and infrastructural borderland. Regionally, it primarily encompasses the countries of the South Caucasus (Georgia, Armenia, and Azerbaijan), but its functional scope extends beyond these borders to include Central Asia, Turkey, and Eastern Europe [24]. The significance of the Caucasus-Caspian Corridor must be analyzed in the context of the shifting balance of power in Eurasia. Academic literature emphasizes that transport infrastructure is not only an economic tool but also an instrument of foreign and security policy [25]. Since transport corridors can strengthen ties between states, create new axes of cooperation, and limit the influence of competing actors, in the case of the Middle Corridor, its diversification function is of key importance. For the countries of Central and Eastern Europe, which were heavily dependent on transport infrastructure running through Russia, the development of alternative routes is a crucial element in enhancing economic security. In particular, this importance has further increased since 2022, as reflected in the region's growing interest in investments in infrastructure connecting Europe and Central Asia and China via the Caucasus.

The Trans-Caspian Corridor, which has been the subject of fairly extensive analysis, is a unique route whose significance varies significantly depending on the specific geographical area it is intended to serve from a logistical standpoint. Given the reference to "Poland's perspective" in the title, defining its role and place requires focusing on two fundamental research questions: **(RQ1)** How do current geopolitical factors influence the utility of the Middle Corridor for entities whose economic interests are centered in Poland? **(RQ2)** What other factors (organizational, technical) make this corridor a problematic route from a logistical standpoint? Naturally, the spectrum of these factors will be analyzed within a limited scope, focused on a macro-logistical perspective. This seems sufficient to present thinking about the corridor from the perspective of a relatively developed economy of a country located in Central Europe and having access to other, alternative routes running through Eurasia.

Although existing literature provides substantial insights into geopolitical dynamics, infrastructure constraints, and macro-regional economic implications of the Middle Corridor, limited attention has been devoted to downstream EU integration and national-level logistics performance. In particular, there is a lack of research examining

how corridor-level determinants translate into operational efficiency within EU member states functioning as gateway economies. The Polish case is especially relevant due to:

- its strategic location at the EU's eastern border,
- its developed rail freight sector,
- its role in intermodal container handling,
- its potential function as a distribution hub for Central Europe.

By combining corridor theory, network analysis, supply chain resilience, and quality-oriented economic performance assessment, this study aims to provide a multidimensional evaluation of the effective use of the Trans-Caspian International Transport Route from a Polish logistics perspective.

3 The role of the geopolitical perspective and the essence of regionalization in macrologistics

All processes—past, present, and future—take place within a specific time and space. Events usually occur in close connection with the natural environment in its many forms. Human activity leaves lasting traces on the earth, creating a specific layer over the original, physical space. This is the civilizational and cultural layer, which translates into politics. All phenomena, both material and immaterial, are characterized by a spatial dimension linked to a specific moment in history. This creates a specific reality. The present is usually considered solely in terms of time, while the space in which it occurs is regarded as a secondary factor. Nevertheless, and this is very important from a logistical perspective, every country is not only an element of a larger space but also participates in processes occurring on a larger scale. This creates a need to seek various syntheses, e.g., economic, sociological, or cultural. A synthesis that takes into account temporal and spatial phenomena in equal measure—characteristic of geopolitics—is both legitimate and essential. It is difficult to provide an unambiguous definition of it. Given its subject matter and rather controversial history, few fields generate such extreme reactions and assessments. On the one hand, the literature contains statements describing it as a political doctrine asserting that political phenomena, processes, and facts are determined by geographical conditions [26-27], which reduces it to the status of an ideology. On the other hand, geopolitics is regarded as a science. It is sometimes situated within the fields of geography, political science, or international relations. It is also frequently denied the status of an independent science, with the term "geopolitics" being considered synonymous with political geography [27]. Meanwhile, the geopolitics, being an interdisciplinary science, bases its research on two main fields of science: the social sciences and the Earth sciences. In terms of scientific disciplines, it is most closely related to geography, history, political science, demography, economics, military science, and geology. From the perspective of the general classification of sciences, geopolitics is situated between idiographic and nomothetic sciences. It studies not only individual phenomena, but above all processes, based on which it formulates hypotheses, concepts, theories, and laws.

