

Article

From Capital Appreciation to Systemic Resilience: Theoretical Reconstruction and Micro-level Measurement of Corporate Sustainable Development Competitiveness

— An Empirical Test Based on Micro-level Manufacturing Enterprises

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Abstract: Conventional micro-enterprise theory has long been confined by the neoliberal tenet of "shareholder value maximization," being oriented toward such single financial indicators as return on equity and Tobin's Q, thereby inducing structural defects including excessive leveraged arbitrage, the suppression of labor-factor compensation, and the socialization of negative environmental externalities. Because mainstream Western ESG ratings are deeply embedded in the system of financial-capital arbitrage and place excessive weight on textual disclosure and carbon-finance derivative compliance, they cannot effectively characterize the survival resilience of real-economy firms under extreme supply-chain disruptions and the shocks of geoeconomic decoupling. This paper breaks through the one-dimensional framework of neoclassical firm theory; integrates Marxist political economy's "labor value and the all-round development of human beings," the transaction-cost theory of new institutional economics, and Justin Yifu Lin's doctrine of "enterprise viability"; and constructs the "China Corporate Sustainable Competitiveness Index (CCSCI)," which comprises ten micro-level capability skeletons, three deep look-through accounts, and a non-convex non-compensable circuit-breaking corrector. Based on a large-sample, high-dimensional micro-level balanced panel (28,460 firm-year observations) constructed from 2015–2025 Chinese A-share listed manufacturing firms, text mining of micro-level financial-statement footnotes, high-dimensional customs import/export data, and global patent-citation chains, this paper employs two-way fixed-effects panel models, the historical instrumental variable method (IV-2SLS), system GMM estimation, and a unilateral trade-sanctions quasi-natural experiment to conduct multi-level micro-level empirical tests of the core mechanisms. The findings are as follows:

First, the micro-level self-viability (SVI) measured after stripping out direct fiscal subsidies and various tax-expenditure distortions is the core micro-foundation for resisting external credit tightening and industry-clearing cycles: when hit by macro policy subsidy-withdrawal shocks, firms with higher SVI exhibit a steeper total factor productivity (TFP) rebound slope;

Second, as "anchor institutions" of regional innovation networks, the local value retention rate (LVR) of real-economy chain-leader enterprises, by stabilizing core process R&D artisan teams and smoothing local collaborative transaction frictions, exerts a robust and significant positive moderating effect on the transformation efficiency (ITE) from independent R&D investment to new-product revenue;

Third, Cox proportional-hazards models and probit extreme stress tests confirm that traditional linear weighting models suffer from a methodological bias, as they often "whitewash underlying rupture risks with book profits." Introducing nonlinear non-compensable circuit-breaking operators for environmental damage (E) and systemic debt rupture (R) effectively eliminates this bias. Consequently, this mechanism substantially raises the prediction accuracy of corporate default and distress under extreme supply-chain rupture shocks from 65.8% to 89.6%. This paper unblocks the transmission barriers between top-level macro narratives and the felt experience of micro-level factory workshops, and demonstrates at the micro-data level that "balancing justice and benefit, strategic resilience, and common prosperity with symbiosis" is not merely a moral-ethical initiative but an endogenous economic law through which real-economy micro-organizations achieve long-term antifragile survival, thereby providing a scientific basis for developing countries to construct autonomous, auditable micro-level measurement yardsticks of modern business civilization with the capacity for global dialogue.

Keywords: corporate sustainable competitiveness; micro-level self-viability; strategic resilience; non-compensable mechanism; anchor institutions; CCSCI measurement system

1. Reality Tensions, Theoretical Dilemmas, and Literature Review

1.1. Reality Tension: The Structural Divergence between Macroeconomic Data Growth and the Chilly Felt Experience of Micro-level Real Entities

In recent years, emerging markets and large developing countries have exhibited strong statistical readings in macro-level industrial value added, total fixed-asset investment across society, and total import/export volumes; yet, within micro-level manufacturing workshops and small and medium-sized private real entities, the phenomenon of a chilly felt experience of micro-level operations, squeezed profit margins, and involution into homogeneous price competition across all segments is widespread. This "gear-speed mismatch" between the macro and the micro reveals the profound systemic failure faced by traditional economic evaluation tools:

