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STRATEGIC OPERATIONS MANAGEMENT AND INSTITUTIONAL SUSTAINABILITY: A CULTURAL ANALYSIS OF SUPPLY CHAIN PRACTICES

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ABSTRACT

This study analyzes how this national cultural orientation affects the institutional sustainability, and how the institutional sustainability affects the supply chain performance among countries. In the context of growing global interdependence and the complexity of supply chains, an understanding of the macro-level drivers of logistics competitiveness has become important. Supply chain performance is measured through the Logistics Performance Index (LPI), institutional sustainability is operationalized through a composite index as a result of the Worldwide Governance Indicators, and national culture is represented through the Hofstede dimensions summarized through principal component analysis. The design of a multi-country panel for seven waves (2007-2022) is adopted. The merged LPI-WGI core panel contains 169 countries and after using cultural data and applying a minimum coverage rule the final analytical sample contains 37 countries and 252 country-year observations. Robust OLS results show that cultural components significantly predict institutional sustainability on opposite directions. Two-way fixed effects models show that there is a significant positive impact of institutional sustainability on LPI and lagged specifications test for temporal robustness. Between-country models show institutional

sustainability to be the most important source of cross-national variation in logistics performance, with cultural influences working mainly through institutions.

KEYWORDS: Logistics Performance; Institutional Sustainability; National Culture; Governance Quality; Panel Data Analysis.

1. Introduction

Strategic operations management has moved from being a firm-centric discipline to a more system-level view of the role of national infrastructures, governance environments and institutional quality on supply chain competitiveness. In a world economy that is becoming more and more global, logistics capability is an essential not just an enabler of trade integration or economic performance. The Logistics Performance Index (LPI) developed by the World Bank is an index to fully measure the effectiveness of national logistics, which includes customs efficiency, infrastructure quality, reliability of international shipping, logistics competence, tracking, and timeliness (Arvis et al., 2010). Countries with better logistics systems are more competitive in the global market and more capable of being within international value chains. Empirical research also further proves that the logistics performance has a high impact on trade volume and economic integration which further shows the strategic importance of the efficiency of the supply chain at the macro level (Hausman et al., 2013).

Simultaneously, the complexity of global supply chains has increased as a result of digital transformation, technological disruption and increased systemic interdependence. The diffusion of Industry 4.0 technologies has multiplied the connectivity of the network and raised the vulnerability to the ripple effects and cascading disruptions (Ivanov et al., 2019). Such complexity cannot be managed without operational integration as well as stable governance environments in which coordination and mitigation of risks can be achieved. Theoretical work on supply chain uncertainty is geared toward the integration mechanisms improving performance in volatile situations (Flynn et al., 2016). However, integration is influenced by wider institutional factors which influence regulatory predictability, transparency and enforcement reliability.

Beyond efficiency and integration, sustainability has become a strategic imperative of defining proportions. Contemporary supply chains are destined to strike a balance between economic competitiveness, environmental and social responsibility. Sustainable supply chain management research has argued that long-term performance requires that one makes sustainability a part of one's core operational strategies rather than as peripheral compliance (Montabon et al., 2016). The adoption of sustainable practices, however, are influenced by institutional pressures as well as stakeholder expectations and governance structures which shape the organizational behavior (Sarkis et al., 2010). This highlights the importance of institutional sustainability - the durability, effectiveness and accountability of governance systems - as a basic determinant of supply chain practices and outcomes.

Institutional sustainability is closely linked to the overall interplay between the power of the state and societal norms. Institutional capabilities to institute rules and safeguard property rights and accountability are what define whether the markets operate effectively and fairly. The equilibrium between the power of the state and the cooperation of the society plays a central role in maintaining prosperity and stability (Acemoglu & Robinson, 2019). In the supply chain domains, the presence of strong institutions involves low transaction uncertainty, low risk of corruption, and higher efficiency of coordination, thereby promoting logistics competitiveness. Weak institutions on the other hand can lead to inefficiencies, regulatory uncertainty, and operational disaggregation, which ends up limiting the performance of a national supply chain.

Despite the intensive studies on the performance of logistics, integration of the supply chain, and sustainability, empirical research has little been conducted to systematically associate institutional sustainability with supply chain outcomes at the national level. Operations management studies regularly center on firm-level practices, whereas institutional analyses tend to concentrate on economic growth instead of operational competitiveness. This disconnectedness leaves an important theoretical and empirical gap. In an era of geopolitical volatility, digital transformation and pressures for sustainability, understanding the role that the quality of institutions plays in shaping strategic supply chain performance is increasingly critical.

This study helps to address that gap by combining perspectives from the fields of strategic operations management and institutional theory in order to examine the degree of institutional sustainability in national logistics performance. By placing the quality of governance as a structural enabler of supply chain competitiveness, the research broadens traditional operations frameworks beyond the boundaries of the organization to the macro-level. The research adds to the body of

theory by relating institutional sustainability to quantifiable logistics consequences and identifies governance as a strategic factor in operational effectiveness.

