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## Transport Infrastructure and Territorial Competitiveness As Drivers of Sustainable Regional Development: Evidence from Central Asia and Uzbekistan

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**Abstract:** The paper analyzed the impact of transport infrastructure and territorial competitiveness on sustainable regional development, using Central Asia and Uzbekistan as a case study. The research integrated public capital theory, new economic geography, and Porter's competitiveness framework into a unified analytical model. Empirical analysis was based on the World Bank's 2023 Logistics Performance Index, providing a comparative assessment of regional economies. The findings showed that transport quality affected competitiveness through three key channels: cost reduction, integration into value chains, and increased investment attractiveness. Uzbekistan's significant improvement in LPI ranking during 2016–2023 was attributed to institutional reforms and infrastructure development. The study proposed a corridor-based specialization model and identified policy directions to support sustainable regional growth.

**Keywords:** transport infrastructure, competitiveness, logistics, LPI, regional development, Central Asia, corridors

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### 1. Introduction

Transport infrastructure has long been regarded as a foundational determinant of where economic activity locates, how regions specialise, and at what cost firms access distant markets. The argument that high-quality public capital exerts first-order effects on productivity was formalised by Aschauer and has since been refined by a substantial body of empirical work. For landlocked emerging economies, the question carries additional weight: distance to seaports, the thickness of the road and rail network, and the institutional quality of cross-border logistics jointly shape the integration of regions into international value chains [1].

Territorial competitiveness, in the Porterian tradition, captures the capacity of a place to mobilise productivity-enhancing conditions for firms; at the regional scale, it expresses the ability to attract, retain and reallocate productive resources. Logistics quality, corridor throughput and the stability of shipping costs constitute observable, policy-relevant proxies of this capacity. The Global Competitiveness Report has consistently treated transport infrastructure as a first-pillar component of competitiveness, while the OECD/ITF outlook documents a strong correlation between transport network quality and aggregate growth.[2]

Despite the breadth of evidence from advanced economies and selected large emerging markets such as China and India, the theoretical and empirical literature on the transport - competitiveness - sustainability nexus remains comparatively thin for Central

Asia. The region combines several features that make it a useful, and arguably understudied, laboratory: double landlockedness in the case of Uzbekistan, ongoing institutional transformation, an active corridor-building agenda under the CAREC programme, and visible reform-driven gains in logistics performance over the past decade.[3]

Three research questions guide the present study. First, through which channels do transport-infrastructure quality and logistics performance translate into territorial competitiveness in landlocked emerging settings? Second, how do Central Asian economies, and Uzbekistan in particular, currently position themselves on comparable international logistics indicators? Third, which corridor- and cluster-based policy levers can convert observed logistics gains into sustainable regional development outcomes?[4]

The contribution of the paper is threefold. Conceptually, it integrates the new economic geography view of transport costs with Porter's competitiveness framework and Banister and Berechman's conditionality thesis into a single transmission model, and operationalises that model through the six LPI dimensions. Empirically, it supplies an up-to-date comparative reading of the 2023 LPI scores for Central Asian economies and traces Uzbekistan's thirty-rank improvement to a sequence of policy reforms documented in primary sources. Normatively, it derives a corridor-based specialisation typology for the regions of Uzbekistan and three concrete policy directions for converting logistics gains into sustainable regional outcomes.[5]

The remainder of the paper is organised as follows. Section 2 develops the theoretical background and reviews the empirical literature. Section 3 describes the data and analytical approach. Section 4 presents the comparative findings and the conceptual transmission model. Section 5 discusses theoretical, policy and methodological implications. Section 6 concludes.