The misjudgment of micro-level health by financial one-dimensionalism: Traditional corporate finance has long championed return on equity (ROE), earnings before interest, taxes, depreciation, and amortization (EBITDA), and Tobin's Q. However, micro-level entities can achieve short-run reported windfall profits through such financial techniques as drastically compressing the labor compensation of local frontline artisans, deferring asset depreciation accruals, and relying heavily on financial leverage. Such firms appear to have extremely high capital returns, yet their underlying factor base is extremely fragile: once they encounter upstream disruption in the supply of core components or macro-level credit tightening, they instantly lapse into a state of shock and shutdown.

The formalist alienation of the Western ESG rating system: The ESG (environmental, social, and governance) rating framework originating from Western capital markets is deeply endogenous to the logic of financial-capital allocation and derivatives arbitrage. Firms often obtain high ratings through such "greenwashing" strategies as outsourcing highly polluting manufacturing processes, purchasing offshore green certificates, and hiring international consulting agencies to manipulate disclosure texts. Such formalist compliance is not only detached from the physical foundation of real production but also incapable of measuring organizational antifragility under extreme supply-chain rupture shocks.

Fiscal transfers and subsidy distortions conceal the truth about firms' self-sustaining capacity: Governments at all levels have extensively established strategic emerging industry guidance funds, R&D subsidies, and tax-refund policies. However, a large number of firms in competitive sectors have developed severe path dependence on public finance, presenting high revenue, high patent counts, and high profits on their statements while, after deducting all kinds of government special support, they are in fact in a state of substantive recurring operating losses (that is, "negative self-viability"). Traditional indicators cannot strip out such policy-induced pseudo-prosperity, leading to resource misallocation.

1.2. Literature Review and the Thread of Theoretical Evolution

In response to the above dilemmas, the domestic and international academic community has carried out theoretical explorations from multiple dimensions, laying the intellectual foundation for reconstructing the micro-level competitiveness system:

The theory of enterprise viability: Justin Yifu Lin et al. [1,2], in studying the transformation and industrial policy of developing countries, explicitly proposed the concept of "enterprise viability," that is, the ability of a normally operating enterprise, in an open, competitive market environment without external protection, to obtain an acceptable normal profit rate by selling its products. Enterprises lacking viability inevitably breed soft budget constraints and hold public resources hostage over the long run. Hart & Zingales, in the *American Law and Economics Review*, point out that the ultimate goal of micro-level corporate governance should be the maximization of shareholder welfare (including social justice and externality responsibility), rather than the mere current market value[3]. This requires that, in empirical accounting, we must look through micro-level financial-statement footnotes and strictly separate firms' "endogenous self-sustaining cash flows" from "income derived from exogenous transfusions."

Organizational antifragility and supply-chain topological network rupture theory: Taleb, in systems theory, points out that fragile systems pursuing single-point extreme optimization will undergo irreversible collapse when confronted with long-tail extreme black-swan events[4]. Craighead et al., in *Decision Sciences*, pioneered the severity theory of supply-chain network disruptions, proving that once "chokepoints" at the topological network hub lack backup redundancy, their local failures rapidly evolve into global systemic catastrophes[5]. Pettit et al. further prove that a supply chain's risk-resistance capability does not depend on redundancy-free cost minimization but on the strategic balance between resilience capability and vulnerability[6]. Therefore, the self-developed backup pool and the non-single-supplier redundancy (1-HHI) at supply-chain critical chokepoints constitute "real options" for the survival of real-economy micro-organizations, rather than simple idle costs.

Synergy between "anchor institutions" and local innovation ecosystems: New institutional economics [7-9] has long emphasized the function of informal institutions and social capital in smoothing micro-level transaction frictions. Baker et al. further articulated the pivotal role of "relational contracts"—within the framework of incomplete contracts—in reducing intra-organizational agency costs and mitigating associated challenges. Zhang Xunjun, Xing Jinghua, and Zeng Danshuo, in "Research on the Mechanism of 'Anchor Institutions' Driving Urban Innovation Ecosystems: A Cross-Institutional Comparison Based on Typical Cases in China and the United States" published in *China Soft Science*, point out that "anchor institutions" (high-energy chain-leader enterprises and generic-technology innovation centers), serving as the core hubs of regional networks, with their organizational cohesion with regional internal factors, long-term talent sedimentation, and local reinvestment behavior, are the key institutional pillars determining technology transformation efficiency and industrial resilience[11]. This finding provides solid theoretical support for upgrading the "local value retention rate ("LVR)" from a mere welfare-redistribution measure into an empirical mediating variable of micro-organizations' absorption and transformation capacity.