The scope of the study is limited to country-level analysis on the basis of internationally recognised indicators on logistics and governance. Although it allows cross-national comparison and revealing generalities, this macro approach does not reflect the heterogeneity of firms or operational peculiarities in their sector. Moreover, institutionalized measures of governance might not be complete when it comes to capturing informal institutional forces. However, comparability and analytical rigor is assured by the application of international standard indicators.

The importance of this research is the interdisciplinary contribution it has provided. By linking the strategic operations management with the institutional sustainability, the research enhances the understanding of how governance structures are the foundation of the competitiveness of supply chains. It gives policy relevant information on needed institutional reforms to improve logistics performance and provides a structural lens for scholars to analyse operational sustainability in global networks. In addition to economic consequences, this study understands logistics systems as techno-social infrastructures imbedded in national cultural and institutional situations. The digital era has made supply chains coordinating systems in the society dependent on the effectiveness of regulations, trust and transparency. Institutional sustainability is therefore an ability of a society to transform technological modernization into reliable and responsible operation systems. The study connects the cultural settings to the institutional quality and logistics performance, which adds to the knowledge of how the technological systems work in the greater societal value systems. In this regard, national logistics systems can be taken to mean as the part of the modern digital culture, in which technological infrastructures are the refractors and redefiners of the patterns of social coordination and institutional learning.

The following are the main research objectives for this study:

- To investigate the link between institutional sustainability and national supply chain performance.
- To analyse the impact of governance structures on national logistics competitiveness.
- To assess the importance of institutional sustainability as a structure enabler of strategic operations results at the country level.

From the point of view of a scientific culture, national logistics systems constitute techno-social infrastructures in which digital technologies, institutional norms and cultural values co-evolve. Their effectiveness is not solely dependent on physical assets but depends on the quality of governance, transparency, and trust of society too. By relating the cultural dimensions with the institutional sustainability and the logistics performance, this study contributes to the understanding of how technological systems get embedded in the broader social and cultural structures.

2. Literature Review

The literature on strategic operations and supply chain management has gradually begun to move beyond efficiency and cost optimization towards the factors of sustainability, resilience, institutional governance, and cultural dynamics. Modern supply chains exist in complex global systems, where environmental responsibility, regulatory stability and societal norms interact in the process of determining performance outcomes. As a result, there is an increasing recognition in supply chain research that success in operations is embedded in much wider institutional and socio-cultural context.

Sustainable supply chain management (SSCM) is a theme of recent scholarship. Ahi and Searcy (2015) give a systematic analysis of the performance metrics applied in green and sustainable supply chains, and prove that in order to evaluate sustainability, multidimensional indicators that address the dimensions of environment, economy and society are needed. Their analysis points to the need to move beyond traditional measures of cost and service to integrated approaches to measuring sustainability. Complementing this view, Pagell and Shevchenko (2014) make the important yet critical point that sustainability research should challenge conventional growth assumptions and fundamentally redesign supply chain systems rather than incremental improvements. These insights highlight that sustainability is not about what is on the outside of the strategy but is at its core, regarding long term operational viability.

The increasing susceptibility of global supply networks has given increased focus to the issues of resilience and survivability. Ivanov and Dolgui (2020) introduce the notion of supply chain viability which is an extension of resilience focused on the capacity of networks to adapt and survive under extended disruptions. Their model

highlights the fact that the structural flexibility and coordinated governance mechanisms are critical towards performance sustainability in unpredictable environments. In parallel, the digital transformation has transformed the manufacturing and logistics systems. De Sousa Jabbour et al. (2018) How industry 4.0 technologies can support environmentally sustainable manufacturing when harmonized with organizational capabilities and governance structures. Together, these studies conclude that technological advancement is neither sufficient nor innovation delivers without an institutional alignment that will translate innovation into sustainable operational performance.

Institutional governance forms the basis of supply chain environments. The Worldwide Governance Indicators offer commonplace measures of regulatory quality, government effectiveness, rule of law, and control of corruption that make it possible to compare institutional quality on a cross-national basis (Kaufmann & Kraay, 2024). Strong governance systems minimize transaction uncertainty, increase transparency and facilitate efficient coordination across supply networks. Beyond the formal institutions, there are also informal rules and societal norms that have an effect on economic behavior. Helmke and Levitsky (2012) underline that informal institutions may complement, or may undermine, formal governance; both having effects on compliance, trust and coordination. It is this two-sided view on the importance of taking into account both indicators of supply chain governance (measurable) and the societal and political processes at the broader level that affect supply chain performance.