We have become accustomed to treating Europe and Asia as separate entities. In geography, Eurasia is considered the largest continent on Earth, consisting of two parts

of the world—Europe and Asia. The concept of Eurasia was introduced into science in the 19th century by the Austrian geologist E. Suess [28] who justified it by the lack of a clear structural boundary between Europe and Asia. It is worth noting that in geographical sources there is a valid doctrine according to which equating a part of the world with a continent (and vice versa) is a mistake of the same kind as considering the terms "culture" and "civilization" to be synonyms. This stems from the uncritical adoption of the term "Old Continent," which European settlers in the New World used to refer to the continent from which they themselves (or their ancestors) had come. That continent, however, was Eurasia, and Europe is merely a part of it. In this regard, the following statement is noteworthy: "There is no geographical definition of our continent, but only an ethnic and cultural one. It is not the Urals that mark the border of this continent, but a specific line that separates the way of life of the West from that of the East" [29].

Before examining the spatial structure of economic processes, it is essential to understand the qualitative aspects of the issue—that is, to define the nature of the phenomenon under study and the significance and character of its individual components. In the geographical literature, regions are generally defined as homogeneous, functional, or administrative. From the perspective of proper economic development, regions characterized by strong degrees of interdependence and significant complementarity seem appropriate [30]. In contemporary English-language economic literature, the term "functional region" is increasingly used [31, 32]. Its definitions can vary widely, much like the definitions of any concept in the various disciplines that draw on geography. The essence of this concept lies in its "territorial" approach and regionalization [30], within which economic (including trade and transport) or social relations can be analyzed. A functional region is therefore a territorial area characterized by a high frequency of economic interactions, such as interregional trade in goods and services [33]. The analogous term in the American approach is Functional Economic Area, the definition of which should take into account, among other things, local and regional transportation corridors (commuting routes) and supply chains, treated as the most important links in trade that form a functioning regional economy [34]. Economic literature features a number of adaptations of this term, such as Functional Urban Areas, used by the OECD's Territorial Development Policy Committee [35], or Functional Economic Market Areas, considered one of the best levels of economic analysis for evaluating market performance [36].

Based on the above, it can be concluded that since, in today's world, the boundaries of economic flows increasingly do not coincide with national borders, the functional area within which the local economy and its key markets operate is entitled to function across administrative boundaries. The Functional Economic Market Area is, as confirmed by economic research, the most appropriate unit for economic policy analysis, since management decisions within the defined area are more effective than in cases where the analyzed territory remains confined by administrative boundaries [36]. This view can be found, among others, in the works of M.F. Goodchild and V. Noronha [37]. A region, in the formal sense, has been defined by them as the largest area in which generalization remains valid. Formal regions are internally homogeneous. Formal regionalization, meanwhile, is achieved by grouping spatial units at a lower level (e.g., communities, municipalities, or postal code zones popular in Anglo-Saxon culture, etc.), which allows for the minimization of group variance on one or more variables.

Functional regions, on the other hand, are internally heterogeneous both socially and economically. This results in their mutual complementarity and independence. And, at the same time, in quantitative literature, a functional region is also sometimes defined as an aggregation of elementary spatial units at a lower level that maximizes relationships within the region and between regions [38]. The structural taxonomy of regions, in addition to formal and functional regions, further distinguishes between nodal regions (defined by cores and regional dominance) and equitable regions.

An economic region may be a specific area designated by the governing authority (the state) for the purpose of more efficient management or reporting (e.g., statistical). It may also be an area that exists independently of institutional divisions and possesses a specific set of characteristics related to the economic sphere. From an economic perspective, a region is an area distinguished on the basis of economic criteria, functionally linked to the entire national economy, and possessing a specific economic profile. As an economic category, a region functions in three ways: as an object of knowledge, a subject of research, and a tool for action. This approach appears to be particularly useful for the purposes of studying and diagnosing regional disparities within larger economic spaces. It allows the concept of an economic region to be applied for the following purposes [27]:

- cognitive (when it comes to dividing economic space into regions, i.e., their delimitation and description),
- research (involving the development of methodological foundations for regional research and studies),
- applied (serving to formulate premises, conclusions, and recommendations for socio-economic or regional policy).