### **Theoretical Background and Literature Review**

#### **Foundational theories of the transport - economy link**

The modern theoretical case for treating transport infrastructure as a productivity-enhancing public input dates to Aschauer who showed that core public capital exerts a high marginal product on private output. Subsequent work generalised this insight in macroeconomic and regional growth models and placed transport investment among the most consequential categories of public capital. The result has been broadly robust across estimation strategies, even as the size of the elasticity has been refined downward in later studies that controlled for endogeneity.[6]

The new economic geography (NEG) literature initiated by Krugman reframes the question in spatial terms. Falling transport costs, in this framework, reinforce agglomeration up to a threshold, after which dispersion forces become dominant. The model offers a clean rationale for the observed coexistence of core - periphery patterns and gradual catch-up by peripheral regions, and it identifies transport policy as a determinant of the spatial equilibrium itself, not merely a marginal adjustment to it.[7]

A complementary line of work, exemplified by Banister and Berechman cautions that the link between transport investment and economic outcomes is conditional. Their evidence indicates that transport spending only translates into productivity gains when accompanied by mature market mechanisms, an investment-ready environment and adequate institutional capacity. The conditionality thesis is central for emerging-economy applications, where the marginal impact of physical infrastructure can be muted by institutional bottlenecks at borders, customs and logistics interfaces.

Rodrigue provides the geographic-systems view that ties the previous strands together: the transport network is the spatial organiser of production, distribution and consumption, with multimodal hubs, ports and terminals serving as the nodal points through which regions plug into international value chains. From the Porter perspective, the same nodes shape the locational diamond on which firm-level productivity rests. Read jointly, these theories suggest that transport quality matters less as a stand-alone amenity and more as a relational variable embedded in institutional and market environments.[8]

### **Empirical evidence on transport, growth and competitiveness**

Empirical estimates across heterogeneous settings have been broadly consistent with the theoretical priors. Using panel data for the EU-28, Cigu et al. reported a robust long-run positive effect of transport infrastructure development on GDP, mediated by public-sector performance. For India, Pradhan and Bagchi used a vector error-correction model to identify a causal effect of road and rail infrastructure on output, with bidirectional dynamics over the long horizon. In Portugal, Holl documented a positive association between motorway proximity, agglomeration economies and firm birth rates, suggesting that improvements in connectivity translate into endogenous business creation rather than only displacing existing activity.

International organisations have placed comparable findings in a policy frame. The World Bank Logistics Performance Index reports across six dimensions - customs efficiency, infrastructure quality, ease of arranging international shipments, logistics services quality, timeliness, and tracking and tracing - and its 2023 edition documents widening dispersion between top performers and low-income, landlocked economies. UNCTAD emphasises that maritime and multimodal corridors carry the bulk of international trade, while the OECD/ITF outlook quantifies the long-run elasticity of transport demand to economic growth in major regions.[9]

For Central Asia, the most policy-relevant lens is the CAREC Transport Strategy 2030, which prioritises six economic corridors and a shared transport-logistics space among member states (Asian Development Bank, 2020). Four of these corridors traverse Uzbekistan, situating the country at a structurally advantageous node and creating measurable spillovers for its regions.

### **Research gap and conceptual framework**

Three gaps emerge from the synthesis. First, much of the empirical literature on the transport - growth link is anchored in advanced economies or in large emerging markets with seaboard access; comparable conceptual work for landlocked Central Asian economies is sparse. Second, the productive capital, NEG and Porterian strands are typically deployed in isolation rather than integrated into a single transmission framework that explains both why and how transport quality maps onto territorial competitiveness. Third, policy-oriented work rarely connects observed LPI movements to a corridor-based specialisation typology at the sub-national level.

The present paper addresses these gaps by proposing a three-stage transmission framework: transport-infrastructure quality → territorial competitiveness → sustainable regional development, with a feedback loop in which sustained regional growth funds further transport investment. The framework is presented graphically in Figure 1 (Section 4) and operationalised through the six LPI dimensions.[10]

## **2. Materials and Methods**

### **Research design**

The research design combined a structured literature synthesis with a comparative cross-country analysis grounded in publicly available secondary data. A theory-building strategy was adopted in light of the data limitations that characterise sub-national time series in Central Asia and the corresponding preference, in the regional-economics tradition, for conceptual integration over high-frequency econometrics in early-stage empirical settings.