Cultural context also has an impact on the integration and functioning of supply chains across borders. Consistent with these findings, Liu et al. (2021) show that national culture moderates the association between supply chain integration and performance, which means that the mechanisms of integration do not produce consistent results across countries. Expanding the conceptualization of culture Taras et al (2016, p. 1641) maintains that the definition of culture is not restricted to geographical, thus call for refined approaches on cultural analysis in international management research. Cultural persistence and slow change also shape long-term institutional trajectories as well as patterns of economic coordination (Giuliano & Nunn, 2021). These findings together point to the importance of cultural configurations for effectiveness in governance, norms of collaboration and strategic alignment in global supply networks.

Operational alignment and structural complexity is another research stream. Chhetri et al. (2022) stress that the supply chain complexity should match the product demand characteristics if it is to ensure optimal performance. The misalignment of the structure can enhance inefficiencies and sluggishness. Similarly, Wang and He (2022) study decision-making in dual-channel supply chains in the context of mass customization, showing how strategic decisions concerning modularity and pricing affect the operation results. These studies confirm the importance of strategic design within larger institutional and market constraints.

At the firm level, economic performance is also determined by network positioning. Seiler et al. (2020) demonstrates that the structural position of a firm in supply chain networks does affect its financial outcomes suggesting that embeddedness and relational ties create competitive advantages. This micro-level evidence complements the macro-level governance perspectives and the way in which institutional environments and network structures are tied together.

Overall, according to the literature, supply chain performance is affected by an integrated set of factors such as sustainability orientation, resilience capabilities, institutional governance quality, cultural dynamics and structural alignment. While previous research has analyzed these elements separately, less is done to synthesize these elements into a holistic macro-level framework at the intersection of institutional sustainability and cultural context to national supply chain outcomes. Building on these scholarly backgrounds, the current research extends our understanding about the collective effects of governance systems and cultural configurations on the performance of strategic operations in global supply networks.

3. Methodology

3.1 Research design and unit of analysis

This study uses a multi-country panel approach to investigate how national cultural orientation is related to institutional sustainability, and how institutional sustainability is related to supply chain performance. The unit of analysis is a country-year observation, which is observed at seven time points: 2007, 2010, 2012, 2014, 2016, 2018 and 2022.

3.2 Data sources and sample construction

This is an integration of three secondary data sets that help build a harmonized country level panel that illustrates supply chain performance, institutional sustainability, and national culture. The Logistics Performance Index (LPI) of the World Bank was used to measure the supply chain performance. The data was formatted from wide to long and limited to the seven survey years (2007, 2010, 2012, 2014, 2016, 2018 and 2022) to take into account temporal consistency. Institutional sustainability was measured in terms of the Worldwide Governance Indicators (WGI) (World Bank, 2023) and retention was applied to the estimate (EST) series for six governance dimensions and filtered data were selected to represent the same seven study years. National culture was measured by using the dataset on cultural dimensions of Hofstede (Isamathr, n.d.), treated as time-invariant data, and matched to each country in all years of the study.

All datasets were harmonized on the basis of the use of ISO3 country codes. LPI and WGI were initially combined to form a core panel, following standardisation of country codes and reconciliation by hand of a small number of non-standard entries, the combined LPI-WGI panel had 169 countries in 7 years. Hofstede data was then merged and integrated so that the cultural augmented panel was narrowed down to 55 countries (364 country year observations). To ensure reliable cultural measurement, a coverage rule that requires a minimum of four available Hofstede dimensions was applied resulting in a final analytical sample of 37 countries and 252 country-year observations.

3.3 Measures and variable operationalization

3.3.1 Dependent variable: supply chain performance

Supply Chain Performance was measured by the LPI (overall score) which is a continuous measure where higher values indicate better performance of the logistics. The LPI was kept as it was (no rescaling) after filtering to the study years and removing missing values in the selected years.

3.3.2 Mediator / institutional sustainability: Institutional Index

Institutional sustainability was summarized by a composite Institution_Index, which was the mean of WGI estimate indicators for fundamental institutional conditions. In particular, the index took an average of a few WGI series of estimations (e.g., control of corruption, government effectiveness, regulatory quality, rule of law; the index was calculated using a uniform sample across all the observations on the country-year in which these components existed). The index obtained was continuous and tended to be centred around zero with a wide dispersion (min around -1.96; max around 2.05 in the study population).

3.3.3 Key predictors: cultural orientation factors (PCA)

National culture measured according to Hofstede's six dimension (PDI, IDV, MAS, UAI, LTO, IVR). Countries with four or more dimensions available were retained and missing values were imputed using the within-country mean of observed dimensions in order to maintain the sample coverage.

The variables of culture were all standardized (z-scores) and were summarized by Principle Component Analysis (PCA) to minimize multicollinearity and dimensional redundancy. Two elements were retained. The first (Cultural_Factor, PC1) accounted for about 32.8% variance and the second (Cultural_Factor2, PC2) accounted for about 27.2%. Together they explained about 60% of total cultural variance and they were employed as short measures of national cultural orientation in further analyses.