The approaches presented allow to identify the Caucasus as a region characterized by a range of economic ties that determine the flow of goods and services between the economies of the individual states that comprise it. And from the previously mentioned theory of transport corridors, one can conclude that the South Caucasus (in particular: Georgia and Azerbaijan)—being the area through which the Middel Corridor runs—should be recognized as a functional area suitable for analysis.

The validity of conducting an economic analysis of processes occurring in any given area can also be derived from the theory of spatial economics. In a situation where the spatial economy is assessed as a network of overlapping markets or functional areas linked to various activities, administrative regions and local government areas are used as equivalents of functional areas, revealing serious shortcomings in the analysis of the spatial economy and the implementation of local policies. In such cases, the spatial economy is viewed as a complex network of economic flows within a hierarchical system [39]. Both approaches—the one acknowledging the existence of spatial structures constituting the material fabric of specific, generic production regions, as well as the aforementioned approach to the spatial economy as a network of flows—allow for the identification of the Eurasian Economic Area as a field of study. After all, specific economic phenomena occur within it that drive the functioning of the international logistics system, of which the transport – a branch of the economy – is a component.

Given that the management of the flow of all resources within an organization constitutes the essence of logistics, its primary task is therefore to integrate these flows and optimize the costs of their execution. Coordinating and managing cooperation between individual units is particularly important in light of the constant expansion of issues

accompanying flow processes. Integration, which is the goal of logistics, plays a crucial role in the sphere of flows—including international ones—that are significant from a research perspective. Integration concerns all aspects of the movement process, both in terms of its actual execution and its optimization based on criteria such as time and cost of execution, spatial connections, or ensuring the desired level of service. Optimization occurs at the operational and strategic levels. Hence, integration in the logistics context is understood in both an objective sense (integrating resource flows and logistics functions themselves) and a subjective sense (integrating the logistics functions of individual units within a company, between companies, and across socio-economic systems) [27]. The integration of logistics processes enables better planning of investments that facilitate the flow of goods. Interoperability initiatives contribute to this.

Interoperability, in common parlance, is often understood as the ability of people, systems, or products to interact seamlessly and compatibly in providing services to users. It is a characteristic of products or systems whose functionality operates without disruption. An interoperability framework is an agreed-upon approach to interoperability intended for organizations wishing to collaborate with one another to jointly provide services. It defines a set of common elements, such as: vocabulary, concepts, principles, strategies, guidelines, recommendations, standards, specifications, and practices [40]. Each of these factors, essential for formulating conditions that ensure interoperability, must take into account the interrelationships between the key entities: data, information, and knowledge. Their interrelationships, in the most common understanding of these concepts, are presented in a three-level hierarchy. Data, which serves as a carrier of information, is placed at the highest level. Information is understood as data subject to interpretation. Knowledge, on the other hand, is derived from information that requires appropriate meaning and understanding—that is, semantics—taking into account prior knowledge. Integration creates conditions for harmonizing operational objectives regarding procurement, production, and distribution. This facilitates the integration and control of undertaken activities, which in turn translates into a reduction of potential risks. It is also a source that generates new ways of utilizing tools and techniques, contributing to innovation [27].

The perception of business activity through the lens of extensive networks of dependencies and connections existing within various structures within a company, between companies, and also between companies and customers and other stakeholders in the business environment constitutes, alongside the concept of time, the second key premise for the development of logistics. It is a specific philosophy of action and the appropriate way of thinking at the current stage of development. After all, logistics is based on appropriate relationships [41]. Its goal is the implementation of multi-layered and multifaceted coordination of cooperation that is both desirable and necessary from the perspective of resource flow. Its function boils down to ensuring the rational use of the inputs necessary to provide services to entities requiring these resources at an appropriate level. Logistics thus has integrative functions related to the synergy effect observable in supply and distribution chains. The task of logistics boils down to overcoming all barriers occurring in flow processes. This goes beyond the realm of economic processes. It encompasses not only the organizational aspect of the flow but also the technical and technological spheres, which translate into the economic efficiency of economic processes.