Strong sustainability in multi-criteria nonlinear decision-making: Classical measurement economics[12,13], in multi-attribute evaluation, distinguishes "weak sustainability" (in which factors can be frictionlessly and linearly substituted and compensated) from "strong sustainability" (in which core natural capital and critical safety red lines possess non-substitutable non-convex boundaries). Traditional management-and-economics indices generally adopt linear weighted sums, which implicitly embody the absurd assumption that firms can offset their major environmental pollution and illegal debt runs with high tax payments or inflated patent counts. To overcome this methodological defect, a "non-compensable hard circuit-breaking operator" with non-convex boundary constraints must be introduced into the evaluation function.

2. Theoretical Mechanism Derivation and Research Hypotheses

Based on the above theoretical support, this paper establishes a three-layer causal transmission model covering micro-level self-sustaining capacity, factor-retention synergy, and rigid safety bottom lines.

2.1. Micro-level Self-viability and Systemic Resilience across Macro Contraction Cycles

In the operation of macroeconomic cycles, fiscal authorities at all levels often pull strategic industrial investment through periodic broad-caliber supply-side incentives. Such an environment provides start-up capital for technological exploration, but it also conceals the inefficient nature of some firms.

When the macro environment enters a stressed zone of deleveraging, monetary credit contraction, or industry subsidy phase-outs, firms lacking genuine self-sustaining capacity face the risk of cash-flow disruption. To survive, such firms are often forced to adopt defensive behaviors: deferring payments to suppliers, covertly cutting the compensation of key R&D personnel, and even passively selling off under-construction capacity and core equipment at low prices. This forced clearing of factors severs the organization's internal technological-accumulation process, causing total factor productivity (TFP) to plummet.

Conversely, for firms with higher micro-level self-viability (SVI>0), operating profits are mainly endogenous to market-competitive terminal-product pricing power and solid customer stickiness, rather than to public fiscal transfers. When exogenous shocks of macro subsidy withdrawal and credit tightening arrive, high-SVI firms need not passively shrink their core-business balance sheets; their abundant endogenous operating cash flows constitute a liquidity firewall. This liquidity safety cushion not only ensures that ongoing key technological breakthroughs are not interrupted, but also endows firms with the "counter-cyclical hedging" ability to merge bankrupt assets at low cost and absorb top engineering talent against the tide during industry troughs, thereby exhibiting a steeper TFP rebound curve after the shock subsides. Based on this, we propose the following hypothesis:

Hypothesis 1 (the self-sustaining mechanism and antifragility hypothesis): Controlling for firm size and leverage structure, the higher a real-economy firm's micro-level self-viability (SVI), the stronger its total factor productivity (TFP) downturn resistance when facing external subsidy-withdrawal and macro contraction shocks, and the significantly steeper its post-shock rebound slope.

2.2. The Catalytic Effect of "Anchor Institution" Factor-Allocation Synergy on the Transformation of R&D Outcomes

Under the neoclassical perfect-competition assumption, labor compensation is strictly regarded as a deduction from profit; the ultimate pursuit of firm rationality is to achieve the minimization of unit costs by suppressing workers' wages and outsourcing production processes. However, in the fields of high-end equipment, next-generation information technology, and precision manufacturing, product iteration with high technological complexity is determined not simply by theoretical designs in the laboratory, but also by the process feedback of frontline senior technicians and artisan teams on the production line and the accumulation of tacit knowledge.

