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TRANSPORT AND LOGISTICS SECURITY IN LANDLOCKED ECONOMIES: CONSTRAINTS, VULNERABILITIES, AND DIVERSIFICATION STRATEGIES

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Abstract

Landlocked economies depend on neighbours for every tonne that reaches the sea, yet their transport vulnerability is usually described only by distance. This paper asks which constraints and vulnerabilities shape transport and logistics security in landlocked economies, and how far diversification strategies have reduced them. Using a qualitative-comparative design in the IMRAD format, it synthesises scholarly studies and institutional reports, and compares five cases chosen for contrast: Kazakhstan, Uzbekistan, Ethiopia, Paraguay and Bolivia. Evidence is coded against three dimensions (route concentration, reliability and governance, diversification progress) and three risk types (neighbour dependence, natural hazard, external shock). The evidence indicates that (i) vulnerability follows concentration on one route or mode: about 90% of Ethiopia's international trade passes through Djibouti, and about 80% of Paraguay's grain exports moved by river in early 2024, when the river fell to 0.74 metres; (ii) diversification is real but gradual, as Bolivia's exports via Chile fell from 74.4% to 63.4% between 2018 and 2020 while Peru's share rose to 13.3%; and (iii) corridor investment in Central Asia raises transit volumes without removing dependence on neighbours' infrastructure and administration. The paper concludes that landlocked transport security depends on route choice, reliability and regional cooperation together, not on distance or infrastructure alone, and it proposes a harmonised panel for formal testing.

Keywords: landlocked economies, transport security, logistics, transit dependence, corridors, diversification

1. Introduction

Trade needs a way to the sea, and 32 countries do not have one of their own (United Nations, 2024). For these landlocked developing countries, every export and import crosses at least one foreign border, and the speed, cost and reliability of that crossing are set partly by other governments. The United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLLS, 2025) estimates that landlocked countries' exports are about 18% lower, and their Human Development Index scores about 19% lower, than they would be with sea access. The effect is not only about distance. Between March 2020 and roughly eighteen months later the cost of shipping a container on transoceanic routes rose seven-fold, and the same report cites evidence that inflation pass-through from freight costs is particularly high in landlocked developing countries (UN-OHRLLS, 2025).

Security of transport and logistics therefore means more than low cost. It means that goods can reach markets and inputs can reach producers on time, at predictable prices, even when a border closes, a river runs dry or a port is congested. The classic account by Faye et al. (2004) identified four types of dependence on neighbours: on their infrastructure, on cross-border political relations, on their peace and stability, and on their administrative practices. Each is a channel through which a shock outside the country becomes a logistics failure inside it.

Governments have responded. The Awaza Programme of Action for the decade 2024–2034, adopted by the UN General Assembly on 24 December 2024, names transit, transport and connectivity among its five priority areas (United Nations, 2024). Kazakhstan, Uzbekistan, Ethiopia, Paraguay and Bolivia are building rail links, dry ports, new port access and waterway options. Whether these measures lower vulnerability, or only add capacity to the same dependent routes, is unclear.

A gap remains. Existing studies estimate the cost of being landlocked, usually as a trade or income penalty, or describe a single corridor. Few compare countries that differ in region, trade structure and transit geography under one framework, and fewer link each country's specific vulnerability to the diversification it has actually achieved. Reliability, a factor that Arvis et al. (2010) place at the centre of landlocked countries' logistics costs, is rarely observed directly.

This paper therefore asks three questions. **RQ1:** What constraints characterise transport and logistics in landlocked economies? **RQ2:** Where does vulnerability concentrate in Kazakhstan, Uzbekistan, Ethiopia, Paraguay and Bolivia? **RQ3:** How far have diversification strategies reduced it? Three propositions are assessed qualitatively. **P1:** vulnerability follows concentration on a single route, mode or gateway. **P2:** diversification reduces dependence only gradually, because new routes start from a small base. **P3:** new corridors do not remove dependence on neighbours' infrastructure and administration. The thesis is that landlocked transport security depends on route choice, reliability and cooperation with neighbours together, not on distance or on infrastructure alone.

The paper proceeds as follows: Section 2 reviews the literature, Section 3 sets out the methods, Section 4 reports the results, Section 5 discusses them, and Section 6 concludes.