The availability of resources in the appropriate form and format determines whether the goal is achieved. It is therefore a prerequisite for carrying out the fundamental process of meeting the needs of economic and social systems [42]. Every link in the chain must perform its tasks in a beneficial, efficient, and effective manner. Resources can be obtained from many sources and various suppliers. In the face of the globalization of economic processes, this is becoming increasingly easier. Nevertheless, the right choice of supplier determines not only the costs of transporting them to the point of use (processing), but also the quality of the goods in question. At a later stage in the logistics process, there is a need to make effective use of the acquired resources. This, in turn, requires minimizing natural and technological losses and optimally organizing internal flows, e.g., within the production line, its location relative to the source of resources, and the warehouse for semi-finished and finished products. The issue of resource flow remains relevant also at the stage of physical product distribution, which falls under the purview of logistics. The specific technical and technological level of logistics systems enables the organization and execution of logistics processes (logistics chains). Information is also a factor influencing the efficiency, economy, and effectiveness of processes. As a resource, information is also subject to movement.

The currently observable, growing access to information will determine the sources of competitive advantage for many companies (including virtual companies). This is linked, among other things, to the specific skills of their leaders, including the ability to create markets that do not yet exist. Limiting the scope of logistics to the flow of materials or raw materials is an inappropriate approach. This is because a wide spectrum of resource flows exists within the sphere of economic activity. Therefore, the coordination of process flows within an entity and between entities must encompass all resources, including information and human resources [43, 44].

The concept of a logistics channel encompasses all elements directly related to the movement of resources. It constitutes one of the most important components of the logistics system for both organizations (companies) and the state (at the supranational level). The logistics system is formed by logistics infrastructure at all levels: functional, organizational, legal, and technical. The interdependencies between these levels determine the feasibility of logistics processes and, consequently, the functioning of logistics chains. The operational capacity of individual system elements—such as logistics channels, warehouses and logistics centers, information flow channels, means of transport, and information exchange devices—determines the efficiency of the logistics system as a whole [45]. The organization and execution of logistics processes—that is, logistics chains—are made possible by the specific technical and technological level of logistics systems.

Regardless of the definition of a supply chain, the key point is that modern supply chains are, for the most part, global in nature; after all, the locations where raw materials are sourced, processed, and assembled into finished products, as well as warehousing and distribution centers and points of consumption, are spread across many countries. Logistics chains, which provide actual logistics support for supply chains, themselves become a complex sphere of economic activity with intricate conditions. The objective of this activity focuses on the efficient, effective, and successful organization and execution of a full range of logistics functions that determine the existence and proper functioning of supply chains (both local and transnational). Setting aside the importance of coordinating and managerial functions related to the manufacturing process itself,

tasks related to the logistical support of global supply chains remain highly significant. Currently, virtually all market participants face the challenge of optimization. Striking the right balance between cost-effectiveness, safety, environmental requirements, and the benefits expected by customers has become a key factor in maintaining a successful market presence [46, 47]. In this context, it is worth mentioning another function of logistics. Since it facilitates changes in the relationships between participants in the flow process, sources often highlight a key feature of logistics: its contribution to mitigating and minimizing conflicts. This constitutes an important social aspect of logistics. Conflicts between links in supply chains, as well as potential conflicting objectives that may arise during the decision-making stage regarding logistical support for core operations, can be mitigated through proper coordination of the tasks and objectives of individual stakeholders [48]. This is achieved by properly defining the role of each link in the chain within the framework of mutual interconnections.

4 A logistical perspective on the significance of the TSITR from Poland's perspective

The Middle Corridor brings the vision of connecting the economic hubs of China and Europe, as well as the territories of Central Asia, the Caspian Sea, the South Caucasus, and the Black Sea region, to life. The route is intended as an alternative to the Trans-Siberian Northern Corridor, and experienced exceptionally rapid growth in freight traffic from 2013 until the start of Russia's full scale invasion of Ukraine in 2022 [49]. The relatively less developed Southern Corridors complement both routes. These corridors are intended to connect Europe with China through Central Asia, Iran, and Turkey. Land routes still constitute a minor supplement to sea and air transport on the Europe–Asia route. For landlocked countries in Central Asia and the Caucasus, the Central Corridor, which runs from East to West, offers a significant alternative to trade through Russia or Iran [50]. The onset of a new phase of the war in Ukraine led to significant changes in transport route usage within the Eurasian context.

From the beginning of the war, traffic on the Northern Corridor, which runs through Russia to Poland and other EU countries, has declined. This decline was caused by several factors, including a sharp decrease in ocean freight rates, a decrease in EU trade with Russia due to economic sanctions imposed on Russia, the withdrawal of some European companies from the local market, and limited access to transport insurance through Russian territory. Furthermore, for image reasons among other factors, freight forwarders from Europe have been forced to import goods from China via the cheaper, albeit much more time-consuming, sea route.

