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The Coordinating State in a Fragmented Production Network: A Coordination–Network DSGE Model for the Vietnamese economy.

Model Code: VN-CNDSGE

Pilot Data Scope: **63 provinces and cities • 2020–2024**

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Summary

This study develops a stochastic dynamic network equilibrium model for Vietnam (VN-CNDSGE), in which the economy consists of provincial-sector nodes linked by intermediate inputs and knowledge diffusion. Unlike the approach of using "institutional quality" as an exogenous productivity coefficient, the model considers state coordination capacity, institutional fragmentation, public data, and shared research infrastructure as states that can accumulate, decline, and be subject to shocks. These states affect productivity at the nodes and change costs at the network edges. Seed capital and public procurement share innovation risk, but their effectiveness is adjusted by losses and public expenditure.

The model yields five theoretical outcomes. First, the marginal value of coordination increases with network centrality. Second, optimal R&D support is achieved by the difference between the social and private value of knowledge, after accounting for fiscal costs and losses. Third, seed capital is needed to supplement data, research infrastructure, and coordination capacity. Fourth, optimal public investment balances marginal social benefits according to the *centrality index* $\times$ *bottleneck sensitivity* $\times$ *execution efficiency*. Fifth, a centralized hub can become a systemic failure point if data, auditing, and backup mechanisms are lacking.

The pilot data pipeline combined 315 province-year observations from official data of 63 provinces for the period 2020–2024 with PCI; the expanded sample has 189 observations in 2022–2024 when DTI is added; PII 2024 was used as a descriptive test. The principal components of the seven coordinating indicators explain 31.78% of the variance and have Cronbach's $\alpha = 0.620$. In 2024, the CCI–PII output correlation is 0.318. However, three exploratory regressions did not identify non-zero CCI coefficients: GRDP growth -0.00113 (SE 0.00436), non-state investment rate 0.00295 (SE 0.00390), and PII output 1.029 points (SE 0.765). These are not causal estimates. The draft proposes identification through coordinated interaction with predetermined network exposure, digital Bartik tools, and state-space Bayesian estimation. Four policy resolutions for the 2024–2026 period only define ex ante antirealism; the study does not claim to have measured their impact.

Keywords: state capacity; coordination; DSGE; production network; public data; innovation; Vietnam.

JEL codes: C32, C54, E62, H11, H54, O32, O43, R15.

Abstract

This paper develops a Vietnam Coordination–Network Dynamic Stochastic General Equilibrium model (VN-CNDSGE) in which province–sector production nodes are connected through intermediate inputs and knowledge spillovers. State coordination capacity, institutional fragmentation, public data, and shared research infrastructure are modeled as accumulable, depreciating and stochastic states that affect both node productivity and bilateral network wedges. Seed funding and public procurement address innovation externalities, subject to fiscal

costs, leakage and capture. The model yields five propositions linking the social value of coordination to network centrality, the Pigouvian innovation subsidy to the social–private value gap, policy complementarity, a leakage-adjusted priority rule, and the systemic risk of a single coordination point of failure.

The reproducible pilot combines 315 province–year observations for Vietnam's historical 63 provinces in 2020–2024 with PCI indicators; 189 observations remain in 2022–2024 when DTI indicators are added, and the 2024 PII innovation-output score is used only as descriptive validation. The extended coordination index has moderate internal consistency and the exploratory regressions are inconsistent inconclusive. Consequently, no causal effect is attributed to resolutions adopted in 2024–2026. The paper sets out a pre-estimation strategy combining a latent-state measurement system, predetermined network exposure, a leave-one-out digitization Bartik instrument, and Bayesian structural estimation. Policy exercises are clearly ex ante and subject to equal-present-value budget constraints.

Keywords: state capacity; coordination; coordination; DSGE; production networks; public data; innovation; innovation; Vietnam.

JEL: C32, C54, E62, H11, H54, O32, O43, R15.

Status of evidence. The 2020–2024 data and pilot statistics in this paper are reproducible observations/calculations; the CCI is an exploratory scale with errors; provincial-sector MRIO and full Bayesian estimates are not yet complete; any policy multipliers or welfare changes during this period are subject to counter-actual results, not observed outcomes. Meeting high academic standards does not guarantee acceptance in a Q1 journal; the decision depends on the quality of the full estimates and independent peer review.

1. Introduction

In many areas of Vietnam's development, bottlenecks are no longer primarily due to a lack of ideas, participating entities, or individual resources. Increasingly, the bottleneck lies in the ability to connect these resources into a system that can produce tangible results. A research project may be completed but hasn't yet found a business capable of commercializing it; a business may be ready to invest but lack access to shared research infrastructure, data, land, or credit; or people may be willing to adopt technology but lack a mechanism for risk-sharing during the testing phase. Each agency manages a part of the process and may perform its functions as prescribed, but no single entity is held accountable for the effectiveness of the entire value chain.

This fragmentation creates a different type of economic cost than conventional taxes, capital costs, or transportation costs. It's the “coordination wedge”: waiting times between procedures, database incompatibilities, duplication in public investment, gaps in responsibility between agencies, uncertainty about standards, and a failure to internalize spillover benefits across localities, sectors, and businesses. A single investment might have a low private yield but a high social yield because it opens the way for

many downstream activities. Conversely, a project might be considered efficient within a single agency but add costs to the entire system. When the economy is organized according to networks of production, data, knowledge, and logistics, evaluating each policy as an independent “piece” can lead to misallocation of resources even when each individual decision is reasonable.

This issue is particularly important for Vietnam. The economy is highly open, deeply involved in international value chains, and is simultaneously undergoing digital transformation, green transformation, technological upgrading, and spatial restructuring. According to the World Bank, Vietnam's trade in goods and services has reached approximately 170% of GDP, meaning that technological shocks, international demand, logistics, and policy changes in one sector or locality can quickly spread to the rest of the economy (World Bank 2026). In this context, a locality's productivity depends not only on its own capital, labor, and institutions, but also on the quality of its connections to other supply, knowledge, data, and market nodes.

This study proposes the **Vietnam Coordination-Network Dynamic Stochastic General Equilibrium (VN-CNDSGE) model** to quantify the role of the State as a coordinating entity in a multi-regional, multi-sectoral economy with a network of inputs and outputs. The model does not assume the State directly replaces the market or selects all production activities. Instead, the State influences the efficiency of the private sector through five channels: inter-agency coordination capacity; reduction of institutional fragmentation; formation of public data assets; provision of shared research infrastructure; and risk sharing for innovation through seed capital and public procurement. These channels alter the linkage costs between industries, localities, and innovation entities, thus amplifying or diminishing the impact of policies across the production network.

The central question of the study is: **Given limited budgetary resources, how should the State allocate resources among public physical capital, data, research infrastructure, human resources, coordination capacity, and innovation support to maximize social welfare?** This question is explored through four groups of issues. First, can coordination capacity be modeled as an accumulating state, rather than merely an immutable institutional parameter? Second, how does the social value of coordination change according to the central position of a sector or locality within the network? Third, are seed capital, data, and shared infrastructure complementary or can they be designed as separate tools? Fourth, how can the impact of coordination be distinguished from general governance capacity, initial development levels, and other growth shocks?

The study incorporates coordination capacity Γ_{it} , institutional fragmentation levels F_{it} , public data assets D_{it} , and shared research infrastructure R_{it} into a dynamic state system. In the model, these states not only directly increase productivity but also reduce transaction wedges and knowledge diffusion wedges across each link in the network. Therefore, the same budget expenditure can produce different impacts depending on where it is allocated, the input-output structure, and the ability to control losses. The model also allows a centralized coordination capacity to become a source of systemic risk: if too many links depend on a single hub lacking data or capacity, the shock at that hub can spread more widely than under the initial fragmentation mechanism.

The draft is set within the context of four major policy directions: Resolution 57-NQ/TW on science, technology, innovation and digital transformation; Resolution 68-NQ/TW on the development of the private economy; Resolution 79-NQ/TW on the development of the state-owned economy; and Resolution 10-NQ/TW on the development of the foreign-invested economy (Political Bureau 2024; Political Bureau 2025; Political Bureau 2026a; Political Bureau 2026b). These four resolutions should not be seen as four independent shocks, but rather as complementary components within the same development ecosystem.

It is important to emphasize from the outset that this is a **pre-structural estimation draft**. The aforementioned resolutions were only enacted during the 2024–2026 period, so there is not enough post-policy length to identify long-term causal impacts. The study therefore does not claim to have measured the effectiveness of each resolution. The initial empirical part only tests the feasibility of the data, constructs measurement variables, and describes some correlations, while policy simulations are presented as **ex ante**, based on adjusted parameters or publicly available prior distributions. The Q1 category is a characteristic of journals in each year, and publication results are subject to independent peer review; therefore, acceptance of a manuscript in a Q1 journal cannot be guaranteed. The goal here is to build research according to verifiable, reproducible, and continuously refined standards to aim for that journal group.

2. The institutional and policy context of Vietnam

Resolution 57-NQ/TW identifies science, technology, innovation, and digital transformation as top priority breakthroughs, while considering data as the primary means of production and emphasizing the leading role of the State in forming the infrastructure, institutions, and ecosystem for innovation (Political Bureau 2024). The goals for 2030 include research and development spending reaching 2% of GDP, with social resources accounting for over 60%; allocating at least 3% of the total annual state budget expenditure to science, technology, innovation, and digital transformation; the contribution of total factor productivity to growth exceeding 55%; and the digital economy accounting for at least 30% of GDP. In the VN-CNDSGE, these orientations are represented through the accumulation of data assets D , research infrastructure R , knowledge capital Z , coordination capacity Γ , and controlled testing mechanisms.

Resolution 68-NQ/TW, issued in May 2025, places the private sector as the most important driving force of the economy, while also requiring improvements in property rights, access to resources, the business environment, technological innovation, and linkages between private enterprises and the state sector and foreign investment sector (Political Bureau 2025). From a model perspective, the effectiveness of policies to develop the private sector lies not only in reducing capital costs for individual enterprises. It also depends on reducing network entry costs, expanding access to data and shared laboratories, creating initial demand through public procurement, and sharing the risks that private investors cannot internalize.

Resolution 79-NQ/TW of January 2026 clarifies the role of the state economy and requires improved efficiency in the use of resources, assets, and enterprises held by the State (Political Bureau 2026a). In this study's approach, state assets include not only land, financial capital, infrastructure, or state-owned enterprises. Interoperable administrative data, open research infrastructure, technical standards, public procurement capacity, and organizational coordination capabilities are also productive assets. Their value should be assessed through the increased productivity and welfare of the entire network, rather than solely through the direct revenue of the managing unit.

Resolution 10-NQ/TW of June 2026 on the development of the foreign-invested economy sets out requirements to improve the quality of capital flows, increase linkages with domestic enterprises, transfer technology, and contribute to the self-reliance of the economy (Political Bureau 2026b). In the VN-CNDSGE, foreign investment impacts through three channels: supplementing capital and production capacity; expanding export demand and input networks; and creating the potential for knowledge diffusion. The third channel does not occur automatically. It depends on the absorption capacity of domestic enterprises, the quality of human resources, research infrastructure, access to data, and the level of substantive linkages between enterprises.

The reorganization of provincial-level administrative units from 63 to 34 provinces and cities, effective from July 1, 2025, creates both opportunities and challenges for quantitative research (National Assembly 2025). The merger may reduce some administrative coordination costs, but it does not automatically eliminate fragmentation in processes, data, or responsibilities. Statistically, the study retains the structure of 63 provinces for historical data and uses a mapping matrix to convert to the new 34 units. Sum-added quantities such as population, capital, or GRDP are aggregated by addition; ratios and indicators are aggregated according to appropriate weights; absolute rankings are not averaged. This approach avoids confusing changes in administrative boundaries with changes in economic performance.