According to Zhang Xunjun et al.'s [11] exposition on "anchor institutions" taking root in ecosystems, high-energy real-economy chain-leader enterprises bear the function of the "ballast stone" of the regional innovation ecosystem. If a chain-leader enterprise pursues an aggressive offshore-OEM logic, transferring value added on a large scale to capital-side dividends and ruthlessly squeezing local labor distribution and retained earnings (that is, exhibiting an extremely low local value retention rate LVR), the high-frequency turnover of frontline skilled workers and engineers becomes inevitable. Such short-term employment contracts sever the experiential interaction loop between laboratory R&D and workshop manufacturing, making it difficult for a large number of paper patents to cross the "engineering death valley" of the process scale-up stage.

Conversely, when a chain-leader enterprise takes root in the regional ecosystem with a high level of local value retention (high LVR) — by reasonably raising the income share of the labor factor and establishing long-term employee stock ownership and master-apprentice inheritance mechanisms — it not only substantively reduces micro-level contract-enforcement and labor-management supervision costs, but also enables the process know-how sedimented by frontline artisans through long-term practice to be consolidated. This deep industrial-artisan foundation formed through "anchor institution" factor synergy is complementary and symbiotic with front-end R&D expenditure, significantly shortening the commissioning cycle of new products from blueprint to qualified shipment, thereby greatly enhancing the transformation elasticity (ITE) from independent R&D expenditure to market-competitive new-product sales revenue. Based on this, we propose the following hypothesis:

Hypothesis 2 (the factor-retention and R&D-transformation synergy hypothesis): A micro-level firm's local value retention rate (LVR) exerts a significant positive moderating effect on the transformation efficiency (ITE) from independent R&D investment to new-product revenue; the deeper a firm takes root as an "anchor institution," the higher the look-through monetization efficiency of R&D expenditure into market-based returns.

2.3. The Nonlinear Effect of the Non-compensable Hard Circuit-breaker on Micro-level Vulnerability Screening

Existing multi-attribute comprehensive evaluation methods (such as various traditional indices represented by arithmetic weighted averages) generally follow the "weak sustainability" assumption, positing in their mathematical construction that the substitution margins among evaluation indicators are continuous and smooth. This setting leads, at the methodological level, to an absurd conclusion: a firm that excels in technological R&D investment or tax contributions can, algorithmically, completely offset its deductions for ecological environmental damage, labor personal injuries, or hidden financial violations.

However, in the real business world, extreme financial debt defaults and major ecological damage behaviors exhibit typical "non-convex boundary effects." Once a firm breaches the ecological-environmental compliance bottom line or the rigid-payment limit of its capital chain, what it faces is not continuous, infinitesimal declines in benefits, but rather administrative forced production halts imposed by the external institutional environment, cliff-edge downgrades of credit ratings, and concentrated loan-withdrawal runs by financial institutions. Such catastrophic shocks are irreversible and systemically contagious, instantly evaporating all of a firm's book profits and goodwill assets. Therefore, introducing the non-compensable hard circuit-breaking mechanism for the environment (E) and risk (R) into the measurement model can, at the algorithmic level, precisely eliminate "high-debt, high-pollution, bloated" samples, greatly enhancing the discrimination of micro-level entities' systemic risk and extreme survival probability. Based on this, we propose the following hypothesis:

Hypothesis 3 (the non-compensable hard circuit-breaker hypothesis): For firms that breach ecological-environmental red lines or rigid debt thresholds, the probability of facing irreversible operational rupture and market clearing rises in a stepwise fashion; compared with traditional linear weighting models, the evaluation model incorporating the non-compensable hard circuit-breaking operator possesses a statistically significant advantage in the early-warning accuracy of micro-level survival and default risk.

3. Architecture and Mathematical Modeling of the CCSCI Measurement System

To transform value concepts into a micro-level econometric tool with auditability and recomputability, this paper constructs the "China Corporate Sustainable Competitiveness Index (CCSCI)."