### **Data sources**

Comparative logistics performance was measured using the World Bank LPI 2023, which aggregates six dimensions on a 1 - 5 scale and is constructed from a global survey of international freight forwarders and logistics operators. Macro-level competitiveness context was drawn from the Global Competitiveness Report and the ITF Transport Outlook. Corridor-level information was sourced from the CAREC Transport Strategy 2030. National statistics for Uzbekistan were obtained from the State Statistics Committee while policy context was anchored in the Development Strategy of New Uzbekistan for 2022 - 2026. UNCTAD data complemented the analysis on global maritime and multimodal flows.[11]

### Analytical approach

The analysis proceeded in three steps. First, the literature was systematised into a single transmission framework with three latent constructs (transport quality, territorial competitiveness, sustainable regional outcomes) and observable proxies for each. Second, a comparative reading of LPI 2023 scores positioned Uzbekistan against its closest regional peers (Kazakhstan, Tajikistan and the Kyrgyz Republic), with attention to dimension-level patterns rather than aggregate scores alone. Turkmenistan was excluded from the country comparison because it is not covered by LPI 2023. Third, the Uzbek case was examined at the sub-national level through a corridor-based specialisation typology, mapping each macro-region to its dominant export or service profile.

Robustness was enhanced by triangulating across independent data producers (World Bank, ADB, UNCTAD, OECD/ITF, national statistics), by drawing on both theoretical and empirical literatures, and by formalising the transmission model in a way that allows future replication with sub-national panel data once these become available.[12]

## 3. Results and Discussion

### Results

#### Logistics performance in Central Asia

The 2023 edition of the World Bank Logistics Performance Index places the four covered Central Asian economies within the global mid-range, but with a clear internal gradient (Table 1). Kazakhstan leads the sub-region with an aggregate score of 2.7 and a global rank of 79; Uzbekistan follows with 2.6 and rank 88; Tajikistan scores 2.5; the Kyrgyz Republic scores 2.3. Disaggregation by dimension shows that the regional weakness is concentrated in tracking and tracing and, to a lesser extent, in physical infrastructure, while timeliness and the quality of logistics services hold up comparatively well.[13]

**Table 1.** Logistics Performance Index scores of Central Asian economies, 2023.

Country	Overall LPI	Customs	Infra structure	Int'l shipments	Logistics quality	Time liness	Tracking & tracing
Kazakhstan	2.7	2.6	2.5	2.6	2.7	2.9	2.8
Uzbekistan	2.6	2.6	2.4	2.6	2.6	2.8	2.4
Tajikistan	2.5	2.2	2.5	2.5	2.8	2.9	2.0
Kyrgyz Republic	2.3	2.2	2.4	2.4	2.2	2.4	2.3

Notes: Scores measured on a 1 (low) to 5 (high) scale. Turkmenistan is not covered in LPI 2023 and is therefore excluded. **Source:** compiled by the author from World Bank (2023).

Two patterns merit emphasis. The first is the magnitude of Uzbekistan's reform-led improvement: the country advanced from rank 118 in LPI 2016 to rank 88 in LPI 2023, one of the more pronounced single-country gains globally over the period. The second is that the remaining gap relative to Kazakhstan is concentrated in the dimensions most amenable to digital and institutional reform - tracking and tracing, infrastructure quality, and ease of international shipments - rather than in fundamentals that would require multi-decade build-out. This combination suggests a relatively short pathway to convergence on the sub-regional logistics frontier.

#### Channels of the transport - competitiveness link

Figure 1. Three transmission channels connect transport quality to territorial competitiveness in the integrated framework. First, a cost channel: lower freight and time costs improve the price competitiveness of regional output, in line with the NEG mechanism articulated by Krugman. Second, a value-chain channel: reliable and timely shipping enables regional firms to enter just-in-time production and distribution

networks, a precondition for value-chain integration documented across emerging-economy studies. Third, a locational-attractiveness channel: transport hubs raise the marginal product of co-located private capital and stimulate firm birth, as shown empirically by Holl for Portugal and consistent with Porter ' s diamond. The three channels are complementary: gains in cost competitiveness without value-chain integration risk low-margin commodity export specialisation, while connectivity without institutional reform yields underutilised corridors.