3.4 Empirical strategy

3.4.1 Culture → institutions (path a)

To test the hypothesis that culture and institutional sustainability are related, an OLS model was estimated with robust (HC3) standard errors:

$$Institution\_Index_{it} = \alpha + \beta_1 Cultural\_Factor_i + \beta_2 Cultural\_Factor2_i + \varepsilon_{it} \quad (1)$$

This "a-path" model utilizes the country-year panel but culture is time-invariant, and so inference focuses on cross-country differences in institutional sustainability that are associated with cultural orientation factors.

3.4.2 Institutions → LPI with two-way fixed effects (within-country, over time)

To estimate the relationship between changes in institutions and changes in LPI net of time invariant country heterogeneity and global shocks a two-way fixed effects specification was adopted using country and year indicators and with standard errors clustered by country:

$$LPI_{it} = \alpha + \gamma Institution\_Index_{it} + \mu_i + \tau_t + u_{it} \quad (2)$$

where μ_i are country fixed effects and τ_t are year fixed effects. This within-country model isolates the

association between institutional improvements and LPI changes over time.

A robustness version replaced $Institution_{Index_{it}}$ with a one-period lag $Institution\_Index_{i,t-1}$ to reduce simultaneity concerns and align with the idea that institutional improvements precede performance gains.

3.4.3 Between-country models (long-run differences)

Given that there are also structural differences in the institutions and logistics performance of the countries, "between" models were estimated using country averages over time (one observation per country). First, LPI was regressed upon the country mean Institution_Index. Then, a fuller between model included Cultural_Factor and Cultural_Factor2 to check if culture explains more between country variation when one model includes institutions.

3.4.4 Mediation test (culture → institutions → LPI)

To assess mediation, a nonparametric bootstrap procedure (5000 resamples) was used to estimate the indirect effect as:

$$Indirect = (\hat{a}) \times (\hat{b}) \quad (3)$$

where $\hat{a}$ is the effect of culture on institutions and $\hat{b}$ is the effect of institutions on LPI (with culture controls). The bootstrap generated an empirical sampling distribution and percentile 95% confidence interval for the indirect effect. The indirect effect was considered statistically supported when zero was not contained in the interval.

3.5 Software and reproducibility

All the preprocessing and analyses were implemented in Python by using common scientific libraries for handling the data, PCA, and regression estimation such as clustered and heteroskedasticity-robust inference. The workflow was implemented in a Jupyter environment and structured as a sequence of cells dealing with the ingestion, cleaning, merging, index construction, PCA, regression models, bootstrapping and visualization.

4. Results

This section will provide the empirical results of the final analytical sample of the 37 countries and 252 observations of country years between 2007 and 2022. The results are organized according to four main analytical components: (1) descriptive statistics and correlation structure, (2) correlations between the national culture and institutional sustainability, (3) the impact of institutional sustainability on the performance of the supply chain under various model specifications, and (4) mediation analysis that looks at the indirect cultural effects. All the reported coefficients are based on the estimated models in the methodology, HC3 robust standard error for OLS and country-clustered for fixed-effects regressions.

4.1 Descriptive Statistics and Correlation Structure

Country-level average correlations are given in Table 1. The correlation between LPI and Institutional Sustainability is robust and positive (r = 0.89), meaning that there is a significant association between the quality of governance and the performance of national supply chain. This is a large number which implies that almost 79% of the variation in LPI across countries is linearly correlated with differences in institutional sustainability at aggregate level.

Cultural_Factor (PC1) shows a moderate negative correlation with Institutional Sustainability (r=-0.58) and LPI (r=-0.48), suggesting that the cultural configurations that we capture with this component are associated in their structure with weaker governance and low logistics performance. In contrast, Cultural_Factor2 (PC2) has moderate positive correlation with Institutional Sustainability (r = 0.31) and LPI (r = 0.33). The result of successful PCA dimensional separation and absence of multicollinearity between retained components is shown by the orthogonality between the two cultural components (r = 0.00).

The visual representation in Figure 1 reinforces these patterns by showing high positive clustering of governance variables with LPI, with opposite directional effects of the two cultural components.

Table 1. Correlation Matrix (Country-Level Averages, N = 37)

Variable	LPI	Institution_Index	Cultural_Factor	Cultural_Factor2
LPI	1.00	0.89	-0.48	0.33
Institution_Index	0.89	1.00	-0.58	0.31
Cultural_Factor	-0.48	-0.58	1.00	0.00
Cultural_Factor2	0.33	0.31	0.00	1.00