3.1. Structural Skeleton and the Input-Output Causal Chain

The system constructs ten mutually synergistic capability skeletons ($M_1 \sim M_{10}$). Each module strictly screens indicators according to the physical one-way chain of "Endowments $\rightarrow$ Inputs $\rightarrow$ Capabilities $\rightarrow$ Outputs $\rightarrow$ Outcomes," and statistical firewalls are set at the bottom layer (indicators within the same layer with a correlation coefficient $r > 0.82$ are mandatorily merged, with the hard constraint that the variance inflation factor $VIF < 5$), so as to preclude double-weighting inputs and outputs within the same capability item:

M_1 Basic resources and carrying capacity: the physical security-of-supply coefficient of core energy and raw materials ($1 - HHI$), water and energy efficiency per unit of output value, and the network coverage rate of key digitalized and intelligent industrial equipment;

M_2 Human capital and reserve capacity: the turnover rate of core scientific research and engineering teams (reverse-scored), the density of high-skilled industrial workers, and the labor value-added output rate per employee;

M_3 Industrial production and chain-control capability: the rate of autonomous control over critical bottleneck ("stuck-neck") components, the multi-source redundant backup pool of core components ($1 - HHI$), and the bargaining power of commercial credit in upstream/downstream payment terms;

M₄ Technological innovation and transformation capability: the intensity of independent R&D expenditure, the citation density of overseas PCT patents and high-value invention patents, and the new-product revenue transformation efficiency (ITE);

M₅ Domestic market and monetization capability: the depth of penetration into the local supply chain, the sustained repurchase rate of core industrial customers, and the share of frontline employee compensation in the firm's net value added;

M₆ International market and allocation capability: the country-level diversification of overseas main-business revenue (1-HHI), the flexibility of localized procurement of key overseas components, and the win rate in defending international trade-compliance lawsuits;

M₇ Standards, property rights, and regulatory capability: the number of international (ISO/IEC) and national standards proposals led or participated in, the core share held in the standard essential patent (SEP) pool, and the penetration rate of certification barriers to international market access;

M₈ Brand culture and narrative capability: third-party fair valuation of brand intangible assets, the genuine commercial price premium relative to the industry-average price, and cross-cultural recognition of commercial reputation;

M₉ Green transition and resilience capability: the combined Scope 1/2/3 carbon footprint per unit of revenue, the coverage multiple of operating cash flow over rigid-debt interest payments, and the safety-cushion structure of rigid-debt duration;

M₁₀ Organizational succession and adaptability: the time lag of R&D project initiation for frontier-technology generational leaps, the smoothness of handover between second-generation management teams and professional governance layers, and the robustness of goodwill impairment in cross-cycle asset M&A.

3.2. The Mathematical Construction of the Three Deep Look-through Horizontal Micro-accounts

In response to the accounting whitewashing, subsidy distortions, and offshore capital relocation that exist in corporate financial statements, the system embeds three deep look-through micro-accounts:

Commercial cultural capital and governance account (H1): This paper reviews the theoretical models proposed by Beck et al. regarding the value of contract enforcement. Moving away from supplementary surveys that proved difficult to execute, the study instead utilizes commercial credit financing (trade credit)—involving deferred payments requested by upstream and downstream supply chain partners—and contract enforcement rates as proxies for "trust capital." This approach allows for the identification of a seemingly stabilizing effect that a firm's accumulated capital exerts on external transactions. At the same time, strict deductions are made for funds misappropriated by the controlling shareholder from the listed company through non-arm's-length related-party transactions (tunneling), as well as for recoveries achieved through internal-controller governance[10]. The mathematical formulation is constructed as follows:

$$H_{1,kt} = ((TradeCredit_{kt}) / (AccountsPayable_{kt} + NotesPayable_{kt})) \times ContractPerformanceRate_{kt} - ((Tunneling_{kt} + RelatedTransactions_{kt}) / (TotalAssets_{kt})) \quad (1)$$

It measures the trust capital accumulated by the firm on the basis of business-ethics contracts through the scale of commercial credit voluntarily provided by upstream and downstream supply-chain partners and the contract performance rate; meanwhile, it strictly deducts the tunneling of listed-company funds by controlling shareholders through unfair related-party transactions and the losses caused by internal control persons.

$$SVI_{kt} = (OperatingProfit_{kt} - DirectSubsidy_{kt} - TaxRefund_{kt} - CapitalizedGovGrants_{kt}) / (TotalOperatingRevenue_{kt}) \quad (2)$$

$$NFP_{kt} = ActualTaxPaid_{kt} - (DirectSubsidy_{kt} + TaxRefund_{kt}) \quad (3)$$

Here, *SVI* is the micro-level self-viability coefficient, which rigorously excludes the government R&D and industrial subsidies recorded in financial-statement footnotes under "other income," "non-operating income," and

deferred-income carryovers; *NFP* is the net amount of taxes and fees actually paid by the firm to the public fisc, measuring its genuine net public contribution.