2. Literature Review

2.1 Geography and dependence on neighbours

Faye et al. (2004) argued that despite improvements in transport technology, landlocked developing countries still face structural barriers to world markets and often lag behind their coastal neighbours in development and trade. They attribute the gap partly to distance from the coast, but also to dependence on transit neighbours, which they divide into four types: infrastructure, cross-border political relations, peace and stability, and administrative practices. The strength of this framework is that it treats a landlocked country's logistics as partly outside its own control. Its limit is that it was written before the recent wave of corridor investment and does not measure how much dependence has fallen since.

2.2 Infrastructure and the cost of trade

Limão and Venables (2001) used several data sets to show that infrastructure is an important determinant of transport costs, particularly for landlocked countries. Their estimates put the elasticity of trade flows with respect to trade costs at about −3, and they found that worsening infrastructure from the median to the 75th percentile raises transport costs by 12 percentage points and cuts trade volumes by

28%. More recent work reviewed by UN-OHRLLS (2025) reaches similar conclusions from different angles: Jetter et al. (2019) find that lack of ocean access reduces GDP per capita by 13%, with better transport infrastructure partly offsetting the loss, and Rivero et al. (2020) find that institutional innovations could reduce the negative effect of landlockedness on GDP by 68%. The second finding points beyond physical infrastructure.

2.3 Reliability, governance and logistics services

Arvis et al. (2010) argue that traders in landlocked developing countries bear heavy logistics costs that weaken their competitiveness, and that these costs stem mainly from unreliable and unpredictable logistics. Poor reliability, in their account, is driven largely by rent-seeking and governance problems that tend to thrive in low-volume environments, so logistics and trade-services efficiency may matter more than heavy infrastructure spending. UN-OHRLLS (2025) supports the point: in its estimates, landlocked countries score about 7.8% lower on logistics performance, 9.66% lower on supply-chain traceability and 7.27% lower on customs efficiency than they would with sea access. This literature shifts attention from how much is built to how reliably the system runs.

2.4 Chokepoints, shocks and diversification

UNCTAD (2024) reports that combined Panama and Suez Canal traffic fell by over 50% from peak levels by mid-2024, because of conflict in the Red Sea region and low water in the Panama Canal, and that rising container rates hit the least developed countries and small island developing states hardest. The report does not single out landlocked countries, but they sit at the end of the same chains, so their exposure is plausibly larger, a point that needs direct evidence. On the supply side, the World Bank's Middle Corridor work, as reported in 2025, expects trade among Middle Corridor economies to grow by 150% in value from 2023 to 2040 and freight volumes to triple, while flagging that bottlenecks in the rail and port sectors remain significant obstacles (Report.az, 2025). Diversification is thus promoted widely, but its outcomes are measured mostly as forecasts.

2.5 Research gap

The literature is strong on the cost penalty of being landlocked and on the role of reliability, but weak in three respects. First, it seldom compares landlocked countries from different regions under one framework. Second, it rarely tracks diversification outcomes, such as changes in a gateway's share, against the vulnerability the diversification is meant to reduce. Third, it treats corridor investment and neighbour dependence separately. This paper addresses these gaps by comparing five contrasting cases on route concentration, reliability and diversification progress.

3. Methodology

3.1 Research design

The study uses a qualitative-comparative multiple-case design with three components: (1) a structured review of scholarly and institutional sources; (2) a comparison of one gateway or route-concentration indicator for each country; and (3) five country cases coded against common dimensions. A formal regression was considered and rejected: five countries, indicators measured for different gateways and years, and no harmonised annual series on reliability or transit times would make

conventional inference unreliable. The aim is to explain why landlocked economies with similar disadvantages face different vulnerabilities, not to estimate an average effect.

3.2 Case selection

The five countries were chosen purposively, to maximise contrast in region, transit geography and trade structure.