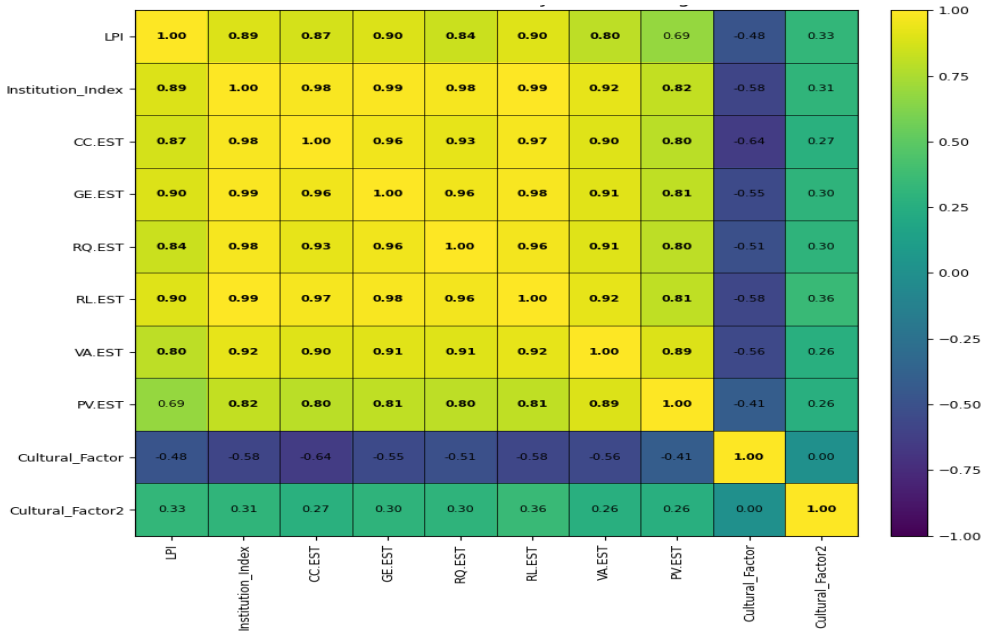

Figure 1. Correlation Matrix Heatmap (Country-Level Averages)
Heatmap visualization of pairwise correlation between supply chain performance, institutional sustainability and cultural components.

4.2 Cultural Determinants of Institutional Sustainability

To test the hypothesis that national culture is a predictor for institutional sustainability, an OLS regression with HC3 robust standard errors was estimated. Results are shown in Table 2.

Cultural_Factor (PC1) have statistically significant negative effect on Institutional Sustainability (β = -0.4309, $p < 0.001$). This suggests that a one-unit change in PC1 is linked with a 0.431-unit decrease in institutional sustainability, other cultural dimensions held constant. The size of this coefficient is large, indicating a strong structural relationship between cultural orientation and quality of governance.

Cultural_Factor2 (PC2) shows a positive and statistically significant relation ($\beta = 0.2574$, $p < 0.001$). Thus, countries with higher scores in PC2 are likely to have higher institutional sustainability. The opposing signs of PC1 and PC2 suggest that different cultural configurations have asymmetric effects on the structure of governance.

The model accounts for 49.1% of the variance in institutional sustainability ($R^2 = 0.491$), which is highly significant with the macro-level cross-national nature of the data. The intercept at (0.6005, $p < 0.001$) is the baseline institutional sustainability with cultural components centered at zero.

Table 2. OLS Regression: Culture → Institutional Sustainability (N = 252)

Predictor	Coefficient	p-value
Intercept	0.6005	<0.001
Cultural_Factor (PC1)	-0.4309	<0.001
Cultural_Factor2 (PC2)	0.2574	<0.001
R^2	0.491	

4.3 Institutional Sustainability and Supply Chain Performance

4.3.1 Two-Way Fixed Effects (Within-Country Effects)

The relationship between institutional sustainability and supply chain performance was assessed based on a two-way fixed effects model with controls both for country and year effects. Results are shown in table 3.

Institutional Sustainability has a strong positive effect on LPI ($\beta = 0.695$, $p < 0.001$). Substantively, an increase in institutional sustainability of one unit is associated with an increase of about 0.70 points in LPI, which is economically meaningful in light of the scale used in LPI. The model accounts for 93.1 percent of the total variation in LPI ($R^2 = 0.931$) and thus possesses considerable explanatory power accounting for the unobserved heterogeneity.

4.3.2 Lagged Robustness Specification

In order to avoid the potential problems of simultaneity, a one period lag of Institutional Sustainability was included. The lagged coefficient is also positive and statistically significant ($\beta = 0.3124$, $p < 0.001$) showing that institutional quality before the study is associated with improvements in supply chain performance in the future. Though the effect is smaller than the current effect, the continued existence of the statistical significance proves the robustness of time.

4.3.3 Between-Country Models

Between-country regressions on country-level means further confirm the existence of structural differences. Institutional Sustainability is a significant predictor of LPI ($\beta = 0.4483$, $p < 0.001$) in the institutions only model, accounting for 79.3% of the cross-country variation ($R^2 = 0.793$).

When Cultural_Factor and Cultural_Factor2 are added, we still have a stable coefficient of institution ($\beta = 0.4552$, $p < 0.001$) but both cultural variables are statistically insignificant. This pattern suggests that the independent direct impact of culture on LPI is nonexistent when the institutional dimension of sustainability is taken into account.