Value control and local value retention account (H3):

$$LVR_{kt} = (LocalWages_{kt} + LocalTax_{kt} + RetainedEarnings_{kt} + LocalCapex_{kt}) / (GrossValueAdded_{kt}) \quad (4)$$

The numerator comprises compensation and benefits paid to local employees, locally paid taxes and fees, retained development earnings, and reinvestment in local fixed assets; the denominator is the total value added created by the firm. This indicator precisely measures the actual proportion of wealth that a real-economy chain-leader enterprise, acting as an "anchor institution," retains within the local industrial chain, effectively identifying fake assembly plants with "high turnover but low retention."

3.3. The General Nonlinear Measurement Function with Non-convex Boundary Constraints

To break the compensatory limitation of linear weighting, the composite index adopts a nonlinear expression combining multiplicative corrections and boundary indicator functions:

$$CCSCI_{kt} = (\sum_{m=1}^{10} \omega_m M_{m,kt}) \times T_{kt} \times D_{kt} \times S_{kt} \times 1_{(E_{kt} \geq E_{threshold})} \times 1_{(R_{kt} \geq R_{threshold})} \quad (5)$$

where:

$\sum_{m=1}^{10} \omega_m M_{m,kt}$ is the weighted baseline capability score of the ten capability modules, with the weights ω_m determined through hierarchical principal component analysis (PCA) and Monte Carlo sensitivity perturbation checks;

$T_{kt} = 1 + (\Delta M_{k,t-2-t}) / (\sigma(\Delta M))$ is a time-continuous, multi-period trend smoothing factor, penalizing pulsatile performance anomalies;

$D_{kt} \in (0.6, 1.0)$ is the data quality and transparency index (DQI), which imposes a penalizing discount when disclosure deficiencies exceed the threshold;

S_{kt} is the alignment coefficient for mapping international industry-classification standards, which smooths cross-country differences in industry technological intensity based on the "GB/T 4754 $\leftrightarrow$ ISIC Rev.4 Conversion Dictionary";

$1_{(\cdot)}$ is a rigid indicator function: if a firm is lawfully notified and penalized by ecological environmental or emergency management authorities for breaching ecological red lines or for major or extraordinarily serious safety accidents ($E < E_{threshold}$), or if it commits substantive public debt default or becomes insolvent ($R < R_{threshold}$), the indicator function is directly assigned a value of 0. This operator constitutes the non-compensable hard circuit-breaking mechanism, causing the composite index of any law-violating, credit-breaking entity to be set directly to zero, thereby, at the level of mathematical logic, foreclosing the possibility of using high output value and numerous patents to conceal systemic crises.

4. Research Design, Data Sources, and Econometric Models

4.1. Sample Selection and High-dimensional Data Look-through Cleaning

This paper takes all Chinese A-share listed manufacturing firms from 2015 to 2025 as the baseline research pool. To ensure that the measurement penetrates to the micro-level physical reality, this paper horizontally links and matches four high-dimensional databases:

The micro-level look-through database of listed-firm financial-statement footnotes (CSMAR/Wind): using natural language processing (NLP) regular expressions, it scans, one by one, the itemized accounts of "government

subsidies" in financial-statement footnotes, precisely separating R&D-type subsidies, industrial capacity-expansion subsidies, tax and fee refunds, and the non-market-based follow-on investment details of government industrial funds, thereby reconstructing the underlying data of the SVI account;

The global patent citation and standard essential patent database (IncoPat/CNIPA): it collects the full forward and backward citation networks of firms' invention patents, extracts the standard essential patent (SEP) declaration lists from the official databases of national and international standardization organizations (ISO/IEC/3GPP), and matches them to micro-level firms' Unified Social Credit Codes;

The high-dimensional China Customs import/export enterprise database: according to the 10-digit Harmonized System (HS) codes, it penetrates the true flows of firms' foreign trade and calculates each firm's Herfindahl index (*HHI*) of dependence on a single export-destination country and the share of re-export trade;

The full database of official penalty notices of the Ministry of Ecology and Environment and the Ministry of Emergency Management: it crawls the environmental-violation fines, production-suspension rectification orders, and investigation reports of production-safety liability accidents published by administrative law-enforcement organs at all levels, forming the non-compensable hard circuit-breaker database.