Country	Transit setting	Why selected
Kazakhstan	Large landlocked economy on China–Europe overland routes	Transit provider as well as transit user; Caspian and rail diversification
Uzbekistan	Doubly landlocked: two borders to cross to reach the sea	Corridor building to move from transit route to hub
Ethiopia	Landlocked since independence of Eritrea; single dominant port gateway	Concentration on one port (Djibouti) and one rail line
Paraguay	River-based exports to the Atlantic	Natural-hazard risk on a single mode
Bolivia	Several coastal outlets in neighbouring countries	Measurable shift of port shares over time

3.3 Indicators and data

For each country the study records the most relevant concentration indicator with its year and source: the share of overland transit handled (Kazakhstan), transit volume and its share of China–Europe traffic (Uzbekistan), the share of international trade passing through one port (Ethiopia), the share of grain exports moving by river (Paraguay) and the shares of exports via Chilean and Peruvian ports (Bolivia). These indicators are not interchangeable and are not ranked as numbers. Where available, the World Bank's Logistics Performance Index (LPI) score is given as a general context indicator, with its year, because the latest edition could not be retrieved for all five countries. Diversification progress is measured by changes in these shares and by documented projects, not by announced targets alone.

3.4 Source search and inclusion

Searches in November 2026 combined the terms landlocked, transit, logistics, corridor, dry port, Djibouti, Middle Corridor, Paraguay River, Bolivia ports and each country name, using web searches of publisher, repository and institutional records. Sources were included if they (a) addressed transport costs, reliability, concentration or diversification in landlocked economies; (b) were peer-reviewed or issued by an international or national institution; and (c) gave a figure or mechanism that could be traced to a date. Trade-press items were used only for facts attributed there to an official or industry source, and are flagged in the text and references.

3.5 Analysis

Evidence was coded against three dimensions (route concentration, reliability and governance, diversification progress) and three risk types (neighbour dependence, natural hazard, external shock). Ratings use three levels (higher, moderate, lower) assigned by the author from the evidence in Section 4; where a source gave no figure the cell is marked not documented and not rated. Each proposition was then rated supported, partly supported or not testable according to the number, quality and consistency of the evidence.

3.6 Ethical considerations

No human participants were involved, and all data are secondary and public, so ethical approval and informed consent were not required. Limitations are discussed in Section 5.3.

4. Results

4.1 Evidence base

Table 1 lists the studies and reports that form the conceptual and empirical base.

Table 1. Sources used for the framework (author's synthesis)

Study	Context and method	Main finding	Dimension
Faye et al. (2004)	Conceptual and regional overview of landlocked developing countries	Four types of dependence on neighbours: infrastructure, political relations, peace and stability, administrative practices	Neighbour dependence
Limão & Venables (2001)	Several data sets; bilateral trade analysis	Poorer infrastructure raises transport costs and cuts trade; matters most for landlocked countries; trade elasticity about −3	Infrastructure
Arvis et al. (2010)	World Bank study of landlocked developing countries	High logistics costs stem mainly from unreliability, driven by rent-seeking and governance problems	Reliability
UN-OHRLLS (2025)	Artificial-benchmark model of the cost of landlockedness	Exports about 18% lower; logistics performance about 7.8% lower	Reliability
UNCTAD (2024)	Annual maritime review	Suez and Panama traffic fell by over 50% by mid-2024; LDCs and SIDS hit hardest	External shock
Report.az (2025), reporting the World Bank	Middle Corridor outlook	Trade value up 150% and volumes triple by 2040 (forecast); rail and port bottlenecks remain	Diversification

4.2 Route concentration and diversification by country

Table 2 gives the main indicator for each country, with the year and source. The figures describe different gateways and periods, so they are read as profiles and not ranked.

Table 2. Concentration and diversification indicators

Country	Concentration indicator	Diversification evidence	LPI (overall score, rank; year)
Kazakhstan	About 85% of overland transit between Western Europe and Western China (2026 statement)	Trans-Caspian container volumes up 36% in 2025; 42,000 TEU moved by Kazakhstan along it; Aktau and Kuryk capacity to rise from 80,000 to 300,000 TEU by 2029	2.81, 69th (2018)
Uzbekistan	Share of China–Europe transit freight only 1–2%; 15.3 Mt of transit in 2025	China–Kyrgyzstan–Uzbekistan railway: about US$4.7 bn, 523 km from Kashgar to Andijan, up to 15 Mt a year; financing agreement signed December 2025	2.58, 100th (2018); rank reported as improved from 129th to 88th between 2014 and 2023
Ethiopia	About 90% of international trade through Djibouti's ports	Addis Ababa–Djibouti railway: 1.8 Mt in 2024 and 3.2 Mt in 2025; rail 14% of total cargo, trucks 84%	2.38, 134th (2016)
Paraguay	About 80% of grain exports moved by river in Q1 2024	Not documented in the sources used	2.78, 75th (2018)
Bolivia	Exports via Chile: 74.4% (2018), 66.7% (2019), 63.4% (2020)	Exports via Peru: 7.4%, 10.8%, 13.3%; Atlantic waterway carried 1.37 Mt of exports in 2019	2.36, 136th (2018)