Vietnam currently has many suitable data sources for measuring aspects of coordination capacity, but no single index directly observes the entire concept. The Provincial Competitiveness Index provides information on transparency, time costs, dynamism, informal costs, and legal institutions. The Provincial Digital Transformation Index reflects digital institutions, infrastructure, and digital operations. PAPI measures citizens' experience with governance and public service delivery. The Local Innovation Index covers innovation inputs and outputs, but some components of this index already utilize PCI, PAPI, PAR

Index, and DTI; therefore, it is not possible to simultaneously include all composite indices in a single latent variable without controlling for the risk of double counting.

International data plays two roles. First, the Penn World Table, World Development Indicators, and Worldwide Governance Indicators provide macroeconomic, productivity, and institutional variables to construct a priori distributions and test their external validity. Second, the OECD's cross-country input-output table allows placing Vietnam's production network in relation to the world. The ICIO 2025 version covers 80 economies, 50 sectors, and the period 1995–2022, but data lags mean that recent shocks must be treated with extrapolation or scenarios, not as direct observations. The GovTech Maturity Index and the UN E-Government Development Index provide additional benchmarks for comparing digital government capabilities.

According to the Global Innovation Index 2025, Vietnam ranks 44th out of 139 economies; its innovation input ranking is 50th while its output ranking is 37th, and Vietnam has been in the group of countries with innovation performance exceeding expectations for its level of development for 15 consecutive years (WIPO 2025). The gap between input and output may suggest the ability to utilize innovation resources relatively effectively, but it is not causal evidence of the quality of state coordination. Similarly, the World Bank's estimate that Vietnam's public investment output could increase by approximately 23% if it reaches the global efficiency margin is a benchmark, not a prediction that any single reform will necessarily produce that level of improvement (World Bank 2024).

3. Literature Review

Research links four branches of capital that are often analyzed separately. The first branch studies public capital and growth. Growth models with productive public services show that public spending can increase private productivity, but the impact depends on how it is financed and the potential for bottlenecks (Barro 1990). Aggregate evidence shows that public capital has a moderately positive impact, but the magnitude varies considerably between types of infrastructure, timeframes, and institutional quality (Bom and Ligthart 2014). Hulten emphasized that the contribution of a factor to growth depends on its revenue weight and its linkages within the system, laying the groundwork for using Domar weights to assess aggregate impacts (Hulten 1978). The current research extends the concept of public capital to data, research infrastructure, and coordination capacity.

The second branch is the theory of production networks. In an economy with input-output linkages, micro-shocks can create macro-volatility when nodes have different levels of centrality (Acemoglu et al. 2012). Networks also amplify financial costs, supply disruptions, and allocation wedges (Jones 2011; Bigio and La'O 2020). Baqaee and Farhi showed that in an economy with distortions and non-linear linkages, welfare effects cannot be inferred solely from direct productivity changes; the redistribution and network location of each activity must be considered (Baqaee and Farhi 2020). VN-CNDSGE inherits

this logic but allows policy coordination to change costs at each link, instead of just creating a productivity shock at a single node.

The third branch studies coordination failures and industrial policy. “Big nudge” models suggest that businesses may not invest even when the pool of investments is beneficial, due to unlocalized demand and additional benefits (Murphy et al. 1989). Industrialization and export upgrading may require coordination mechanisms, cost discovery, and risk sharing, but policy can also be influenced by information asymmetry and vested interests (Rodrik 1996; Hausmann and Rodrik 2003). The market-making state argument emphasizes the role of task-oriented investment and acceptance of technological uncertainty (Mazzucato 2018). This research brings both sides of intervention into a single model: coordination can overcome externalities, while losses, project selection bias, and over-reliance on a single point of contact can diminish or reverse benefits.

The fourth branch relates to state capacity and digital transformation in the public sector. The capacity to collect taxes, enforce contracts, and deliver public goods is the result of dynamic investment, complementary to economic development (Besley and Persson 2009; Besley and Persson 2010). State capacity also has a network structure: the quality of an agency may depend on the capacity and behavior of related agencies (Acemoglu et al. 2015). Digital government has the potential to reduce transaction costs and create integrated services, but digital transformation does not simply mean digitizing existing procedures; it requires redesigning organizations, data, and accountability (Dunleavy et al. 2006; Mergel et al. 2019). In the proposed model, data is both a productive asset and a monitoring technology that helps reduce losses.

Studies on allocation biases provide an additional warning. Wedge discrepancies between firms or industries can drastically reduce aggregate productivity, even if total capital and labor remain unchanged (Restuccia and Rogerson 2008; Hsieh and Klenow 2009). Administrative fragmentation can be understood as a source of uneven wedge formation. However, reducing every wedge to zero is not necessarily optimal if some regulations address environmental externalities, safety, or financial stability. Therefore, research distinguishes between unnecessary coordination wedges and management norms with clear social objectives.

The gap that VN-CNDSGE addresses is the lack of a unified framework that combines: state capacity as a state of accumulation; multi-regional, multi-sectoral production networks; data and knowledge assets; loss risks; and a strategy for identifying data appropriate to Vietnam's provincial level. Conventional DSGE models often incorporate institutional quality into aggregate productivity or fixed wedges. This approach fails to demonstrate how a data-linked reform can create greater value at the central node, or how seed capital is only effective when accompanied by research infrastructure and initial procurement markets.

4. Contributions of the research

The first contribution is theoretical. The research constructs coordinating capacity as a type of organizational capital that can accumulate, depreciate, and withstand shocks. This capacity reduces transaction costs and knowledge dissemination costs at the edges of the network. The model leads to the testable hypothesis that the marginal value of coordination increases with the degree of network centrality and the sensitivity of links to fragmentation.

The second contribution is clarifying the complementary nature of the policy package. Seed funding increases the incentive for private research, but its yield is low if businesses lack access to data, research equipment, personnel, and initial market demand. Conversely, research infrastructure may be underutilized if there is a lack of businesses willing to accept the risks of commercialization. The model forecasts positive cross-derivatives between seed funding, data, shared infrastructure, and coordination capacity under defined conditions.

The third contribution is the development of a reproducible measurement architecture. Instead of assigning a single observed index to the “Coordinating State,” the study uses a state-space model to infer coordinating capacity and fragmentation from PCI, DTI, PAPI, budget data, procedural processing time, and output indicators. The measurement structure publicly loads factors, sign rules, and data sources, and separately handles composite indices with overlapping components.

The fourth contribution is an empirical strategy combining structural modeling and semi-empirical evidence. The structural part utilizes the Vietnamese inter-industry balance sheet and the OECD ICIO, while the external testing explores pre-reform network exposure levels, global demand shocks, and the tool variable of transition – sharing – for the digitalization of public services. The study does not freely estimate hundreds of thousands of linkage coefficients; instead, it uses an observed input-output matrix, Bayesian hierarchy, and low-rank factor structure.

The fifth contribution is translating the model's results into usable priority rules for governance. The policy priority index is constructed from three components: the degree of network centrality, the sensitivity of the linkage to the coordination wedge, and the percentage of resources actually transformed into public assets after losses. This rule differs from average allocation or allocation based solely on GRDP size, but still needs to be applied with the same criteria of regional equity and welfare constraints.

4.1. Framework and Hypothesis Testing Mechanism

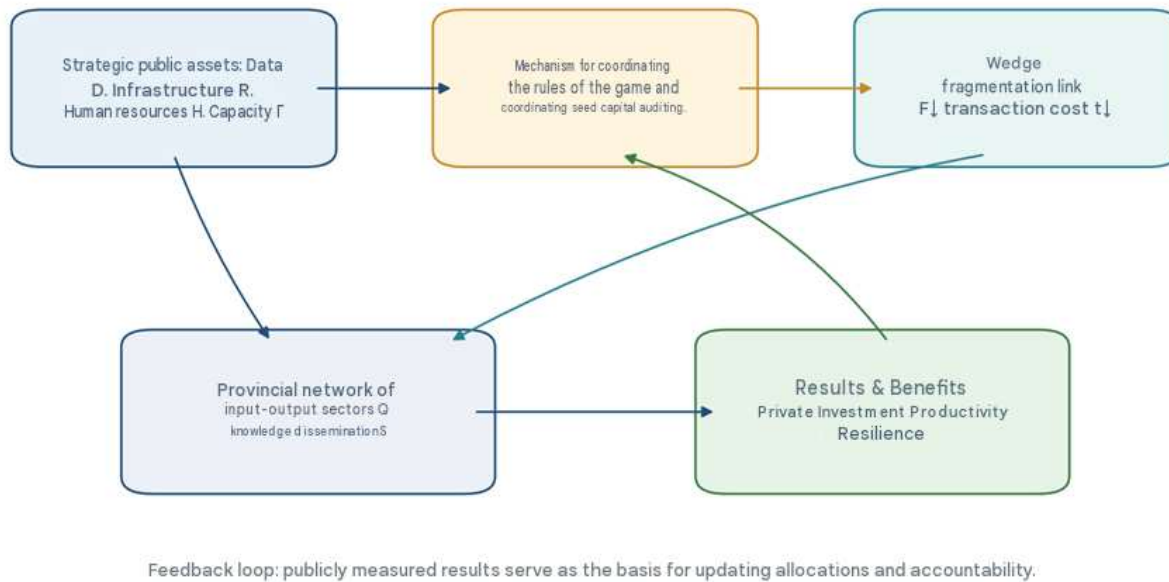


Figure 1. Conceptual architecture of VN-CNDSGE: public assets and coordinating capacity impact the linkage wedge, provincial-sectoral network and outcomes; outcomes return to the accountability system.

Based on the above architecture, the study pre-registers five hypotheses. **H1:** Coordination shocks have a greater output impact at nodes with high Domar centers. **H2:** The impact of coordination on investment and innovation is stronger when exposed to large administrative-data linkages. **H3:** Seed capital has a positive interaction with data, research infrastructure, and absorption capacity. **H4:** The benefits of centralized responsibility decrease as losses or error variance of the hub increase. **H5:** Coordination packages generate greater benefits than the sum of the effects of the individual components under the same budget present value, but only when performance exceeds an endogenous threshold.

Table 1. Mapping from policy concepts to model objects

Concept	Variables/Tools	Direct mechanism	Key Identification Moment
Coordination capacity	$\Gamma_0, t; \Gamma_i, t$	Reduce costs at the edge; improve organizational efficiency.	PCI/DTI/PAPI, processing time, network exposure interaction
Institutional fragmentation	F_i, t	Elevating procedures, data, and accountability.	Time/informal costs, process duplication.
Public data	D_i, t	Productivity, compatibility, and monitoring input	DTI, interoperability, digital service utilization.
Shared research infrastructure	R_i, t	Supplementing private R&D	Power consumption, number of users sharing the device, test results

Concept	Variables/Tools	Direct mechanism	Key Identification Moment
Seed capital	$m_{i,t}$	Narrowing the social-private yield gap	Co-financing, milestones, and private investment follow.
Public procurement innovation	$Q_{n,t}^G$	Create test bridges according to publicly available standards.	Trial contracts, competition, post-procurement results
Loss/Misappropriation	$\ell_{i,t}^e$	Reduce the conversion of budget funds into useful assets.	Auditing, transaction disclosure, conflicts of interest

5. The VN-CNDSGE model: State coordination within a provincial-sectoral network.

5.1. Economic Space and Time Sequence

Consider a small, open economy comprising a set of localities $\mathcal{I} = \{1, \dots, I\}$, a set of industries $\mathcal{S} = \{1, \dots, S\}$, and a set of production nodes $\mathcal{N} = \mathcal{I} \times \mathcal{S}$. A node $n = (i, s)$ represents an industry s at the local level i ; another node $m = (j, r)$ represents an industry r at the local level j . This structure allows the model to be estimated across 63 historical provinces and cities and then consistently aggregated across 34 administrative units using a line mapping matrix, rather than simply averaging ranks or indices.