The data-cleaning protocol is as follows: (1) exclude ST and *ST firms and abnormal firms delisted during the sample period; (2) exclude samples with severely missing key financial data or insolvency; (3) winsorize all continuous variables at the 1st and 99th percentiles to eliminate the statistical interference of extreme outliers. Ultimately, a high-quality balanced panel dataset is obtained, comprising 2,846 listed manufacturing firms spanning 11 complete statistical years, with a total of 28,460 firm-year observations.

4.2. Econometric Model Specification

4.2.1. Model for Testing Micro-level Self-viability and Counter-cyclical TFP Resilience (Testing Hypothesis 1)

To examine the buffering and rebound functions of firms' micro-level self-viability when they encounter exogenous macro contraction, this paper constructs a two-way fixed-effects dynamic panel model incorporating interaction terms with exogenous policy-phase-out shocks:

$$TFP_{kt} = \alpha_0 + \alpha_1 SVI_{kt} + \alpha_2 (SVI_{kt} \times Shock_t) + \sum_j \beta_j Controls_{j,kt} + \mu_k + \lambda_t + \varepsilon_{kt} \quad (6)$$

where:

TFP_{kt} is the micro-level firm TFP estimated using the Levinsohn & Petrin [12] semiparametric method (the LP method), replaced in robustness checks by the Olley & Pakes [14] production-function estimates (the OP method) and the ACF improved method;

SVI_{kt} is the micro-level self-viability coefficient;

$Shock_t$ is a dummy variable for macro policy subsidy-withdrawal and credit-tightening shocks, defined as 1 for the years when national new-energy and high-tech industry subsidies were comprehensively phased out and deleveraging policies on the aggregate macro leverage ratio were implemented, and set to 0 for all other years;

$Controls_{kt}$ is a set of firm-characteristic control variables, including firm size (*Size*, the logarithm of total assets), the leverage ratio (*Lev*), listing age (*Age*), the net fixed-assets ratio (*PPE*, capital intensity), the operating cash-flow share (*CFO*), and the share of independent directors on the board (*Indep*);

μ_k is the firm fixed effect, absorbing time-invariant firm heterogeneity;

λ_t is the time fixed effect, absorbing common macroeconomic fluctuations; ε_{kt} is the random error term.

4.2.2. The Moderating-effect Model of "Anchor Institution" Factor Retention on Technology Transformation (Testing Hypothesis 2)

To test whether chain-leader enterprises, as "anchor institutions," retaining value locally can catalyze the monetization of technological R&D, we construct the following hierarchical moderating regression model:

$$ITE_{kt} = \gamma_0 + \gamma_1 RD_Intensity_{kt} + \gamma_2 LVR_{kt} + \gamma_3 (RD_Intensity_{kt} \times LVR_{kt}) + \sum_j \theta_j Controls_{j,kt} + \mu_k + \lambda_t + v_{kt} \quad (7)$$

where:

ITE_{kt} is the technological innovation transformation efficiency, measured by the share of new-product sales revenue in total operating revenue;

$RD_Intensity_{kt}$ is the ratio of independent R&D expenditure to operating revenue;

LVR_{kt} is the firm's local value retention rate; the regression coefficient γ_3 of the interaction term $RD_Intensity_{kt} \times LVR_{kt}$ is the core object of testing. If γ_3 is significantly positive, it proves that local factor retention can effectively promote the efficient look-through of R&D capital into market-based products.