4.3 Country evidence

Kazakhstan. Kazakhstan handles about 85% of overland transit between Western Europe and Western China, according to the prime minister's statement reported in April 2026 (Astana Times, 2026). Trans-Caspian container volumes rose 36% in 2025, Kazakhstan moved 42,000 TEU along the route, transit times are around 18 days against a long-term target of 10, and the government targets 100 Mt of transit a year by 2035 (Astana Times, 2026). The World Bank's Middle Corridor work, as reported, records freight up 62% to 4.5 Mt in 2024, with 5.2 Mt expected in 2025 and capacity possibly reaching 10 Mt a year by 2027 (Report.az, 2025).

Uzbekistan. Uzbekistan is one of only two doubly landlocked countries, and an official quoted in September 2026 puts transport at around 20% of its import and export costs (CGTN, 2026), a figure that is attributed to the speaker and not independently verified here. Transit cargo reached 15.3 Mt in 2025, up 54% from 2021, yet the country's share of China–Europe transit freight is only 1–2% (Times of Central Asia [TCA], 2026). Of 27 logistics centres that meet international standards, only one is in the highest category, and class A automated warehouses meet 10–15% of demand (TCA, 2026). The China–Kyrgyzstan–Uzbekistan railway, about US$4.7 bn and 523 km from Kashgar to Andijan, had a financing agreement signed in December 2025 with China holding 51% and Kyrgyzstan and Uzbekistan 24.5% each

(TCA, 2026). The World Bank is reported to have approved a US$200 million project in March 2026 for transport infrastructure in Surkhandarya (TCA, 2026).

Ethiopia. About 90% of Ethiopia's international trade moves through Djibouti's ports (Further Africa, as reported by Kana Television, 2026). The railway carried 1.8 Mt in 2024 and 3.2 Mt in 2025, a rise of 78% (The Diplomat, as reported by Kana Television, 2026), but rail handles only 14% of total cargo, with trucks carrying 84% (The Reporter Ethiopia, as reported by Kana Television, 2026). The railway's design capacity is reported as 11.2 Mt a year (GIHub, as reported by Kana Television, 2026).

Paraguay. About 80% of Paraguay's grain exports moved along rivers in the first quarter of 2024, according to the grain-exporters' association CAPPRO (Reuters, 2024). The Paraguay River near Villeta stood at 0.74 metres, against more than 5 metres a year earlier, and the Reuters report notes that levels that had been near zero remained critical. Soybean exports in the quarter were 2.5 Mt, up from 1.6 Mt, with a record 10.4 Mt crop forecast; exports slowed in March as water levels dropped (Reuters, 2024).

Bolivia. The share of Bolivian exports (by tonnage) passing through Chilean ports fell from 74.4% in 2018 to 66.7% in 2019 and 63.4% in 2020, while the share via Peruvian ports rose from 7.4% to 10.8% and 13.3% (University of Navarra, n.d.). Flows through Peruvian ports rose 57.7% between 2018 and 2019. The Paraguay–Paraná waterway via Canal Tamengo carried 1,370,903 t of exports and 740,473 t of imports in 2019. A customs broker quoted in the source says that what moves through Peru is under 15%.

4.4 Assessment of the propositions

Table 3. Assessment of the propositions

Proposition	Evidence	Assessment
P1: Vulnerability follows concentration on a route, mode or gateway	Ethiopia about 90% through one port; Paraguay about 80% of grain by river with a 0.74 m river level; Bolivia 63–74% via Chile	Supported
P2: Diversification reduces dependence only gradually	Bolivia's Chile share fell 11 points in two years; Ethiopia's rail carries 14% of cargo; Uzbekistan 1–2% of China–Europe transit	Supported (Bolivia is the only case with a time series)
P3: New corridors do not remove dependence on neighbours	CKU railway runs through Kyrgyzstan with shared ownership; Ethiopia's rail ends at Djibouti; Middle Corridor depends on Caspian and Caucasus links	Partly supported (qualitative; no outcome measure)