The Polish sources note that the concept of expanding the route and fostering cooperation among the various stakeholders had been taking shape slowly since 2013 [52]. It was not until 2017 that the International Association TITR (International Association *Trans-Caspian International Transport Route*) was established, which provided the impetus for the institutionalization of the initiative. Over time, rail carriers, logistics operators, and seaports from outside the region began to join it (including the Polish company PKP LHS – *Linia Hutnicza Szerokotorowa*, the Ukrainian rail carrier *Ukrzaliznytsia*, the Lithuanian *LTG Cargo*, the ports of Burgas and Constanta, and the China Communications and Transportation Association). This led to the agreement and

organization of regular meetings aimed at coordinating e.g., customs rates, launching regular train and ship services, and increasing the route's capacity. The invasion of Ukraine proved to be an extremely powerful catalyst for the development of the TITR in the South Caucasus and Central Asia. In October 2023, a joint venture was formed among the state railways of Azerbaijan, Georgia, and Kazakhstan to operate logistics on the route jointly. The joint venture will regulate tariff issues and handle cargo on the Caspian Sea–Black Sea section. Furthermore, in November 2022, Azerbaijan, Georgia, Kazakhstan, and Turkey signed a roadmap regarding the acceleration of the corridor's modernization [51]. At the Organization of Turkic States summit, a forum for Central Asian and Turkic-speaking countries to cooperate, Azerbaijan and Turkey ratified a document focused on expanding the TITR from 2023 to 2027.

The world's largest transportation and logistics companies are expressing interest in the Central Corridor. Shipping lines such as the Italian-Swiss MSC, the Danish Maersk, the French CMA CGM, the Chinese COSCO, and the Israeli ZIM have launched services on this route, primarily using the port of Poti. From there, they transport cargo to Baku and across the Caspian Sea to Kazakhstan. They also transport cargo westward to Turkey (mainly by land) and to ports in Romania, Bulgaria, and Greece. Also, in June 2022, the German logistics company CEVA Logistics launched a connection from Xi'an, China, to Duisburg, Germany. In March 2022, Finnish Nurminen Logistics signed an agreement with Kazakh railways to commercialize the corridor and launch test trains from China via the port of Constanța, followed by a ferry connection from Hamburg to Helsinki. DHL, a courier service company, also offers its services on this route. Meanwhile, Georgian tomatoes and Kazakh wheat are transported to Italy via the Middle Corridor. This shows that, with the right level of commitment at all levels, it is possible to significantly increase the volume of operations carried out along the corridor. Of course, this requires further, even more extensive integration, which is the foundation of effective logistics processes. Nevertheless, changes in the TITR capacity illustrate the potential for its practical utilization in the near future.

Poland's trade with the countries of the South Caucasus (Georgia, Azerbaijan, and Armenia) showed a generally upward trend between 2019 and 2025, with Georgia and Azerbaijan remaining the key partners in terms of volume. In 2024 and 2025, interest in Polish goods in this region persisted [53], which to some extent generates cargo flows in bilateral trade. But, which also appears to be crucial from the perspective of Polish market participants, is a geopolitical perspective. The Middle Corridor (most commonly associated in Poland with the term *the Caucasus-Caspian Corridor*) is also part of the competition for influence in the Eurasian region. Both regional states (Turkey, Azerbaijan, Kazakhstan) and global powers (China, the European Union, the U.S.) are involved in this competition. The development of the corridor could lead to the emergence of a new system of economic ties, in which Central and Eastern Europe will serve as a bridge between East and West. However, due to the complexity of the logistics chain, the freight cost for a 40-foot container from Kazakhstan to Poland via the TITR —as well as the delivery time—are higher than those of the routes previously used through Belarus and Russia, and therefore not competitive.