In each period t , the following sequence of events unfolds. First, productivity shocks, global demand, institutional fragmentation, coordination capacity, and policy losses are realized. Second, the State identifies investments in public data, shared research infrastructure, human capital, coordination capacity, public procurement, and innovation seed capital. Third, households decide on consumption, labor, and asset accumulation; businesses select capital, labor, intermediate inputs, and knowledge investment. Finally, inter-provincial and inter-sectoral production and trade, and budget payments are processed.

The endogenous state of the model includes private capital $K_{n,t}$, business knowledge $Z_{n,t}$, public data assets $D_{i,t}$, shared research infrastructure $\mathcal{R}_{i,t}$, public human capital $H_{i,t}$, local coordination capacity $\Gamma_{i,t}$, central coordination capacity $\Gamma_{0,t}$, level of institutional fragmentation $F_{i,t}$, and public debt B_t .

5.2. Households

A national representative household owns businesses, trades assets domestically and internationally, consumes goods from production nodes, and provides specialized labor according to province/sector. This is a maximizing household.

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\sigma} - 1}{1-\sigma} - \chi \sum_{n \in \mathcal{N}} \varpi_n \frac{L_{n,t}^{1+\nu}}{1+\nu} \right], \quad 0 < \beta < 1 \quad (1)$$

where σ is the consumer volatility aversion coefficient, ν the inverse of Frisch elasticity, and ϖ_n reflects the differences in labor supply.

Total consumption is

$$C_t = \left[\sum_{n \in \mathcal{N}} \omega_n^{1/\eta_c} C_{n,t}^{(\eta_c-1)/\eta_c} \right]^{\eta_c/(\eta_c-1)}, \quad \sum_n \omega_n = 1 \quad (2)$$

With a fully developed domestic property market, the basic optimal conditions are:

$$\lambda_t = C_t^{-\sigma}, \quad \frac{W_{n,t}}{P_t} = \frac{\chi \varpi_n L_{n,t}^\nu}{\lambda_t} \quad (3)$$

and Euler's equation for risk-free assets is

$$1 = \beta \mathbb{E}_t \left[\frac{\lambda_{t+1} R_{t+1}}{\lambda_t \Pi_{t+1}} \right] \quad (4)$$

The representative household specification aims to isolate the coordination mechanism and network. An expanded version could break down households by income group, skills, or region to assess welfare distribution.

5.3. Production technology and input network

The gross output of the node $n = (i, s)$ is produced according to

$$Y_{n,t} = \tilde{A}_{n,t} \left[K_{n,t}^{\alpha_s} (H_{i,t} L_{n,t})^{1-\alpha_s} \right]^{1-\mu_s} X_{n,t}^{\mu_s}, \quad 0 < \alpha_s, \mu_s < 1 \quad (5)$$

The intermediate input $X_{n,t}$ is a CES combination of goods from across the entire network:

$$X_{n,t} = \left[\sum_{m \in \mathcal{N}} a_{nm}^{1/\varepsilon_s} \left(\frac{M_{nm,t}}{\Delta_{nm,t}^X} \right)^{(\varepsilon_s-1)/\varepsilon_s} \right]^{\varepsilon_s/(\varepsilon_s-1)}, \quad \sum_m a_{nm} = 1 \quad (6)$$

Here $M_{nm,t}$, the input cost to the m purchase $\Delta_{nm,t}^X \geq 1$ node n is the total iceberg cost, including procedural costs, data incompatibilities, approval delays, administrative boundaries, partner search costs, and coordination breakdowns. It only $M_{nm,t}/\Delta_{nm,t}^X$ reaches the production process.

Put

$$f_{ij,t} = \frac{F_{i,t} + F_{j,t}}{2}, \quad d_{ij,t} = \frac{\ln D_{i,t} + \ln D_{j,t}}{2} \quad (7)$$

and effective coordination capacity on the link $i - j$ is

$$\gamma_{ij,t} = \omega_0 \ln \Gamma_{0,t} + \frac{1-\omega_0}{2} (\ln \Gamma_{i,t} + \ln \Gamma_{j,t}), \quad 0 \leq \omega_0 \leq 1 \quad (8)$$

Linkage costs are subject to

$$\ln \Delta_{nm,t}^X = \bar{\tau}_{nm}^X + \psi_F^X f_{ij,t} - \psi_I^X \gamma_{ij,t} - \psi_D^X d_{ij,t} + u_{nm,t}^X \quad (9)$$

Therefore $\psi_F^X, \psi_I^X, \psi_D^X > 0$, fragmentation increases transaction costs; compatible data and orchestration capabilities reduce costs across links, rather than simply boosting the individual productivity of a single business.

Accumulation of physical capital with adjusted costs:

$$K_{n,t+1} = (1 - \delta_K)K_{n,t} + I_{n,t} \left[1 - \frac{\phi_K}{2} \left(\frac{I_{n,t}}{I_{n,t-1}} - \bar{g}_I \right)^2 \right] \quad (10)$$

5.4. Shared knowledge, data, and research infrastructure

Useful knowledge for a node n includes not only knowledge owned by that node itself but also knowledge disseminated from the network:

$$Z_{n,t} = \left[\sum_{m \in \mathcal{N}} b_{nm}^{1/\varepsilon_Z} \left(\frac{Z_{m,t}}{\Delta_{nm,t}^Z} \right)^{(\varepsilon_Z - 1)/\varepsilon_Z} \right]^{\varepsilon_Z/(\varepsilon_Z - 1)} \quad (11)$$

The cost of knowledge dissemination is determined similarly:

$$\ln \Delta_{nm,t}^Z = \bar{\tau}_{nm}^Z + \psi_F^Z f_{ij,t} - \psi_I^Z \gamma_{ij,t} - \psi_D^Z d_{ij,t} + u_{nm,t}^Z \quad (12)$$

The effective productivity in equation (5) is

$$\tilde{A}_{n,t} = A_{n,t} Z_{n,t}^{\zeta_s} D_{i,t}^{\delta_s} \mathcal{R}_{i,t}^{\rho_s} \exp\{-\chi_s [F_{i,t} - \kappa_I \ln \Gamma_{i,t} - \kappa_D \ln D_{i,t}]\} \quad (13)$$

Equation (13) distinguishes three channels: data and research infrastructure are productivity inputs; coordination and fragmentation directly affect local organizational efficiency; and equations (9) and (12) describe network effects. Separating these channels allows testing the hypothesis “coordination is only aggregate productivity” against the full hypothesis “coordination changes topology”.

A company's proprietary knowledge evolves accordingly.

$$Z_{n,t+1} = (1 - \delta_Z)Z_{n,t} + \mathcal{N}_{n,t} \quad (14)$$

in which innovation is created

$$\mathcal{N}_{n,t} = A_{n,t}^Z (I_{n,t}^Z)^{\phi_I} \mathcal{R}_{i,t}^{\phi_R} D_{i,t}^{\phi_D} \Gamma_{i,t}^{\phi_r} \exp(-\phi_F F_{i,t}) \quad (15)$$

with positive exponents and a total not exceeding one of the basic specifications. Technology (15) demonstrates the complementarity between private R&D efforts and public assets: single seed capital does not generate the same amount of knowledge without data, shared infrastructure or coordination capacity.

5.5. Seed funding, public procurement, and policy losses

This $m_{i,t} \in [0,1]$ is called the effective support rate on the actual R&D expenditure received by the business. If the loss or appropriation rate is $\ell_{i,t}^m$, the budget must be spent $m_{i,t}/(1 - \ell_{i,t}^m)$ to transfer one unit of effective support. The private cost of R&D is.

$$(1 - m_{i,t})P_{n,t}^Z I_{n,t}^Z \quad (16)$$

Public procurement of domestic technology products is modeled using a CES consortium:

$$G_t^T = \left[\sum_{n \in \mathcal{N}_T} (\pi_n^G)^{1/\eta_G} (Q_{n,t}^G)^{(\eta_G-1)/\eta_G} \right]^{\eta_G/(\eta_G-1)} \quad (17)$$

This includes $\mathcal{N}_T$ a set of products that meet previously published technological and quality standards. This policy creates an initial test market but does not guarantee revenue for any particular business; competition in terms of price, quality, and interoperability is still maintained.

With $q \in \{D, \mathcal{R}, H, \Gamma\}$, public assets accumulate according to

$$G_{i,t+1}^q = (1 - \delta_q)G_{i,t}^q + (1 - \ell_{i,t}^q)J_{i,t}^q \quad (18)$$

This $J_{i,t}^q$ includes budget investments and $\ell_{i,t}^q \in [0,1]$ the portion that does not transform into useful assets. The expectation of loss is satisfied.

$$\text{logit}(\mathbb{E}_t \ell_{i,t}^q) = \bar{\ell}_i^q - \kappa_{\text{tr}} \ln D_{i,t} - \kappa_{\text{au}} \text{Audit}_{i,t} + u_{i,t}^{\ell,q} \quad (19)$$

Thus, open data, transaction tracing, and auditing are not only inputs to production but also enhance the efficiency of converting budgets into public assets.

5.6. Fragmentation, coordination capacity, and the state budget

Around the steady state, the general kinematics of fragmentation $f_{i,t}$ and the log of coordination capacity $g_{i,t} = \ln \Gamma_{i,t}$ can be written.

$$\begin{bmatrix} f_{i,t+1} \\ g_{i,t+1} \end{bmatrix} = \begin{bmatrix} \rho_F & -\kappa_F \delta_F \\ \phi_F & 1 - \delta_F \end{bmatrix} \begin{bmatrix} f_{i,t} \\ g_{i,t} \end{bmatrix} + \begin{bmatrix} \epsilon_{i,t+1}^F \\ \epsilon_{i,t+1}^G \end{bmatrix} \quad (20)$$

Fragmentation is persistent; coordination reduces fragmentation; and high levels of fragmentation trigger coordinated investment responses in the next period. This is a feedback mechanism, not an assumption that establishing an automated administrative hub will automatically resolve bottlenecks.

The consolidated state budget is

$$B_{t+1} = R_t^b B_t + G_t^C + G_t^T + \sum_{i,q} J_{i,t}^q + \sum_{i,n \in i} \frac{m_{i,t}}{1 - \ell_{i,t}^m} P_{n,t}^Z I_{n,t}^Z + TR_t - \mathcal{J}_t \quad (21)$$

This includes G_t^C normal public consumption, TR_t transfers, and T_t total revenue. To ensure solvency, the primary surplus as a percentage of GDP s_t reacts to debt:

$$s_t - \bar{s} = \phi_b(b_{t-1} - \bar{b}) + u_t^s, \quad b_t = \frac{B_t}{Y_t^{VA}} \quad (22)$$

In a small, open economy, the interest rate facing the private sector consists of the global interest rate and the risk premium:

$$R_t = R_t^* \exp[\phi_{rp}(b_t - \bar{b}) + u_t^{rp}] \quad (23)$$

The export demand for the node n is

$$EX_{n,t} = \bar{X}_n \left(\frac{P_{n,t}}{E_t P_t^*} \right)^{-\eta_x} Y_t^* \quad (24)$$

5.7. Competitive Balancing and the Problem of State Coordination

The goods market at each node is satisfied.

$$Y_{n,t} = C_{n,t} + I_{n,t} + I_{n,t}^Z + Q_{n,t}^G + EX_{n,t} + \sum_{k \in \mathcal{N}} M_{kn,t} \quad (25)$$

A reasonable expected equilibrium is a set of allocations, prices, and policy instruments such that: households are optimized; businesses produce and innovate optimally; private and public accumulation laws are satisfied; the government budget and the balance of payments are balanced; all markets for goods, labor, and assets are closed; and expectations coincide with the probability distributions generated by the model.