5. Discussion

5.1 Interpretation

The evidence answers the research questions in a qualified way. On RQ1, the constraints that recur are heavy dependence on a single gateway, route or mode, and reliance on neighbours' infrastructure and administration, which is the pattern Faye et al. (2004) describe. On RQ2, vulnerability concentrates in different places: in one port and one rail line for Ethiopia, in a river that can fall to 0.74 metres for Paraguay, in the border and rail links that connect Uzbekistan to China and Europe, and in the share of Chilean ports in Bolivia's exports. Kazakhstan differs in that it is both a transit user and a transit provider,

handling about 85% of overland transit between Western Europe and Western China, so its exposure is also to the competitiveness of its own corridor.

On RQ3, diversification is visible but gradual. Bolivia is the clearest case: the Chilean share fell by 11 percentage points in two years and the Peruvian share nearly doubled, yet Chile still handled 63.4% of exports in 2020. Ethiopia's railway carried 3.2 Mt in 2025, up 78%, yet rail handles only 14% of total cargo. In Central Asia the headline numbers are growth numbers, not dependence numbers: Uzbekistan's transit grew 54% in four years but remains a small share of China–Europe transit freight, and the new railway is still at the financing stage.

5.2 Comparison with the literature and implications

The results fit Faye et al. (2004): each case shows at least one of the four dependences. They also fit Arvis et al. (2010) on reliability, in a particular way: Paraguay's problem is not distance or capacity but the variability of one natural route, and Uzbekistan's reported weakness is the quality of warehouses and logistics centres, not only the length of the rail network. Limão and Venables (2001) emphasise infrastructure; the cases suggest that infrastructure widens options only when services and governance allow them to be used, which is consistent with the finding reviewed by UN-OHRLLS (2025) that institutional innovation could offset much of the landlocked penalty. UNCTAD's (2024) evidence on Suez and Panama shows that even maritime chains can fail, so a landlocked economy that has reached a port is not yet secure.

Three policy implications follow. First, measure route concentration directly and publish it, by gateway and by mode, so that diversification can be tracked. Second, treat reliability and services, including warehousing, customs and corridor management, as part of the investment programme, not as an afterthought to it. Third, negotiate shared governance with neighbours, as the CKU railway's ownership structure does, because infrastructure built across borders is only as secure as the agreements that govern it.

5.3 Limitations and future research

The study relies on secondary evidence and estimates no causal effects. The indicators are not harmonised: they describe different gateways and years. Several figures come from trade-press reports that attribute them to officials or other outlets, including the Ethiopian figures reported by Kana Television; the same source also states that rail's share of Ethiopian exports rose from 9% to 50% in two years, which conflicts with the 14% of total cargo reported elsewhere and has not been used. A cargo share and an export share are different measures, but the gap was not resolved. The LPI scores date from 2016 to 2018 and the latest edition could not be retrieved for all five countries. Another source reports the China–Kyrgyzstan–Uzbekistan railway as having opened (CGTN, 2026), while financing documents point to the project still being at the agreement stage; the more specific financing account is used here. The ratings are the author's judgement. Future research should build a harmonised panel using World Bank LPI components, UN Comtrade data on gateway shares, border-crossing times and corridor transit times, with outcome measures such as the share of trade through the largest gateway and landed freight costs. Interviews with freight forwarders and customs officials would help explain why diversification is slow.

6. Conclusion

Transport and logistics security in landlocked economies is best understood as the product of three things: how concentrated the routes are, how reliably they work, and how much of the system depends on neighbours. Kazakhstan, Uzbekistan, Ethiopia, Paraguay and Bolivia show five versions of the problem. Ethiopia and Paraguay depend on one port or one river for most of their trade; Bolivia shows that a share of trade can be moved to other ports, but slowly; Kazakhstan and Uzbekistan show that growing corridor volumes do not by themselves end dependence on other countries' infrastructure and rules. These findings support the thesis that distance and infrastructure alone do not explain landlocked transport security.

The wider lesson is that diversification should be judged by outcomes, not announcements: the falling share of the largest gateway, the rising reliability of the alternatives, and the agreements that keep them open. Until comparable annual data on gateway shares and transit times exist for these countries, the argument made here can be defended but not fully tested.

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