The assessment of logistical viability is complicated primarily by the need for multiple transshipments required to facilitate deliveries between Poland and China and Central Asian countries, which generates high costs and the risk of damage to goods. It is estimated that containers moving between Asia and Europe are transshipped an

average of five times, and those transported via the Central Corridor—at least seven times [52]. This is, of course, due to different track gauge standards (1,435 mm in Poland and China, 1,520 mm in other countries), followed by one of the Kazakh ports on the Caspian Sea (Aktau or Kuryk) goods are loaded onto ships, then unloaded in Alat, Azerbaijan, from where they reach Georgia by various means of transport and continue onward, depending on the destination, either overland toward Turkey or by sea toward the west. It is worth noting that, prior to the Russian invasion of Ukraine, one of the most promising branches of the corridor ran through the Ukrainian ports of Chornomorsk and Odessa, and then along the broad-gauge PKP LHS line to Poland. The end of hostilities should potentially reopen this route and restore the ability to use the familiar, previously operational customs clearance procedures.

Of course, in a geopolitical context, the need to diversify delivery routes seems obvious. Nevertheless, ultimately it is the customers who decide what level of costs (not only financial, but also in terms of time) they are willing to bear; hence, a significant improvement in the quality of logistics services at the intersection of national borders and operators of individual sections is of the utmost importance.

5 Conclusions

The Middle Corridor could increase trade between the South Caucasus, Central Asia, the EU, Turkey, and China. In the long term, it could also serve as an efficient Eurasian route. Compared to the Northern Corridor running through Russia, the Central Corridor differs in two ways. First, the distance between China and Europe is approximately 30% shorter (about 7,000 km) [56]. Second, the Central Corridor has a significantly more complex logistics system and less developed transport and transshipment infrastructure. Therefore, the foundation for improving its capacity must be the development of ports and railways, as well as the construction of an adequate network of logistics terminals in the region's countries. Another weakness of the Central Corridor is the highly varied condition of the railway infrastructure, which means that, for example, in Azerbaijan and Georgia, cargo must also be transported by much more expensive, and certainly not in line with the essence of sustainable development road transport. The countries in the region are aware of the need to build new rail lines and modernize existing ones, which is a prerequisite for improving freight transport. That said, it appears that Kazakhstan continues to give the highest priority to this goal.

Improvements are also needed in terms of common procedures, documentation, and customs clearance, as there are several customs zones along the route. In this regard, the involvement of leading international players, global supply chains companies, and logistics operators should be considered crucial. Poland has been and remains a country for which the ability to make deliveries via various routes is a factor in its broader economic security. This, in turn, requires the diversification of logistics channels.

From an economic perspective (not only for Poland), measures leading to a significant reduction in transit times, the optimization of related costs, and the assurance of predictability (punctuality) in operations are what directly contribute to increasing the Central Corridor’s share in international trade and logistics chains.