The Ramsey criterion of the "coordinating state" of choice

$$\{J^D, J^R, J^H, J^I, m, Q^G, \mathcal{T}\}_{t=0}^\infty$$

To maximize welfare (1), a regional distribution weight can be added, with the constraint being the enforcement conditions of competitive equilibrium. The state does not directly select the output or inputs of each enterprise; the state influences through public assets, linkage costs, innovation risk sharing and public demand design.

6. Network mechanisms, propositions, and stability conditions

6.1. Network simplification

Linearize around a steady state and keep the cost proportions fixed at the first order. Set

$$\Omega_{nm} = \mu_s \theta_{nm}, \quad \theta_{nm} = \frac{P_m M_{nm}}{\sum_k P_k M_{nk}} \quad (26)$$

is the input dependency matrix. Then the logarithmic variation of gross output satisfies the condition.

$$d\mathbf{y}_t = \Omega d\mathbf{y}_t + d\mathbf{a}_t^{\text{eff}} - S_\tau d\boldsymbol{\tau}_t + B_F d\mathbf{f}_t \quad (27)$$

or

$$d\mathbf{y}_t = \mathcal{L}[d\mathbf{a}_t^{\text{eff}} - S_\tau d\boldsymbol{\tau}_t + B_F d\mathbf{f}_t], \quad \mathcal{L} = (I - \Omega)^{-1} \quad (28)$$

$\mathcal{L}$ is the inverse of Leontief. If $\mathbf{v}$ is the final demand weight vector, then $\mathbf{d}' = \mathbf{v}'\mathcal{L}$ is the endogenous Domar weight vector. Equation (28) is the bridge between the DSGE model and the inter-industry balance sheet data.

Proposition 1. The value of coordination increases with network centrality.

Suppose $\Omega \geq 0$, $\rho(\Omega) < 1$, and an increase in local coordination capacity i weakens or severely reduces at least one linkage cost, i.e. $B_F e_i \geq 0$. The first-order impact on real GDP is

$$\frac{\partial \ln Y_t^{VA}}{\partial g_{i,t}} = \mathbf{v}' \mathcal{L} B_F e_i \geq 0 \quad (29)$$

The inequality is strict if there exists a positively weighted path from the improved link to a node serving the final demand. Therefore, the benefit of a larger coordinating capacity unit is greater in provinces/sectors with high input-output centrality.

Proof outline. Conditions $\rho(\Omega) < 1$ for allowing expansion.

$$\mathcal{L} = I + \Omega + \Omega^2 + \dots \geq 0.$$

Each recorded $\Omega^k B_F e_i$ impact across paths of length k . Multiplying by $\mathbf{v}' \geq 0$ and adding over all k results in a non-negative outcome. Strictness is indicated when at least one path connects the coordinating shock to the final demand. The results also show that evenly distributing the coordinating budget is often suboptimal.

Proposition 2. Optimal seed capital is equal to the gap between the social value and the private value of knowledge.

This refers $V_{Z,n}^p$ to the private present value of a new unit of knowledge and $V_{Z,n}^s \geq V_{Z,n}^p$ its social value, including its diffusion through networks. In the absence of fiscal costs and losses, the effective Pigou support rate is

$$m_n^p = \Pi_{[0,1]} \left(1 - \frac{V_{Z,n}^p}{V_{Z,n}^s} \right) \quad (30)$$

where $\Pi_{[0,1]}$ is the projection onto the segment $[0,1]$. If $\lambda_g > 0$ is the marginal cost of public funds and ℓ_i^m is the loss, the optimal efficiency rate becomes .

$$m_n^* = \Pi_{[0,1]} \left[1 - \left(1 + \frac{\lambda_g}{1 - \ell_i^m} \right) \frac{V_{Z,n}^p}{V_{Z,n}^s} \right] \quad (31)$$

Therefore, support increases with knowledge externalities but decreases with the cost of public capital and the level of losses.

Proof outline. The private optimal condition is $(1 - m)P^Z = V_Z^p \mathcal{N}_I$. The planner's condition is $\left[1 + \lambda_g / (1 - \ell^m) \right] P^Z = V_Z^s \mathcal{N}_I$. Equate the two conditions at the same level I^Z and solve according to m to (31); set $\lambda_g = 0$ and $\ell^m = 0$ for (30). This is the seed capital argument, not the reason for the State to fully fund R&D.

Proposition 3. Seed capital and public assets constitute a complementary policy package.

Assuming innovation follows (15), the coefficients $\phi_I, \phi_R, \phi_D, \phi_\Gamma > 0$, private R&D investment increases according to m , and fiscal crowding-out effects are temporarily held fixed. Then

$$\frac{\partial^2 \mathcal{N}_{n,t}}{\partial m_{i,t} \partial \mathcal{R}_{i,t}} > 0, \quad \frac{\partial^2 \mathcal{N}_{n,t}}{\partial m_{i,t} \partial D_{i,t}} > 0, \quad \frac{\partial^2 \mathcal{N}_{n,t}}{\partial m_{i,t} \partial \Gamma_{i,t}} > 0 \quad (32)$$

Because GDP increases with knowledge and $\mathcal{L} \geq 0$, the corresponding cross-derivatives of gross benefits with respect to output are also positive. Net welfare benefits remain positive if cross-fiscal costs do not exceed the technological and network additions.

Proof outline. Cobb–Douglas technology (15) is log-modular and has positive cross derivatives at the middle level I^Z and for each public asset. Due to $dI^Z/dm > 0$, the chain rule for inequalities (32). Multiplying the yield impact by the non-negative Leontief inverse preserves the sign. The proposition explains why seed funding without shared data, labs, standards or responsible focal points can be inefficient.

Proposition 4. The optimal allocation of labor balances marginal social benefits adjusted for losses.

Consider a one-period budget $\bar{J}^q$ for public assets q , with

$$\sum_i J_i^q \leq \bar{J}^q.$$

At the internal solution, the optimal allocation is satisfied.

$$\underbrace{\mathbf{v}' \mathcal{L} \mathbf{b}_i^q}_{\text{certainty and diffusion}} \underbrace{\frac{\partial \ln Y_i}{\partial G_i^q}}_{\text{bottleneck sensitivity}} \underbrace{(1 - \ell_i^q)}_{\text{execution performance}} = \lambda_q \quad (33)$$

For all localities receiving positive investment, the left side does not exceed λ_q . Therefore, a consistent priority indicator with the model is

$$\mathcal{P}_i^q = \text{Centrality}_i^q \times \text{FrictionSensitivity}_i^q \times (1 - \ell_i^q) \quad (34)$$

Proof outline. Formulate the Lagrange function of the first-order GDP or welfare change maximization problem under budget constraints. Differentiate with respect to J_i^q , using (18) and (28), for the left side of (33). The Kuhn–Tucker condition leads to marginal utility equilibrium at internal solutions and inequality at corner solutions. Priority ranking therefore cannot be based solely on GRDP size, poverty level or a single governance indicator.

Proposition 5. Centralized coordination can create the risk of a “systemic bottleneck.”

Assume the shock to central coordination $\epsilon_{0,t}^r$ has variance σ_0^2 , and the first-order effect on linkages is $B_{r0}\epsilon_{0,t}^r$. The GDP variance portion caused by the general shock is

$$\text{Var}_0(d\ln Y_t^{VA}) = \sigma_0^2 (\mathbf{v}' \mathcal{L} B_{r0})^2 \quad (35)$$

Conversely, if the contingency functions are dispersed into independent shocks ϵ_i^r , the corresponding variance is

$$\text{Var}_{\text{dec}}(d\ln Y_t^{VA}) = \sum_i \sigma_i^2 (\mathbf{v}' \mathcal{L} B_{ri})^2 \quad (36)$$

A central hub can reduce the average interoperability cost, but it will increase systemic risk if the overall load factor and error variance of the hub are sufficiently large. Optimal coordination therefore requires unified responsibility coupled with verifiable data, auditability, interchangeability, and redundancy mechanisms.

Proof outline. From (28), GDP change is a linear combination of coordinating shocks. With a common shock, the covariance between all like-sign linkages is fully summed, creating the square of the total loading coefficients as (35). With independent shocks, the cross-covariance products are zero, giving (36). Compare the two expressions for the threshold at which the benefits of reducing fragmentation are outweighed by the risk of concentration.

6.2. Conditions for local existence and stability

First, the input-output system must satisfy

$$\rho(\Omega) < 1 \quad (37)$$

For the Leontief inverse to exist, a final bridge unit does not require infinite pooled inputs.

Second, with the kinematic matrix in (20), set

$$\text{tr} A_{F\Gamma} = \rho_F + 1 - \delta_\Gamma, \quad \det A_{F\Gamma} = \rho_F(1 - \delta_\Gamma) + \kappa_\Gamma \delta_\Gamma \phi_F.$$

Jury conditions are

$$1 - \det A_{F\Gamma} > 0, \quad 1 - \text{tr} A_{F\Gamma} + \det A_{F\Gamma} > 0, \quad 1 + \text{tr} A_{F\Gamma} + \det A_{F\Gamma} > 0 \quad (38)$$

With $0 \leq \rho_F < 1$, $0 < \delta_F \leq 1$ and non-negative feedback coefficients, the following two inequalities are automatically satisfied; the remaining condition is

$$\rho_F(1 - \delta_F) + \kappa_F \delta_F \phi_F < 1 \quad (39)$$

This eliminates an overly strong feedback loop between fragmentation and organizational reorganization.

Third, from (22), linear dynamics of the coefficient debt ratio

$$\frac{1+r}{1+g} - \phi_b.$$

Fiscal stability requires

$$\left| \frac{1+r}{1+g} - \phi_b \right| < 1 \quad (40)$$

A familiar sufficient condition is that the primary surplus reacts more strongly to the interest rate-growth spread, but not so strongly as to create debt volatility.

Finally, after eliminating the equilibrium growth trend, exogenous shocks must cease; capital adjustment costs must be convex; and the system of linear equations must be reasonable.

$$A_0 x_t = A_1 x_{t-1} + B \epsilon_t + C \eta_t \quad (41)$$

The Blanchard–Kahn condition must be satisfied: the number of general solutions outside the unit circle is equal to the number of jumping variables. These conditions guarantee a unique local solution, but do not guarantee that the coordinating government will always improve welfare. The final welfare sign also depends on fiscal costs, losses, data errors, market substitutability, and concentration risk as outlined in Proposition 5.

7. Data and Measurement

7.1. Data Structure

The study strictly distinguishes between three layers of information: (i) official observed data; (ii) latent variables and estimated parameters; and (iii) modeled variables. This distinction is particularly important in the case of Vietnam, since “coordination capacity” is not a directly measured indicator by the statistical agency and because most of the resolutions motivating the study were issued after the endpoint of the data sample.

The baseline dataset is a publication from the General Statistics Office covering 63 provinces and cities for the period 2020–2024. After standardizing local names, the balanced dataset contains 315 province-year observations ($= 63 \times 5$). The extracted variables include GRDP at current prices, GRDP at constant 2010 prices, population, and three groups of real value-added – agriculture, forestry and fisheries;

industry and construction; and services – total realized investment at current prices, state sector capital, and non-state sector capital. FDI capital is calculated as the remainder between total investment and the two components above. From this, the study constructs real GRDP growth, GRDP per capita, and the ratios of state, non-state, and FDI investment to GRDP. All ratio calculations use the same current prices for both the numerator and denominator; growth is calculated from the constant-price GRDP series.