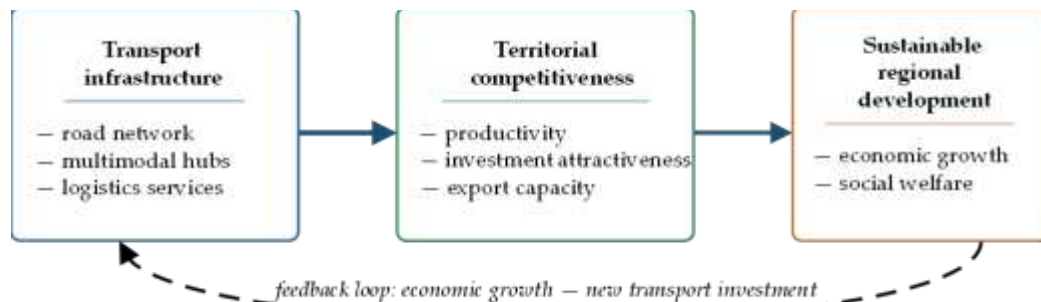


Figure 1. Conceptual model linking transport infrastructure, territorial competitiveness and sustainable regional development.

Source: developed by the author, building on Rodrigue (2020).

### Sub-national patterns and corridor-based specialisation in Uzbekistan

A practical reading of the framework at the sub-national level for Uzbekistan suggests a coherent corridor-based specialisation typology. Tashkent City and Tashkent Region operate as the primary multimodal hub of the national network. Sirdaryo and the Fergana Valley function as agro-industrial export corridors, with high potential for processed-food and light-industry value chains. Karakalpakstan and Khorezm align with the international tourism corridor anchored on the Aral and Khiva landscapes. Bukhara and Samarkand specialise as cultural tourism corridors of global salience. Surkhandarya and Kashkadarya combine energy and industrial freight functions linked to neighbouring markets. The typology is consistent with the policy priorities articulated in the Development Strategy of New Uzbekistan and with the corridor logic of the CAREC Transport Strategy 2030.[14]

The strategic significance of this typology lies in the alignment between logistics performance gains and the comparative advantage of each macro-region. Four of the six CAREC economic corridors traverse Uzbekistan, providing a structural advantage that, when combined with the digital and institutional reforms reflected in the LPI gain since 2016, supports a credible pathway to regional convergence within the sub-region.

### Discussion

#### Theoretical implications

The findings support an integrated reading of the transport - competitiveness link. The cost-channel result is consistent with Krugman's NEG mechanism, the value-chain finding aligns with the Banister and Berechman conditionality thesis, and the locational-attractiveness pattern echoes the Porter diamond. The integration into a single three-stage transmission model, with a feedback loop from sustained regional growth back to transport investment, offers a parsimonious vehicle for sub-national applications in landlocked emerging settings where the productive-capital, NEG and competitiveness literatures have until now been deployed largely in isolation.

#### Policy implications

Three actionable directions follow from the findings. The first is corridor-based multimodal upgrading along the Tashkent - Samarkand - Bukhara - Khiva axis, encompassing accelerated rail and road service, shared digital logistics platforms, and the full digitalisation of transport documentation. The second is the formation of regional logistics clusters tied to the corridor-based specialisation typology presented in Section 4.3 - agro-export hubs in Sirdaryo and Fergana, tourism logistics systems in Karakalpakstan and Khorezm, and energy-industrial freight corridors in Surkhandarya

and Kashkadarya. The third is the consolidation of a unified transport-logistics data space within the CAREC framework, including harmonised customs declarations, mutual recognition of transport documents and common service-quality standards.[15]

#### 4. Conclusion

The paper integrates the productive-capital, new economic geography and competitiveness traditions into a three-stage transmission framework that links transport infrastructure to sustainable regional development through territorial competitiveness. The framework is operationalised through the six dimensions of the World Bank Logistics Performance Index and applied comparatively to the four LPI-covered Central Asian economies, with sub-national reading focused on Uzbekistan.

Three findings stand out. Central Asian economies cluster within the global mid-range of logistics performance, with Kazakhstan and Uzbekistan leading the sub-region. Uzbekistan recorded one of the strongest reform-led improvements globally between 2016 and 2023. Three theoretically grounded transmission channels - cost, value-chain and locational-attractiveness - connect transport quality to regional gross product, investment inflows and export capacity in the integrated framework.

The policy contribution is a corridor-based specialisation typology for the regions of Uzbekistan and three concrete reform directions within the CAREC framework. The methodological contribution is the formalisation of a transmission model that is portable across landlocked emerging settings and ready for empirical extension once sub-national panel data become available.

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