References

1. Roberts, M., Melecky, M., Bougna, T., Xu, Y.: Transport corridors and their wider economic benefits: A critical review of the literature, Journal of Regional Science **60**(2), 207–248 (2020)
2. Redding, S.J., Turner, M.A.: Transportation costs and the spatial organization of economic activity. In: Duranton, G., Henderson, J.V., Strange, W.C. (ed.), Handbook of Regional and Urban Economics, Vol. 5, Elsevier, Amsterdam, pp. 1339–1398 (2015)
3. Melo, P.C., Graham, D.J., Brage-Ardao, R.: The productivity of transport infrastructure investment: A meta-analysis of empirical evidence, Transport Reviews **33**(5), 626–647 (2013)
4. Straub, S.: Infrastructure and development: A critical appraisal of the macro-level literature, Journal of Development Studies **47**(5), 683–708 (2017)
5. Krugman, P.: Increasing returns and economic geography, Journal of Political Economy **99**(3), 483–499 (1991)
6. Duranton, G., Puga, D.: Micro-foundations of urban agglomeration economies. In: Henderson, J.V., Thisse, J.F. (eds.), Handbook of Regional and Urban Economics, vol. 4, Elsevier, Amsterdam, pp. 2063–2117 (2004)
7. Venables, A.J.: Transport costs, spatial disparities and economic development. In: Vickerman, R. (ed.), Transport and Economic Development, Routledge, London, pp. 13–32 (1999)
8. Berg, C.N., Deichmann, U., Liu, Y., Selod, H.: Transport policies and development. Journal of Development Studies **53**(4), 465–480 (2017)
9. Quium, A.S.M.A.: Transport corridors for wider socio-economic development: Success factors. Sustainability **11**(19), 5248 (2019)
10. Rosik, P., Wójcik, J.: Transport infrastructure and regional development: Evidence from European regions, Sustainability **15**(3), 2105 (2023)
11. Azimov, R.: International transport corridors and their role in economic development. European Journal of Applied Sciences **13**(2), 45–58 (2025)
12. Rahman, M.H., Baldacci, R.: Trade facilitation, infrastructure and transport corridors. Discover Sustainability **6**, 112 (2025)
13. Sharova, I.V., Golova, D.V.: International transport corridors as a factor of national economic development. Journal of Economics, Entrepreneurship and Law **13**(1), 77–90 (2023)
14. Jugović, A., Hess, S., Poletan Jugović, T., Tadić, S.: Green shipping corridors: A systematic literature review. Applied Sciences **15**(6), 3304 (2025)
15. Wronka, J.: Transport Corridors in the Light of New Concept of European Commission. Zeszyty Naukowe Uniwersytetu Szczecińskiego. Ekonomiczne Problemy Usług 49, 241–250 (2010)
16. Rietveld, P., Bruinsma, F. R.: Is Transport Infrastructure Effective? Transport Infrastructure and Accessibility: Impacts on the Space Economy. Berlin: Springer (Advances in Spatial Science) (1998)
17. Mullen, C., Marsden, G.: Transport, economic competitiveness and competition: A city perspective, Journal of Transport Geography, vol. 49, 1-8 (2015)
18. Luo, H., Qian, Y., Zeng, J., Wei, X., Guang, X.: An Empirical Analysis of Logistics Corridors and Regional Economic Spatial Patterns. Land **11**(5), 726 (2022)
19. Beifert, A., Jintchveleishvili, T., Gvarjaladze, V.: Efficiency of the Middle Corridor: analysis based on empirical evidence from Georgia's transport sector. RelStat 2024, Reliability and Statistics In Transportation And Communication, Riga (2024)
20. Rosik, P., Wójcik, J.:Transport Infrastructure and Regional Development: A Survey of Literature. Sustainability **15**(1), 548 (2023)

21. Tassadiq, F., Silver, J., Kallianos, Y., Guma, P. K.: The unending corridor: Critical approaches to the politics, logics and socio-technics of urban corridorisation. Urban Studies **62**(10), pp. 1961–1984 (2025)
22. Drewello, S., Scholl, B.: Integrated Spatial and Transport Infrastructure Development. Contributions to Economics, Springer, Switzerland (2016)
23. Fabbro, S.: Mega Transport Infrastructure Planning. European Corridors in Local-Regional Perspective. Springer, Switzerland (2015)
24. Kenderdine, T., Bucsky, P.: The Middle Corridor: Policy Development and Trade Potential of the Trans-Caspian International Transport Route. In: Azhgaliyeva, D. (ed.) Unlocking Transport Connectivity in the Trans-Caspian Corridor, pp. 100–138. Asian Development Bank Institute (2021)
25. Coe, N. M., Yeung, H. W.-C.: Global Production Networks: Theorizing Economic Development in an Interconnected World. Oxford: Oxford University Press (2015)
26. Brittannica, https://www.britannica.com/topic/geopolitics, last accessed 2026/04/01
27. Doński-Lesiuk, J.: Nowy Jedwabny Szlak. Transport kolejowy w obsłudze logistycznej. 2nd edn. CeDeWu. Warszawa (2026)
28. Laudan, R.: Geological Thought from Hutton to Suess. Science **219**(4582), p. 280 (1983)
29. Piskozub, A.: Eurazja czyli trzy części świata na jednym kontynencie, Przegląd Geopolityczny **4**, pp. 9–42 (2011)
30. Dunford, M.: Area definition and classification and regional development finance: the EU and China, https://www.sussex.ac.uk/webteam/gateway/file.php?name=area-definition-and-classification.pdf&site=2, last accessed 2026/04/04
31. Philbrick, A.K.: Principles of areal functional organization in regional human geography. Economic Geography (1957)
32. Nystuen, J.D., Dacey, M.F.: A graph theory interpretation of nodal regions, Regional Science Association, Papers and Proceedings **7**, pp. 29–42 (1961)
33. Drobne, S., Bogataj, M.: Evaluating Functional Regions, Croatian Operational Research Review **3**, 14–27 (2012)
34. Robison, M.H.: Defining a Functional Economic Region. EMSI Resource Library, http://www.economicmodeling.com/wpcontent/uploads/2007/10/wp_defining_functional_economic_region.pdf, last accessed 2025/04/24
35. Definition of Functional Urban Areas (FUA) for the OECD metropolitan database, https://www.oecd.org/cfe/regional-policy/Definition-of-Functional-Urban-Areas-for-the-OECD-metropolitan-database.pdf, last accessed 2026/04/04
36. Functional Economic Market Area Study. Final Report. Nathaniel Lichfield & Partners. Londyn (2015)
37. Goodchild, M.F., Noronha V.: Location-allocation and impuls shopping. The case of gasoline retailing. Spatial Analysis and Location-Allocation Models. In: A. Ghosh, G. Rushtob (eds.) Van Nostrand Reinhold. New York, pp. 121–136 (1987)
38. Noronha, V., Goodchild, M.F.: Modelling interregional interaction: implications for defining functional regions, Annals of the Association of American Geographers **82**, pp. 86–102. (1992)
39. Jones, C.A.: Spatial Economy and the geography of Functional Economic Areas. Environment and Planning B: Planning and Design **3**(44), pp. 486–503 (2017)
40. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Towards interoperability for European public services. COM 744 final. Brussels (2010), https://eur-lex.europa.eu/legal-content/EN/TXT/DOC/?uri=CELEX:52010DC0744, last accessed 2026/04/04