The governance data layer comprises three sources. First, the Provincial Competitiveness Index (PCI) provides five components directly related to coordination friction: transparency, time costs, informal costs, dynamism and pioneering spirit of the government, and legal institutions. PCI data is aggregated for the entire period 2020–2024. Second, the Provincial Digital Transformation Index (DTI) is used for 2022–2024, with two pillars, “digital institutions” and “digital government operations,” in addition to the aggregate DTI. Third, the 2024 Local Innovation Index (PII) provides an innovation output index for all 63 localities. Because the PII uses some inputs derived from the PCI, DTI, and other administrative index sets, the PII is not included in the coordination index, is not used as a tool, and is not considered a completely independent assessment. It only serves as a descriptive check outside the main measurement sample; this approach avoids creating mechanical correlations due to the same data source.

To reconstruct the inter-industry structure, the full version of the study uses the 2019 Vietnam Inter-Industry Balance Sheet, compared with the 2012 table and the OECD Inter-Country Input–Output. The national I–O table does not directly observe the intermediate flows between each pair of provinces. Therefore, the multi-region matrix is estimated using a transparent process: Flegg localization coefficients to determine on-site supply capacity; an attractiveness model based on economies of scale and distance costs to allocate inter-provincial flows; and then row and column balancing using RAS so that the total industry matches the national I–O table and the total local GRDP matches. The resulting matrix should be correctly called the “estimated MRIO,” not the official inter-provincial I–O table. The main results will be reported on a family of alternative matrices—FLQ, CHARM, and various distance elasticities—to transfer network measurement uncertainty into policy confidence intervals.

7.2. Observational Coordination Index and Model for Measuring Latent Variables

A pilot project was undertaken to develop the Coordination Capacity Index (CCI) using principal component analysis. First, each indicator was standardized annually to eliminate changes in the overall scale and preserve the relative position of each locality. With the standardized indicator vector z_{it} , the index is...

$$CCI_{it} = \frac{z_{it}'v_1 - \overline{z'v_1}}{sd(z'v_1)}, \quad (41)$$

Where v_1 is the eigenvector corresponding to the largest eigenvalue of the correlation matrix. The sign of v_1 is oriented so that a higher value indicates greater transparency, proactiveness, institutional capacity, and better digital governance. Because the final CCI has a mean of 0 and a standard deviation of 1, the regression coefficient can be read as the change in the dependent variable as the coordinating capacity increases by one standard deviation.

Across the five PCI components, the factor loads were 0.163 for transparency; 0.493 for time costs; 0.541 for informal costs; 0.505 for dynamism; and 0.428 for legal institutions, respectively. The first component explained 43.77% of the total variance; its Cronbach's alpha was 0.646. In the 2022–2024 samples, when digital institutions and digital government were added, the corresponding factor loads for the seven variables were 0.214; 0.455; 0.501; 0.463; 0.346; 0.247; and 0.319. The first component explained 31.78% of the variance, and its alpha was 0.620. All loads had the same sign, consistent with the coordinating concept, but the explained variance and reliability were only moderate. Therefore, CCI is an exploratory index with measurement errors, not a confirmed structural quantity.

In the official VN-CNDSGE estimation, the study does not mechanically homogenize “coordination,” “fragmentation,” and “digitization.” Instead, the indicators are attached to a multi-factor state-space model:

$$x_{it}^k = a_k + \lambda_{rk}\gamma_{it} - \lambda_{fk}f_{it} + \lambda_{dk}d_{it} + \alpha_{ki} + \delta_{kt} + v_{it}^k, \quad (42)$$

$$s_{it} = A_s s_{i,t-1} + B_s \bar{s}_t + C_s w_{it} + u_{it}, \quad s_{it} = (\gamma_{it}, f_{it}, d_{it})' \quad (43)$$

Here, γ the factors are coordination capacity, f institutional fragmentation, and d public data assets; w_{it} including observed variables of infrastructure, human resources, and budget. The sign constraints reflect the theory: dynamism, transparency, and digital governance load positively γ ; time costs and informal costs load positively f after scale reversal; infrastructure and data governance load positively d . Indicator-province effects α_{ki} handle persistent differences in response or implementation; indicator-year effects δ_{kt} handle changes in measurement methodology. The individual error variances are estimated rather than assumed to be equal. This structure allows the Kalman filter to extract the posterior distribution of the state, while simultaneously transferring the measurement error into the uncertainty of the DSGE coefficients.

7.3. A bridge connecting 63 historical units to 34 provinces and cities.

The administrative reorganization, effective from July 2025, creates a classification disruption, not necessarily an immediate economic shock. To avoid confusing boundary changes with growth or improved governance, the study retains 63 units as a historical estimate until the end of 2024 and constructs a binary mapping matrix $M \in \{0,1\}^{34 \times 63}$. For summable quantities such as population, GRDP, investment capital, or goods flows, the summation is

$$X_t^{34} = M X_t^{63} \quad (44)$$

For ratios, price levels, or intensity indices, the value of the new unit is a weighted average consistent with the denominator: population for per capita; GRDP for economic ratio; number of businesses or respondents for survey indicators. Absolutely no simple average of rankings is taken. For multi-sector networks, first group the flows according to $F^{34} = (M \otimes I_S)F^{63}(M' \otimes I_S)$, then divide by the total input or output of the receiving location to calculate the technical coefficient. PCI, DTI, and coordinating latent variables are re-estimated after grouping, along with a test for measurement invariance. In the extended series through 2025, the model includes bridge variables and transition variance; the shift from 63 to 34 geographic labels is not considered a “coordination reform” that has produced results.

8. Identification Strategy

The central challenge in identifying the center is the two-way relationship: localities with good growth can invest more in data and infrastructure; conversely, good infrastructure can fuel growth. PCI quality can also react to business expectations, while public investment is often allocated to areas experiencing adverse shocks. Therefore, the CCI-outcome correlation cannot be interpreted as causal impact.

The main design leverages the differences in network exposure between industries within the same locality. This is called $E_{is,0}$ the predetermined exposure of the industry s in the province i , calculated from the 2019 I-O matrix, prior to the new resolutions. The simplified equation is:

$$y_{ist} = \beta(CCI_{it} \times E_{is,0}) + \alpha_{is} + \mu_{it} + \eta_{st} + \theta^{W_{ist}} + \varepsilon_{ist}. \quad (45)$$

The fixed province-sector effect α_{is} absorbs sustainable comparative advantage; the province-year effect μ_{it} absorbs all general shocks within a province, including the CCI level; and the industry-year effect η_{st} absorbs the national industry cycle. This β is then identified from a narrower question and is consistent with the mechanism: within the same province-year, do industries located in friction-sensitive network positions react more strongly when coordination capacity changes? Standard errors are clustered bidirectionally by province and industry; with a small number of industry clusters, inference is made using wild-cluster bootstraps.

To address the remaining endogenous CCI, the study proposes a digitalized Bartik tool:

$$Z_{it} = \sum_a s_{hare_{ia,0}} \Delta DigitalService_{a,t}^{(-i)}. \quad (46)$$

This $share_{ia,0}$ includes the structure of administrative services by procedure type a in the province before reform; $\Delta DigitalService_{a,t}^{(-i)}$ and the nationwide digitization rate of that procedure type, calculated excluding the province i . The tool forecasts the extent to which a province is “pushed” into digitization due to its initial procedure structure, rather than due to the province's current growth shock. First-order regression reports coefficients, Kleibergen–Paap and Anderson–Rubin statistics; the original weights are fixed before the policy period, and the national shock is left-one-out. The exclusion condition still needs to be checked: the initial procedure structure may be related to the sectoral structure. Therefore, the model controls the interaction between the initial sectoral structure and the annual trend, tests for equilibrium before the period, and reports “plausibly exogenous” estimates to allow the tool to have a small direct impact.

Two sets of off-local shocks support network channel identification but do not replace governance tools. The global demand shock is constructed by multiplying partner imports by product multiplied by the provincial-sector export structure at the base period; the upstream cost shock uses international price fluctuations multiplied by predetermined input-output weights. These help separate demand and cost propagation from local productivity. The placebo tests use undirected network linkages, order-preserving stochastic matrices, and “future shocks” to detect trends in advance.

Resolution 57 was issued in late 2024, Resolution 68 in 2025, and Resolution 79 and the new resolution on the FDI sector in 2026. The current outcome sample ends in 2024. Therefore, the study does not use these resolutions as treatment variables, does not present post-policy difference-in-differences, and does not assign any pilot coefficients to the impact of the resolutions. In the current version, the resolutions only define shock packages for the ex ante. When post-implementation data is available, the study will pre-register an event study based on the specific local implementation time, publish the “treated” criteria, examine parallel trends, and avoid using the date of issuance of the document as the date of economic outcome change.

9. Estimating the structure and evaluating the model.

The estimation was organized in five steps. Step one adjusted the parameters with good controls: input weights and matrix Ω from I–O; labor and capital share from national accounts; depreciation from capital data; openness and export demand from ICIO. Step two estimated the multi-factor measurement system using Kalman Bayes, with sign priors and contraction priors for cross-loading. Step three estimated the linkage elasticity, state strength, and fiscal rule in log-linear form of VN-CNDSGE. The sector coefficients have a hierarchical structure, such as $\psi_{rs} \sim N(\bar{\psi}_r, \sigma_{\psi}^2)$, to share information without forcing agriculture, manufacturing, and services to have the same sensitivity.

Step four combines national, provincial-sector macro moments and local IV estimates into a Bayesian likelihood function. For the linear-Gaussian portion, the likelihood is calculated using a Kalman filter and

the posterior is sampled using a Monte Carlo Hamiltonian or block MCMC. For seed capital losses with non-negative logit or constraint functions, the study uses sequential Monte Carlo and checks with a particle filter. Large networks are represented by dominant spectral factors and sparse exact matrices; hundreds of thousands of provincial-sector linkages are not freely estimated. Uncertainty of the MRIO matrix is handled using Bayesian model averaging or iterative estimation on multiple possible matrices.

Step five compares three nested specifications: M0 is DSGE without coordination state; M1 allows CCI to enter TFP but not propagate through the link; M2 is full VN-CNDSGE, where coordination reduces input friction and knowledge on the network. Selection criteria include log marginal likelihood/Bayes factor, LOO or WAIC, rolling forecast error of 1–3 years, and posterior forecast testing for GRDP–investment–innovation co-movement. M2 is only considered data-backed if it improves out-of-sample forecasts and reproduces network center amplification, not just higher in-sample fit. Sensitivity analysis changes prior to, year I–O, regionalization, CCI definition, and successive removal of major cities.

10. Pilot results: testing the data pipeline, not estimating causality.

The re-establishment pilot was used to test the extraction, province merging, scale construction, and error magnitude before estimating the structural model. The NSO sample had 315 observations. When simultaneously requesting PCI, the two pillars DTI, and GRDP growth, the sample expanded to 189 province-year observations for 2022–2024. The 2024 PII cross-section included all 63 provinces. No observations were added after the 2025–2026 resolutions were implemented.

In 2024, the unweighted average of real GRDP growth across 63 localities was 7.575%; the non-state investment-to-GRDP ratio was 21.257%; the state investment ratio was 10.536%; the composite DTI was 0.6961; and the PII output index was 32.260 points. The unconditional correlation between the expanded CCI and PII output was 0.318; the correlation between the CCI and 2024 GRDP growth was 0.255. These two positive correlations are useful for detecting sign errors or data concatenation errors, but do not address income levels, industry structure, inverse causality, or measurement errors.

Three exploratory regressions were estimated before network inclusion. In the 2022–2024 panel, GRDP growth was regressed against the expanded CCI, fixed effects by province and year, with clustered standard errors by province. The CCI coefficient was -0.00113 , equivalent to -0.113 percentage points of growth for one CCI standard deviation; the standard error was 0.00436, $p = 0.79695\%$ confidence interval $[-0.00968; 0.00742]$, $n = 189$, $R^2 = 0.612$. The wide confidence interval included both negative effects of nearly one percentage point and positive effects of about 0.74 percentage points; short data did not distinguish these values.