The relative magnitudes and confidence intervals of these relationships have been summarized graphically in Figure 2.

Table 3. Institutional Sustainability and LPI (Within and Between Models)

Model	Institution_Index	Cultural_Factor	Cultural_Factor2	R^2
Fixed Effects (Full Panel)	0.695***	Not Included	Not Included	0.931
Lagged FE Model	0.3124***	Not Included	Not Included	0.887
Between Model (Institutions Only)	0.4483***	Not Included	Not Included	0.793
Between Model (Full Specification)	0.4552***	Not Significant	Not Significant	0.799

*Note: *** $p < 0.001$.*

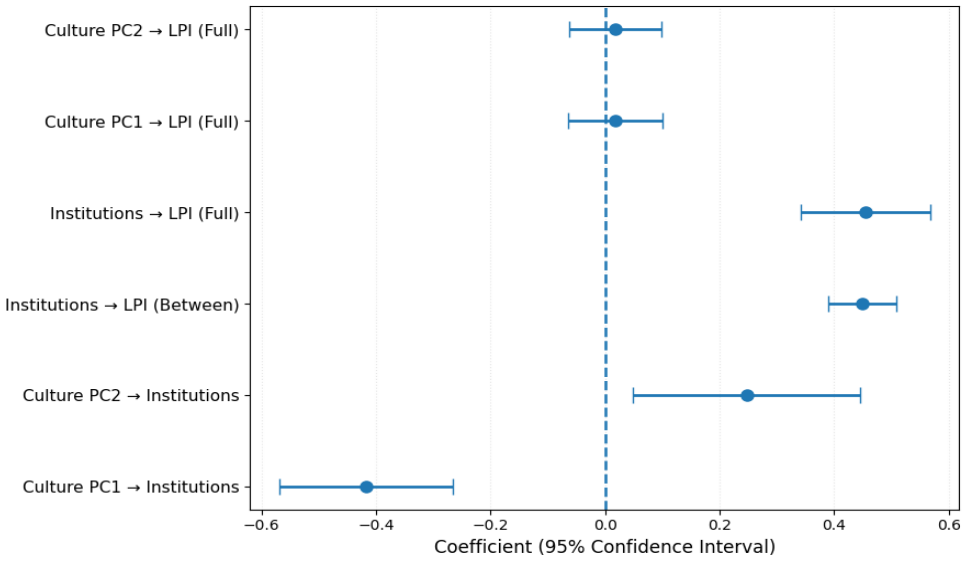

Figure 2. Structural Coefficient Plot (95% Confidence Intervals)
Visualization of estimated coefficients and 95% confidence interval for cultural and institutional relationships.

4.4 Mediation Analysis

To formally assess whether institutional sustainability mediates the relationship between Cultural_Factor (PC1) and LPI a bootstrap mediation analysis with 5000 resamples was performed. Results are provided in table 4.

The indirect effect is -0.188 mean, 95% confidence interval: -0.268 to -0.108. Exclusion of zero is confirmation of statistical significance. The negative sign indicates that higher values of PC1 decrease the institutional sustainability which in turn decreases the supply chain performance.

The distribution of bootstrap estimates is shown in figure 3 which shows a stable density around the estimated mean. The narrow confidence interval is further an indication of robustness of the mediation effect.

Table 4. Bootstrapped Indirect Effect (PC1 → Institutions → LPI)

Statistic	Estimate
Mean Indirect Effect	-0.188
2.5% CI	-0.268
97.5% CI	-0.108
Zero within CI	No

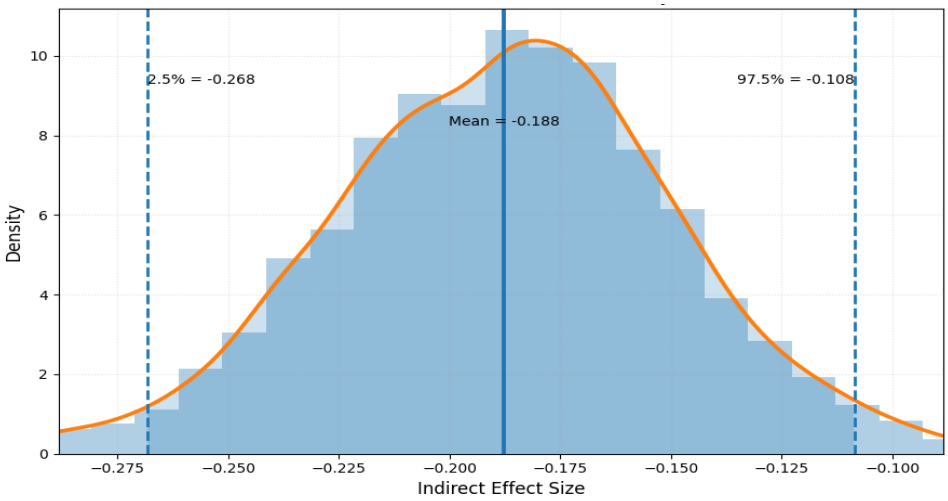

Figure 3. Bootstrapped Indirect Effect Distribution Kernel density distribution of 5,000 bootstrap estimates of indirect effect with 95% confidence interval limits.