41. Jamaluddin, F., Saibani, N.: Systematic Literature Review of Supply Chain Relationship Approaches amongst Business-to-Business Partners. Sustainability **13**(21), 11935 (2021)
42. Kim, S. T., Lee, H.-H., Hwang, T.: Logistics integration in the supply chain: A resource dependence theory perspective. International Journal of Quality Innovation **6**(1), p. 5 (2020)
43. Prajogo, D., Oke, A., Olhager, J.: Supply chain processes: Linking supply logistics integration, supply performance, lean processes and competitive performance. International Journal of Operations & Production Management **36**(2), pp. 220–238 (2016)
44. Dubey, R., Gunasekaran, A., Childe, S. J., Blome, C., Papadopoulos, T.: Big data and predictive analytics and manufacturing performance: Integrating institutional theory, resource-based view and big data culture. British Journal of Management **30**(2), pp. 341–361 (2019)
45. Ji, X., Zhai, Y., Fu, S., Lu, C.: Towards the sustainable development of logistics system model: A system dynamics approach. PLOS ONE **18**(1), e0279687 (2023)
46. Govindan, K., Azevedo, S. G., Carvalho, H., Cruz-Machado, V.: Impact of supply chain management practices on sustainability. Resources, Conservation and Recycling 149, pp. 241–253 (2020)
47. Bányai, T., Tamás, P., Illés, B., Stankevičiūtė, Ž., Bányai, Á.: Optimization of logistics systems: A review of mathematical models and solution approaches. Sustainability **11**(3), p. 634 (2019)
48. Arshinder, A., Kanda, A., Deshmukh, S. G.: Supply chain coordination: Perspectives, empirical studies and research directions. International Journal of Production Economics **115** (2), pp. 316–335 (2008)
49. OECD Report. Realising the Potential of the Middle Corridor. OECD Publishing, Paris (2023)
50. ODI Report. The Middle Corridor: trends and opportunities. https://odi.org/en/insights/the-middle-corridor-trends-and-opportunities/, last accessed 2026/04/08
51. Greater consensus on improving the Middle Corridor. Strategic Comments, 29, ix - xii. (2023), https://www.semanticscholar.org/paper/Greater-consensus-on-improving-the-Middle-Corridor/, last accessed 2026/04/08
52. Popławki, K. et al.: Korytarz Środkowy eurazjatycka alternatywa wobec Rosji. OSW. Warszawa (2024)
53. Polish Economic Institute, https://pie.net.pl/wymiana-handlowa-w-i-kw-2025-utrzymuje-trendy-z-ostatnich-lat/, last accessed 2026/04/01
54. EBRD Report. Sustainable transport connections between Europe and Central Asia, European Bank for Reconstruction and Development, 30.06.2023, https://transport.ec.europa.eu/system/files/2023-06/Sustainable_transport_connections_between_Europe_and_Central_Asia.pdf, last accessed 2026/04/09