With the ratio of non-state investment to GRDP as the dependent variable and the same fixed effects structure, the CCI coefficient is 0.00295, or 0.295 percentage points; standard error 0.00390, $p = 0,45095\%$ confidence interval $[-0.00470; 0.01060]$, $N = 189$, $R^2 = 0,943$. The high value R^2 mainly reflects the fixed effects of the province and should not be interpreted as the CCI's own explanatory power. The positive coefficient is consistent in sign with the "unlocking private capital" mechanism, but is not different from zero according to conventional reasoning.

Finally, in the 2024 cross-section, PII output was regressed against CCI and log GRDP per capita, with a standard error of HC3. One standard deviation of CCI corresponds to a 1.029 point higher PII; standard error 0.765, $p = 0,17995\%$ confidence interval $[-0.471; 2.528]$, $N = 63$, $R^2 = 0,496$. The coefficient of log GRDP per capita is 12.616 (standard error 2.480; $p < 0,001$), indicating that the difference in development levels significantly dominates the cross-section. However, because PII has components close to PCI/DTI and because income is also endogenous, this is only a conditional correlation, not evidence of the impact of coordination on innovation.

The statistical message of the pilot is "undetermined," not "no impact." All three CCI coefficients were not statistically significant; the sign of growth was negative, while the signs of private investment and innovation were positive. This is consistent with four anticipated limitations: only three years for the expansion index; moderate reliability of the coordinating variable; regression not using network exposure interactions as the primary identification mechanism; and economic outcomes potentially reflecting governance assessments. The pilot therefore neither confirms nor rejects VN-CNDSGE. Its value lies in demonstrating the ability to re-establish the pipeline, quantify confounding, and prevent research from drawing causal conclusions beyond the data.

Before using the results for quantitative advice, the study needs to complete four validation thresholds: (i) publish data and CCI construction codes along with provincial name reference tables; (ii) extend PCI and economic data series to before 2020, while updating them to after 2025; (iii) construct and validate MRIO with multiple regionalization methods; and (iv) pass tests for weak instruments, prior trends, network placebo, and out-of-sample forecasts. Only after these steps can the posterior distribution of coordinating multipliers and welfare benefits be reported. Any counter-actuals at this stage must be labeled "ex ante, assumed dependency," with an uncertainty interval, and should not be presented as observed results of the four resolutions.

10.1. Data pipeline validation tables and figures

Table 2. Data structure and its role in research

Source	Usage level/duration	Main variable	Role	Warning
Statistics Department, Ministry of 63 provinces	63 provinces $\times$ 2020–2024; 315 observations	Current/Real GRDP, Population, Major Sector GRDP, Capital by Region	Economic results, investment rate	Comparing geographical boundaries using a bridge 63→34

Source	Usage level/duration	Main variable	Role	Warning
PCI	63 provinces × 2020–2024	Transparency, timeliness, informality, dynamism, legality	Coordination/Fragmentation Indicator	Business survey; reverse cause and effect
DTI	63 provinces × 2022–2024	Digital institutions, digital government, total DTI	Digital data/capability indicators	Short sequence; method can be changed.
PII	63 provinces, 2024	Innovation output	Check the external description.	It has PCI/DTI power indicator; not used for IV/structural moment.
I-O Vietnam 2019; OECD ICIO	National/International Sector	Input coefficient, world demand	Global networks and exogenous systems	Provincial-sector MRIO is an estimation matrix.

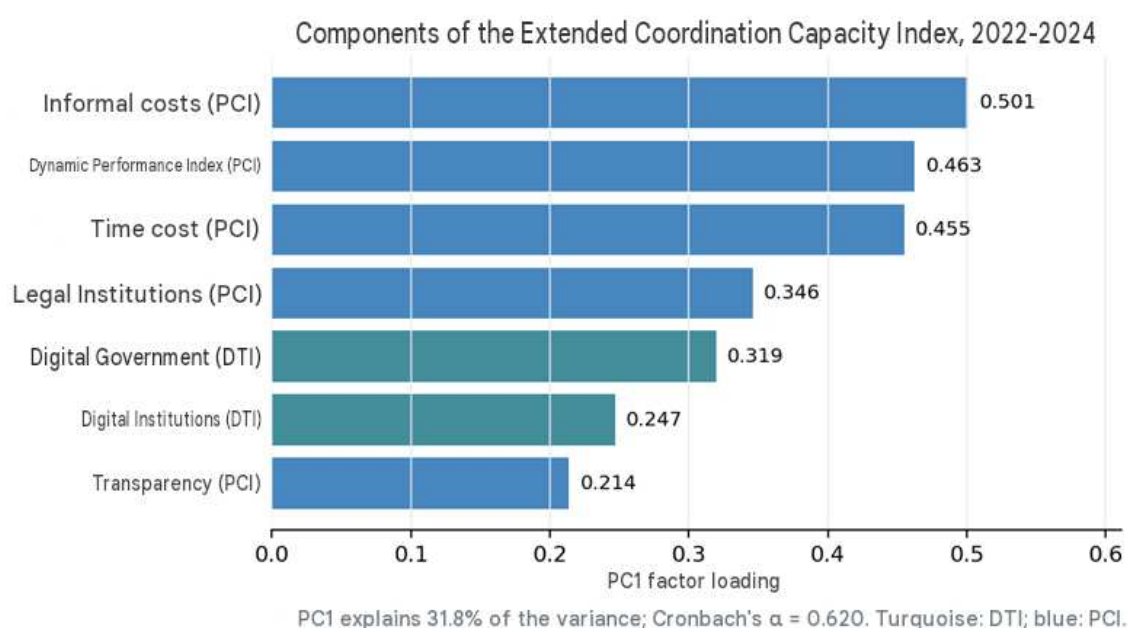


Figure 2. Factor loadings of the Extended Coordination Capacity Index. All loads have the same sign, but the reliability is only moderate.

Table 3. PCA Load of the Coordination Capacity Index

Indicator	PCI-only, 2020–2024	CCI Expansion, 2022–2024
Transparent	0.163	0.214
Time cost	0.493	0.455
Informal costs	0.541	0.501
Dynamic	0.505	0.463
Legal institutions	0.428	0.346

Indicator	PCI-only, 2020–2024	CCI Expansion, 2022–2024
Digital institutions	—	0.247
Digital government	—	0.319
Variance explained by PC1	43.77%	31.78%
Cronbach's alpha	0.646	0.620

Note: Each indicator is normalized within a year. The final CCI score is normalized to a mean of 0 and a standard deviation of 1. Loading signs are chosen so that a higher CCI indicates better coordination capacity.

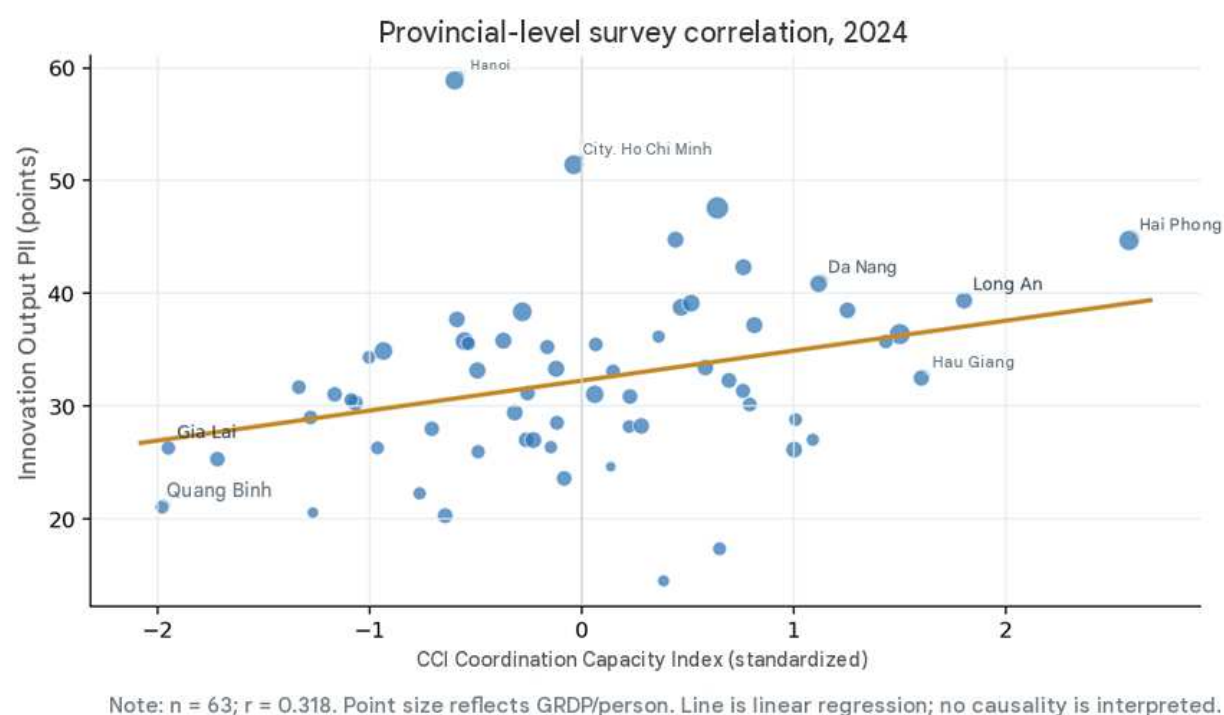


Figure 3. Correlation between expanded CCI and innovation output PII in 63 provinces, 2024. Point size reflects per capita GRDP; regression line does not carry causal interpretation.

Table 4. Pilot regression — coefficients of the extended CCI

Dependent variable	Coefficient	Standard error	p	KTC 95%	N	R ²
Real GRDP growth	-0.00113	0.00436	0,796	[−0.00968; 0.00742]	189	0.612
Non-state investment/GRDP	0.00295	0.00390	0.450	[−0.00470; 0.01060]	189	0.943
PII 2024 Output	1.02881	0.76511	0.179	[−0.47080; 2.52842]	63	0.496

Note: The two panel models have fixed effects at the provincial and annual levels, with clustered standard errors by province. The PII cross-sectional model controls for log GRDP per capita and uses the HC3

standard error. This is an exploratory correlation, not a causal effect. The R^2 panel primarily reflects fixed effects.

Table 5. Status of evidence at the time of draft

Ingredient	Status	It can be concluded that...	No conclusion can be drawn.
NSO/PCI/DTI/PII data	Observed and grafted	Description 2020–2024; pipeline inspection	Impact of the resolution after 2024
PCA/CCI	The pilot program has been considered.	A composite scale with moderate reliability.	CCI is a state of structure without errors.
Three regressions	Survey estimates have been made.	The current data does not determine a non-zero coefficient.	Coordination has no effect; causality
MRI/Specialized provincial-level	Not yet complete	There are regionalization and sensitivity testing procedures.	The official intercity network has been observed.
VN-CNDSGE Bayes	Pre-estimate design	Determine the likelihood, prior, and control models.	The number of policy or benefit multipliers has been estimated.

11. Correction, world data and anti-realistic design ex ante

11.1. Correction and Prior Principles

The full estimate distinguishes three groups of parameters. The first group is calculated directly from the data: input weights θ_{nm} , intermediate input weights μ_s , final demand weights, industry structure, and international exposure. The second group is adjusted or pre-set from international data: household preferences, depreciation, trade elasticity, adjustment costs, and public capital elasticity. The third group must be estimated using Vietnamese data: wedge sensitivity associated with coordination/fragmentation, factor load, durability of coordination capacity, loss levels, and private R&D response. The draft does not replace unestimated values with a single “point estimate”; counter-actuals must integrate on the posterior distribution or scenario range report.