4.5 Temporal Institutional Gradient

To illustrate further the structure patterns, countries were grouped into three categories (terciles) of institutional sustainability (low, medium, high). Average trends in LPI from year to year are presented in Figure 4.

High-institution countries consistently record LPI values over the period of observation ranging from 3.8 to 3.9. Mid-institution countries are clustered around 3.2-3.3 and low-institution countries are clustered between 2.7 and 2.9. The relative ranking of these groups is stable over all seven periods of time examined (2007-2022), so we observe relative structural advantages rather than short-term fluctuations.

The constancy in the institutional gradient through time adds to the argument that the quality of governance is a foundational determinant to supply chain performance. Positive gains in institutional sustainability are systematically linked to upward changes in LPI trajectories, while institutional stagnation is linked to performance plateaus.

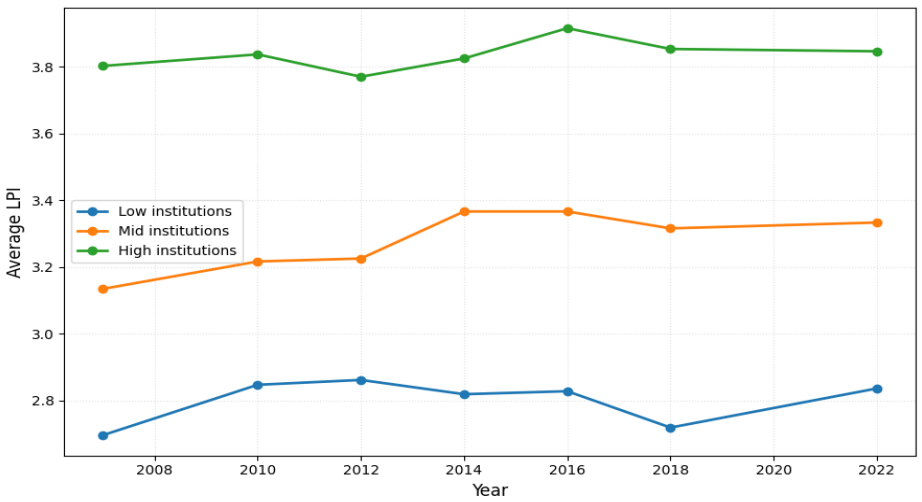

Figure 4. LPI Trends by Institutional Sustainability Group (2007–2022)

Average supply chain performance trajectories for low-, mid- and high-institutional sustainability group at seven points in time.

Collectively, the empirical findings show consistent and robust relationships between national culture, institutional sustainability and supply chain performance in a number of specifications, robustness checks, and time-series. While the statistical models identify strong structural linkages, the findings should not be taken as manifestations of deeper socio-institutional processes, but rather quantitative associations. The observed coefficients represent systematic patterns in which the governance capacity stabilizes technologically mediated logistics systems. In this sense, the econometric results help to provide empirical support for a much wider institutional narrative of how societies organize their coordination, how they enforce rules and how they sustain a complex operational infrastructure in the digital age.

Discussion

The results obtained in this study provide strong empirical evidence to support the case that institutional sustainability operates as a key structural determinant of national supply chain performance and is the key channel through which cultural configurations affect logistics performance. The analysis shows an overall positive and statistically significant relationship between institutional sustainability and Logistics Performance Index (LPI) in multiple specifications. In the two-way fixed effects model, the improvements in institutional quality within countries over time are found to be correlated with meaningful improvements in LPI, which is significant under a lagged specification, indicating that improvements in institutions lead to and contribute to the later improvements in logistics performance, rather than co-vary with them. This temporal robustness adds to the interpretation that institutional sustainability is responsible for reducing systemic friction, such as inconsistency in regulation, poor enforcement, and coordination inefficiencies, and as such, adds to the effectiveness and reliability of national supply chain systems. The results of the between country analysis furthermore suggest that countries with structurally stronger institutions have higher average logistics performance, adding to the idea that governance quality is a long-run enabling condition for supply chain competitiveness. In addition to being statistically related, this relationship can be explained by underlying structural processes that stabilize complex socio-technical systems of institutional capacity of a nationally embedded system of logistics networks.

The cultural analysis shows that national cultural dimensions do not directly determine supply chain performance once the institutional sustainability is taken into consideration. Instead, one cultural component is negatively related to institutional quality, while another cultural component shows a positive association, which means that cultural orientations affect institutional trajectories in differentiated ways. The results of mediation provide evidence that the indirect path from culture to LPI through institutional sustainability is statistically significant while direct cultural influences on LPI are made insignificant in the complete cross-sectional model. This finding implies that culture affects operational competitiveness chiefly by its impact on governance structures as opposed to by direct operating mechanisms. The cultural components obtained with the help of PCA are not to be regarded as stereotypical but rather as the synthesized forms of value orientations towards power, uncertainty and coordination embedded in history. These orientations create perception about the legitimacy of the regulatory system and compliance, which determines the sustainability of governance systems in the long run. Culture thus serves as a structural base of long term institutional sustenance, as opposed to being a driver of current operation. Such result is consistent with macro-level views which place emphasis on the idea that logistics capability is situated within wider institutional frameworks which influence the coordination of markets and trade performance (Hausman et al., 2013).

The findings are also consistent with operations management theory that highlights the importance of integration and coordination in managing supply chain uncertainty (Flynn et al., 2016). Effective integration does not simply depend on the practices of the firms, but also on predictable regulation and institutional trust. From a resilience point of view, the notion of the viability of supply chains stresses the importance of stability of the system and the capacity to adapt under disruption at the system level (Ivanov & Dolgui, 2020). Institutional sustainability can thus be understood as the application of a macro-level resilience resource for the survivability of the national logistics systems during times of volatility. In addition to this, the use of standardized governance indicators strengthens the impact of measurable dimensions of institutions, including the quality of regulation and the rule of law, in determining the outcomes of economic coordination (Kaufmann and Kraay, 2024).

The practical implications of the above findings are important. For policymakers, the results imply that investments in physical infrastructures related to logistics should be complemented by institutional reforms aimed at improving the quality of governance, transparency and effectiveness of regulations. Without such institutional foundations, infrastructure development alone may not result in sustained improvements in the performance of the supply chain. For multinational companies and supply chain strategists, the findings underscore both the importance of taking institutional sustainability into account in decision-making processes relating to location, risk assessment, and network design strategies. Countries with better governance environments provide more predictable and reliable operational context, and mitigate exposure to the risk of coordination failure and systemic risk.

From the angle of science-society, institutional sustainability is a governance infrastructure that allows the effective functioning of technologically mediated logistics systems. Where more than ever before, digital and interdependent environments are the norm, the quality of governance determines whether technological capabilities result in sustainable outcomes. Culture determines the expectations of authority and compliance that affect the strength of institutions and logistics performance. As these digital platforms and algorithmic systems mediate the modern logistics processes, their effectiveness is dependent on transparency, accountability, and rule enforcement. Viable institutions thus do not only prepare functional efficacy but also the lawful societal incorporation of the rising intelligent systems. They also affect the development and spread of knowledge, technical expertise and regulatory capabilities in national innovation ecosystems.

A number of limitations should be taken into account. First, the analytical sample is limited to countries for which cultural and governance data exists, with the result that the panel is limited to 37 countries. Although this makes data consistent, it restricts the generalisability to countries not encompassed in the intersection of datasets. Second, the LPI is built upon periodic waves from surveys which limits the granularity of time and perhaps fails to capture all of the short-term fluctuations inside institutions. Third, cultural dimensions are considered to be time-invariant, which is defendable from the perspective of theory but fails to consider gradual cultural evolution. Finally, although one can use fixed effects and lagged specifications to alleviate any issues of endogeneity, the study is still observational and one cannot completely dismiss the possibility of omitted time-recurrent confounders.

Future research could build upon this work by including alternative measures of logistics performance, investigating non-linear institutional effects at different life stages of development as well as incorporating aspects of informal institutional variables to complement formal governance measures. Additionally, understanding the relationships between digital transformation and the sustainability transitions along with institutional sustainability may help gain greater insight into long-term supply chain competitiveness. Overall the findings support the central thesis of how institutional sustainability is a foundational enabler of performance of strategic operations at a national level and how the cultural influences act primarily through institutional mechanisms rather than through direct operational effects.

Conclusion

This is a study of the relationship between national cultural orientation and institutional sustainability and the influence of institutional sustainability on supply chain performance in a multi-country panel (37 countries; 2007-2022). The results indicate a positive and strong relationship between institutional sustainability and logistics performance and lagged estimates indicate that institutional improvements occur before performance gains. Cultural components affect the results of logistic activities indirectly by determining the quality of institutions instead of directly influencing the operational effects. The findings show that national supply chain competitiveness is not just about infrastructure and ability to operate but also about the quality of governance, effectiveness of regulations and institutional trust. Policymakers should therefore base logistics investments in line with reform that enhances transparency and enforcement while firms should integrate institutional sustainability into their strategic location and risk decisions. Beyond the performance of logistics, the study underlines institutional sustainability as a society basis for digital transformation. Governance structures define the cultural conditions for the legitimation and maintenance of technological systems. In the digital age, resilient and sustainable supply chains need not only to be optimized in operation but require institutional cultures that foster transparency, accountability and long-term coordination for society.

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