Table 6. Suggested adjustment and prior frameworks

Parameters/Blocks	Value or prior basis	Source/logic	Uncertainty handling
β	0.96 annually	Standard macroeconomic model	Sensitivity 0.94–0.98
σ	prior median 2	International useful curvature	Gamma, band 1–4
$1/v$	median 0.5	Frisch elasticity	Range 0.25–1
δK	0.06/year	Capital account and PWT	Range 0.04–0.10
α_s, μ_s	by industry	Vietnam's National Accounts and I-O 2019	Sampling from I-O errors

Parameters/Blocks	Value or prior basis	Source/logic	Uncertainty handling
Ω	I-O 2019; compared with 2012/ICIO	Observed input coefficients	Multiple MRIO matrices
ϵ_s, η_X	prior according to commercial documents	Input/export substitutability	Prioritize by industry
Public capital elasticity	The long-term center is approximately 0.122	International compilation by Bom–Ligthart	Not applicable directly to each individual D, R, H, F
$\psi^{\Gamma X}, \psi^{\Gamma Z}, \psi^F$	The score has not yet been determined.	Moment Network Vietnam	Prior positive, contractile; Bayesian estimation
$\delta\Gamma, \rho^F$	Weak prior in the stable region	State-space	Prior cutting under Jury conditions
ℓ^{φ}	The score has not yet been determined.	Audit/Disbursement/Asset Output	Hierarchical Logit; exception checking
$\varphi^I, \varphi^R, \varphi^D, \varphi^{\Gamma}$	positive, total not exceeding 1 at the facility	Innovative technology	Compare specifications; posterior predictive checks
φ^b	debt stability guarantee zone	Fiscal rules	Cut prior to condition (40)

Prior data from the world is not considered “replaceable Vietnamese data”. The OECD ICIO 2025, covering 80 economies and 50 sectors from 1995–2022, identifies international linkages and provides a reference distribution for network concentration. World Development Indicators, Worldwide Governance Indicators, and the Penn World Table provide growth, productivity, capital, openness, and institutions. The GovTech Maturity Index and the UN E-Government Development Index create benchmarks for comparing the digital capacity of the public sector. A global hierarchical model might use comparable economies to create hyperpriority, but Vietnam’s posterior coefficient is still updated using Vietnamese likelihood and reported separately. This approach avoids mechanical extrapolation from countries with different administrative structures, income levels, or openness.

11.2. Counter-realization packages and policy mapping

Counter-reality is modeled within the same framework, the same world baseline, and the same present value of budget costs. Each package is a vector of tool change, not a single legal text label.

Table 7. Ex-ante anti-electrode packets

Script	Shock/tools in modeling	Main question	Required result labels
C0 — facility	Current rules, no new reforms.	Reference line	The model forecast has a confidence interval.
C1 — NQ57	JD, JR, JH, JF; decrease ΔZ	How do data, R&D, human resources, and digitalization complement each other?	Ex ante; not the observed effect
C2 — NQ68	m, QG; reducing private sector entry/joint costs	How much private capital is lost due to risk and losses?	Ex ante, tool design dependent

Script	Shock/tools in modeling	Main question	Required result labels
C3 — NQ79	Reallocation of public assets, open standards, and performance governance.	How do network-wide benefits differ from operating unit revenue?	Ex ante, budget constraints
C4 — NQ10	Linking FDI with domestic production, absorbing knowledge, and boosting export demand.	When does FDI create spillover effects instead of remaining an "isolated island"?	Ex ante, depends on absorption capacity
C5 — combination package	C1+C2+C3+C4 are under the same PV budget.	Does the additional cost exceed the coordination cost?	The posterior distribution, not just one point.
C6 — Conductor error	A negative shock to Γ_0 increases the overall variance.	At what point does the concentration of benefits reverse?	Stress test, not central forecasting

Comparative budget constraints are

$$\sum_{t=0}^T \frac{Cost_t^{(k)}}{(1+r)^t} = \overline{PV}, \quad k \in \{C1, \dots, C6\} \quad (47)$$

Therefore, a combined package shouldn't "win" simply because it costs more. Beyond accounting budget costs, $Cost_t$ which include administrative expenses, the opportunity cost of taxes, lifecycle operations, and losses, if an asset like data generates services over many years, both the benefits and costs of maintaining it are consistently discounted.

11.3. Objective Function, Regional Equity, and Reporting Measures

The extended Ramsey standard can be written

$$\mathcal{W}^G = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t [U(C_t, L_t) - \lambda_R \text{Var}_i(\ln C_{i,t}) - \lambda_P \text{PovertyGap}_t] \quad (48)$$

where λ_R and λ_P are transparent weights chosen by the planner, not “hidden” parameters adjusted to produce the desired result. The main report must simultaneously present: GDP and TFP; resulting private investment; knowledge capital; regional disparities; fiscal expenditure; losses; resilience; and consumption equivalence variability λ^{CE} , defined as the solution of .

$$\mathcal{W}((1 + \lambda^{CE})C^{base}, L^{base}) = \mathcal{W}^{policy} \quad (49)$$

To explain the bundled package, the study uses Shapley decomposition on the instruments $D, \mathcal{R}, H, \Gamma, m, Q^G$. The interactions are reported separately; the entire benefit of the bundle is not attributed to the instrument that was enabled last. Results should include the probability of the bundle generating a positive benefit, the probability of debt exceeding the threshold, the probability of loss exceeding the control threshold, and the distribution tails under adverse shocks.

11.4. Two illustrative zone modules

The Mekong Delta. The regional module incorporates salinity and climate shocks into agricultural productivity $A_{n,t}$, logistics quality, and information wedges. Shared ecological data reduces forecasting errors and search costs; research infrastructure supports adaptive varieties/processes; seed funding and trial procurement share risks among institutes, businesses, and farmers. The network should include at least agriculture, processing, logistics, finance/insurance, data services, and export markets. The scenario does not predetermine that increasing acreage or yield is the goal; the criteria are income, resilience, and value added across the entire chain.

Northern Midlands and Mountains. Regional modules increase transportation wedges, research infrastructure access costs, and market sparseness. Inter-provincial shared infrastructure, topographic-agricultural data platforms, digital agricultural extension, and pilot clusters can reduce fixed costs. However, the rule of relying solely on network centers will prioritize already strong nodes. Therefore, the report should include both pure efficiency experiments and experiments with regional service/welfare platforms, thereby quantifying the cost-effectiveness of the convergence objective instead of concealing trade-offs.

11.5. Decision-making rules from the perspective of anti-reality

A package is only recommended for expansion when four conditions are met simultaneously: (i) the probability of positive benefits exceeding a previously announced threshold; (ii) sustainable outcomes against the MRIO matrix, prior and replacement losses; (iii) no breach of debt constraints and regional benefit floor; and (iv) observable guiding indicators to halt or modify the design. If the outcome depends on an unidentified parameter, the correct recommendation is not to “choose the best package,” but rather the pilot design with the highest informational value to narrow the uncertainty of that parameter.

12. Policy Discussion

The first implication is that the focus of reform is not on the State “doing more” or “doing less” in a mechanical sense, but rather on changing the structure of the work the State performs. The functions with the highest social returns are often those that individual markets struggle to adequately provide: establishing compatible standards, building shared data, funding open research infrastructure, coordinating inter-entity externalities, sharing experimental risks, and ensuring accountability. A small expenditure reducing the wedge across multiple central links can have a greater impact than a large-scale physical investment isolated from the network.

Regarding Resolution 57, priority should not be measured solely by the number of digital platforms, laboratories, or funded projects. Outcome indicators should reflect cross-sectoral usage, time to access data, the number of businesses and institutions actually connected, the percentage of research results

tested, and the reduction in transaction costs. Public data requires mechanisms for governance of access rights, quality, privacy, and security; centralizing data without accountability standards can create greater risks than decentralizing data.

For Resolution 68, seed funding should be designed on the principle that the State shares the risk of social externalities but does not fully subsidize commercial risks. Mechanisms could include milestone financing, co-financing, option contracts, performance-based awards, and pilot public procurement. The optimal support rate should decrease as the risk of loss or misappropriation of benefits increases, and increase as knowledge externalities and early-stage fundraising difficulties grow. Selection criteria, implementation data, and post-support results should be publicly available to minimize favoritism-based selection.

Regarding Resolution 79, the effectiveness of state assets should be assessed by the system-wide social benefits. A shared research facility may not maximize the operating unit's revenue but is still highly valuable if it increases productivity for many businesses. However, "spillover benefits" should not be a reason for exemption from evaluation. Each project needs to disclose its hypothetical impact, beneficiary groups, utilization indicators, lifecycle costs, and conditions for stopping or redesigning.

For Resolution 10, attracting FDI needs to shift from focusing on the quantity of capital to the quality of linkages. Incentives are only meaningful when linked to human resource training, the development of domestic suppliers, joint research, technological standards, and the domestic sector's ability to absorb knowledge. The model predicts that the spillover effects from FDI will be low if domestic absorption and connectivity capacity is weak, even with a large registered capital scale.

For the Mekong Delta, policy countermeasures should consider the entire agricultural network – processing – logistics – finance – climate data, rather than simply changing the area or yield of individual crops. Suitable scenarios include a regional ecological data warehouse, infrastructure for testing drought- and salinity-adaptive varieties and technologies, public procurement for monitoring services, and a risk-sharing mechanism with businesses and farmers. These scenarios require simulation and pilot testing; research has not yet provided sufficient evidence to definitively state which scenario will generate specific growth rates.

For the northern midland and mountainous regions, topographic costs, small market size, and disparities in administrative capacity make the benefits of shared infrastructure and inter-provincial connectivity particularly significant. However, a purely network-centric prioritization could concentrate resources in already developed areas. Therefore, the Ramsey problem requires additional minimum welfare constraints or distribution weights to effectively balance regional convergence.

The biggest risk of the “single point of responsibility” model is that it makes that single point of responsibility the only point of failure in the entire system. The solution is not to revert to decentralized responsibility, but to combine clear accountability with auditability, real-time data, alternative processes, and operational decentralization. A single point of responsibility can be held accountable for the final

outcome while data, validation, and monitoring remain independent. Decisions requiring seed capital need to be traceable, criteria publicly disclosed, and conflicts of interest checked.

The mechanism for protecting those who dare to think and act must be designed alongside a mechanism for learning from failure. Honest failure in an experiment with a clear hypothesis, risk limits, tracking data, and adherence to procedures is fundamentally different from failure due to negligence or self-serving motives. If the system only rewards successful projects after the results are known, officials will avoid experiments with high informational value. Conversely, if all failures are excused under the guise of innovation, seed funding is easily misappropriated. The testing framework needs to predetermine the maximum budget, stopping criteria, independent evaluation mechanisms, and data sharing obligations.

Regarding implementation, the study proposes three tiers. The first tier involves standardizing data and establishing responsible entities for each outcome chain. The second tier involves piloting in several networks with relatively well-defined boundaries, using a pre-registered evaluation design and a limited budget. The third tier involves expanding components that demonstrate effectiveness while terminating or redesigning those that fail to meet objectives. Any policy comparisons should be conducted under the constraint of the current budget to avoid concluding that the more expensive option is always better.

13. Limitations, rejection criteria, and follow-up research program

13.1. Data and Measurement Limitations

Firstly, the DTI model spans only three years, while organizational states typically change slowly. PCI reflects business perceptions and experiences; PAPI reflects citizens; DTI combines administrative records and scoring; these sources do not measure the same concept. The latent variable model handles measurement errors but does not generate information not present in the data. The PII's use of some governance sources that overlap with PCI/DTI reduces the independence of the descriptive test. The PII output was chosen to limit duplication, but it cannot be considered exogenous.

Secondly, national I-O tables do not observe provincial-sector flows. Regionalized MRIOs can be inaccurate in both strength and orientation of connections. Results heavily dependent on network centers must be evaluated across multiple matrices, reporting row-column balance errors, checking with transport/trade flows where possible, and transferring network uncertainty into the posterior space. If priority rankings vary significantly between FLQ, CHARM, and the attractiveness model, the study must report a sustainable set of priorities instead of a single ranking.

Third, the shift from 63 to 34 provinces disrupts the supply chain. Mergers can simultaneously alter reporting, organization, and economic behavior. The aggregate matrix addresses accounting consistency but does not automatically identify the impact of reforms. Post-2025 analysis requires stable district/commune or economic unit-level data to separate boundary effects and examine the invariance of PCI/DTI/PAPI measurements within the new units.

13.2. Identification and Extrapolation Limits

The Bartik digital tool is only valid if the initial procedural structure has no direct channel to non-digital outcomes, after controlling for industry structure and trends. This is a strong condition and must be verified using pre-trend, balance, leave-one-out, Anderson–Rubin interval, and the “plausibly exogenous” model. The global demand shock helps identify contagion, but does not address the endogenous nature of coordinating capacity. Resolutions for the 2024–2026 period cannot be evaluated causally with a 2024-ending sample.

International parameters only provide prior and external reasonable checks; they do not guarantee transportability to Vietnam. An average coefficient from OECD countries may not be suitable for an emerging economy with high openness, a high FDI role, and a different local government structure. The analysis must report how much posteriority is updated by Vietnamese data compared to the priority. If posteriority is nearly identical to priority, the results should be called “prior-driven,” not “confirmed by Vietnamese data.”

13.3. Model Limitations

Representative households obscure income distribution, skills, and access to services. Perfect competition at the base ignores market power, state-owned enterprises, fractional credit, and supply chain negotiation. Climate only appears as a productivity/wedge shock; the model lacks full water resources, land, and endogenous adaptation. The informal sector, migration, land prices, and local banking are also unrepresented. These extensions should be added block by block and compared outside the model, avoiding turning the model into an overly parameterized and unrecognizable system.

The logit loss function is a simplified representation of many mechanisms: project selection, cost overruns, delays, misappropriation of benefits, and operational capacity. Audit data may observe irregularities but do not fully observe the lost social value. Therefore, it should be interpreted as the “percentage not converted into useful assets” in the model, not as a legal accusation against an entity or individual.

13.4. Rejection Criteria

VN-CNDSGE must be capable of failing in the face of data. Four outcomes would clearly refute or weaken the central mechanism. First, the full model does not improve out-of-sample forecasting compared to uncoordinated DSGE or models that only allow CCI to enter TFP. Second, the interaction of CCI with network exposure does not have stable sign/magnitude across predetermined matrices and placebo tests. Third, the coordination indicator does not load stably onto the general state or fails the measurement invariance test. Fourth, the coordination package does not produce a positive cross-derivative after accounting for fiscal costs and losses. In that case, the study must narrow or eliminate the coordination channel, not explain the posteriors by adding a free shock.

14. Conclusion

VN-CNDSGE transforms the concept of "State Coordination" into a hypothetical system that can be modeled and tested. In this system, state capacity is not only manifested through budget size or the number of permits, but also through the ability to reduce the wedge between entities, accumulate data and knowledge assets, share risks appropriately, and connect resources at nodes with high social value. The production network makes the value of coordination uneven: the same reform can have very different impacts depending on the sector, locality, and quality of implementation.

The research framework also points out the limitations of the “conductor” metaphor. Centralized coordination does not automatically create harmony. When data, capacity, or control mechanisms are lacking, the coordinating hub can become a bottleneck and a source of systemic risk. Seed funding can address funding shortfalls for innovation, but it can also be influenced by vested interests. Therefore, effective coordination requires transparency, accountability for results, independent evaluation, interchangeability, and mechanisms to protect honest experimentation.

Empirically, the study has not yet provided causal estimates for Resolutions 57, 68, 79, or 10. The current post-policy timeframe is too short, and the 2025 boundary realignment creates further measurement disruption. The value of this draft at this stage lies in providing a model, data architecture, identification conditions, and a pre-registered set of counter-reality data. Subsequent quantitative results must clearly distinguish between observed data, adjustment parameters, prior distributions, descriptive correlations, and causal effects.

The ultimate policy message is not that the State needs to control more individual decisions. It is that the State needs to focus its capacity on areas where collective action doesn't spontaneously create: compatible rules of the game, shared data, knowledge infrastructure, network connectivity, and shared risk and responsibility. The success of reform, therefore, should not be measured by the amount of resources the State directly controls, but by the extent to which the resources of the entire society are connected and transformed into productivity, resilience, and well-being.

15. Conflict of interest

The authors declare no conflict of interest. No external funding influenced the design, execution, or reporting of the research.

16. Ethics Statement

This study was conducted using publication from the General Statistics Office covering 63 provinces and cities for the period 2020–2024. The research did not involve human participants, human subjects, personal data, animals, or any form of intervention requiring ethical review or approval.

All data used in this study were collected from publicly accessible sources and analyzed in accordance with applicable research and data-use principles. Therefore, institutional ethical approval and informed consent were not required for this research.

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Technical Appendix

Appendix A. Solutions, likelihoods, and estimation algorithms

A.1. Normalization of the stationary state

Variables with general technological trends are divided by $A_t^{1/(1-\alpha)}$ before finding a steady state. Relative prices are normalized to the consumption index; total labor and population are normalized to one in a steady state. The I-O matrix is adjusted so that the total cost row and total use column are consistent with the national account; any statistical residuals are stored as a “deviation/net tax” node instead of being arbitrarily allocated to productivity.

The steady-state solution is found in the following block order: (i) network price and quantity with Ω ; (ii) capital and private investment; (iii) public state $D, \mathcal{R}, H, \Gamma$; (iv) budget, debt, and foreign assets; (v) labor market and consumption. The condition $\rho(\Omega) < 1$, Jury condition, and debt stability are checked before solving. The set of parameters violating the stability domain receives an likelihood of 0.

A.2. State-space systems

After log-linearization, the structural system is written.

$$A_0 x_t = A_1 x_{t-1} + B \epsilon_t + C \eta_t, \quad y_t = H x_t + D q_t + v_t \quad (A1)$$

This x_t includes economic and institutional conditions, η_t the expected error, y_t the observed variable, and q_t the exogenous world variable. The reasonable expected solution is calculated using the QZ/gensys decomposition. With the Gaussian linear block, the Kalman filter gives...

$$\log p(y_{1:T} | \vartheta) = -\frac{1}{2} \sum_{t=1}^T [\log |S_t| + v_t' S_t^{-1} v_t + n_y \log(2\pi)] \quad (\text{A2})$$

The lossy logit and non-negative constraint were handled using SMC/grain filter; the linearized version was used as a proposal and cross-checked. The post-procedure is

$$p(\vartheta, x_{1:T} | y_{1:T}) \propto p(y_{1:T} | x_{1:T}, \vartheta) p(x_{1:T} | \vartheta) p(\vartheta) \quad (\text{A3})$$

A.3. Reconstruction Algorithm

Table A1. Calculation Procedure

Step	Input	Operation	Export standards
1	Immutable source file	Hashing, standardizing province/sector names, and verifying units.	Manifest and error logs are zero.
2	NSO/PCI/DTI/PII	Panel construction, CCI, and measurement error.	Reproduce correctly 315/189/63 observations
3	I-O/GRDP/auxiliary stream	Perform MRI and RAS reconstruction and balance checks.	Row-column discrepancies below the registration threshold.
4	Prior and Moment	Resolving the stationary state, QZ, Kalman/SMC	All draws satisfy the stability region.
5	Data	Posterior, multiple-strand sampling	R-hat, ESS, and trace meet standards.
6	M0/M1/M2	Rolling forecast, LOO/WAIC/marginal likelihood	M2 needs improvements beyond the design.
7	Package C0–C6	General seed simulation and PV budget	Tail risk report
8	Sensitivity	Replace prior, MRI, measuring instrument, sample	Publish the full specification curve.

The replication code must have random seeding, save software versions, export tables from machine results instead of manual input, and have unit testing to allow matching of provinces, investment ratios, CCI marks, spectral radii, and budget consistency.

Appendix B. Administrative Bridge 63→34

For the unit remaining unchanged, the row M has one element equal to 1. For the merged unit, the corresponding row has two or three elements equal to 1. The table below describes the mapping; the names are standardized according to Resolution 202/2025/QH15 and other officially published documents.

Table B1. Mapping historical provinces and cities to 34 units from July 1, 2025.

The unit after reorganization	The historical unit is merged.
Hanoi	Hanoi
Tuyen Quang	Tuyen Quang; Ha Giang
Lao Cai	Lao Cai; Yen Bai
Thai Nguyen	Thai Nguyen; Bac Kan
Phu Tho	Phu Tho; Vinh Phuc; Hoa Binh
Bac Ninh	Bac Ninh; Bac Giang
Hung Yen	Hung Yen; Thai Binh
Hai Phong	Hai Phong; Hai Duong
Ninh Binh	Ninh Binh; Ha Nam; Nam Dinh
Cao Bang	Cao Bang
Dien Bien	Dien Bien
Lai Chau	Lai Chau
Son La	Son La
Lang Son	Lang Son
Quang Ninh	Quang Ninh
Thanh Hoa	Thanh Hoa
Nghe An	Nghe An
Ha Tinh	Ha Tinh
Hue	Thua Thien Hue/Hue
Quang Tri	Quang Tri; Quang Binh
Da Nang	Da Nang; Quang Nam
Quang Ngai	Quang Ngai; Kon Tum
Gia Lai	Gia Lai; Binh Dinh
Khanh Hoa	Khanh Hoa; Ninh Thuan
Lam Dong	Lam Dong; Binh Thuan; Dak Nong
Dak Lak	Dak Lak; Phu Yen
Ho Chi Minh City	Ho Chi Minh City; Binh Duong; Ba Ria-Vung Tau
Dong Nai	Dong Nai; Binh Phuoc

The unit after reorganization	The historical unit is merged.
Tay Ninh	Tay Ninh; Long An
Can Tho	Can Tho; Hau Giang; Soc Trang
Vinh Long	Vinh Long; Ben Tre; Tra Vinh
Dong Thap	Dong Thap; Tien Giang
An Giang	An Giang; Kien Giang
Ca Mau	Ca Mau; Bac Lieu

Additive variables are used $X^{34} = MX^{63}$. For bilateral streams, $F^{34} = MF^{63}M'$. Technical coefficients are calculated only after stream merging. Ratio uses denominator weights; survey indices require microdata or respondent/business weights; rankings are not merged.

Appendix C. Dictionary of Minimal Symbols

Table C1. Main symbols

Symbol	Define	Type
$n=(i,s); m=(j,r)$	Provincial-sector node and supply node	Index
K, Z, H	Private capital, business knowledge, human capital	Status
D, R	Public data, shared research infrastructure	Public assets
Γ_o, Γ_i	Central/local coordination capacity	Organizational status
F_i	Institutional fragmentation	Wedge/Status
$\Delta X, \Delta Z$	Input/knowledge linking costs	Side wedges
Ω, L	Input dependency matrix, inverse Leontief	Network
m, QG	Effective seed capital, innovative public procurement.	Tools
ℓ^o	The proportion of budget funds that are not converted into useful assets.	Execution performance
CCI	PCI/DTI Survey Coordination Index	Measurement variable
M	34×63 mapping matrix	Border bridge

Appendix D. Checklist for transparent results

Each table or quantitative figure must be labeled with one of four tags: **observation**, **causal estimate**, **correction/prior**, or **simulation ex ante**. Do not use the word “impact” for exploratory correlations. Do not report policy multipliers without posterior and out-of-sample testing. All policy ranking tables must

include uncertainty, budget cost, loss, equity criterion, and MRIO sensitivity. Any analytical choices arising after reviewing results must be clearly marked as posterior.

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