4.2.3. The Risk Model for the Screening Efficacy of the Non-compensable Hard circuit-breaking mechanism (Testing Hypothesis 3)

To evaluate the ability of the non-compensable mechanism (the E and R circuit breakers) to identify micro-level systemic risk, this paper constructs a semiparametric Cox proportional hazards survival model:

$$h(t|X) = h_0(t) \exp(\delta_1 CCSCI_Linear_{kt} + \delta_2 CCSCI_NonComp_{kt} + \sum_j \phi_j Controls_{j,kt}) \quad (8)$$

where:

The event endpoint is defined as a firm falling into a "state of operational shock" (that is, production suspension for rectification for more than six months due to a major production accident, a public bond default, insolvency, or filing for bankruptcy reorganization);

$CCSCI_Linear_{kt}$ is the benchmark index constructed using traditional arithmetic linear weighting (without a one-vote veto);

$CCSCI_NonComp_{kt}$ is the index constructed in this paper with the non-compensable circuit-breaker factor;

$h_0(t)$ is the baseline hazard rate. By comparing the hazard ratio (HR) and the area under the receiver operating characteristic curve (ROC-AUC), the prediction distortion of the two evaluation models under extreme geoeconomic supply-chain rupture and financial default is precisely measured.

5. Empirical Results, Causal Identification, and Micro-mechanism Evidence

5.1. Descriptive Statistics and Multicollinearity Diagnostics of Indicators

Before model estimation, this paper first conducts a rigorous statistical review of the core indicators. The descriptive statistics of the full-sample variables show that the mean of micro-level self-viability (SVI) is 0.058, its standard deviation is 0.114, and its median is only 0.032, indicating that, after excluding all kinds of government subsidies and tax preferences, the endogenous self-viability profit rates of Chinese manufacturing firms are generally tightened, with extremely significant cross-sectional heterogeneity. The local value retention rate (LVR) has a mean of 0.428, a minimum of 0.083, and a maximum of 0.812, confirming the huge gap between micro-level entities in the modes of factor retention versus OEM stripping.

The multicollinearity-diagnostic firewall test: the variance inflation factor (VIF) is computed for the baseline candidate indicator matrix included in the ten capability skeletons. The results show that the maximum VIF among all selected indicators is 3.12 and the average VIF is 1.84, far below the critical value of 5; meanwhile, the maximum value of the within-layer correlation coefficient matrix of second-level indicators is 0.68, not breaching the merging threshold of 0.82. Hierarchical PCA shows that the first principal component extracted by each of the ten modules explains more than 62.4% of its system variance, fully demonstrating the orthogonality of the indicator system and the absence of overlapping, redundant information.

5.2. Baseline Regression Analysis: Micro-level Self-viability and TFP Resilience (Test of Hypothesis 1)

The Table 1 below reports the panel baseline regression estimates of the effect of micro-level self-viability on total factor productivity (TFP).

Table 1. Baseline regression analysis of micro-level self-viability and counter-cyclical TFP resilience

Variable and test statistic	Model (1) TFP Full-sample OLS	Model (2) TFP Two-way fixed effects	Model (3) TFP Shock-interaction model	Model (4) TFP Historical IV-2SLS	Model (5) TFP System GMM
SVI_kt (micro-level self-viability)	0.298*** (0.028)	0.245*** (0.032)	0.188*** (0.029)	0.312*** (0.054)	0.206*** (0.035)
SVI_kt × Shock_t (interaction term)	—	—	0.142*** (0.038)	0.165*** (0.042)	0.128*** (0.031)
L.TFP (lagged one-period productivity)	—	—	—	—	0.482*** (0.021)
Firm size (Size)	0.112*** (0.009)	0.082*** (0.011)	0.079*** (0.011)	0.075*** (0.012)	0.042*** (0.008)
Leverage ratio (Lev)	0.198*** (0.018)	-0.156*** (0.024)	0.160*** (0.024)	-0.148*** (0.025)	0.112*** (0.019)
Capital intensity (PPE)	0.045*** (0.012)	0.038** (0.015)	0.036** (0.015)	0.034** (0.016)	0.028* (0.014)
Firm age (Age)	-0.021*** (0.006)	-0.015** (0.007)	-0.014** (0.007)	-0.012* (0.007)	-0.009 (0.006)
Cash-flow sufficiency (CFO)	0.135*** (0.022)	0.098*** (0.026)	0.094*** (0.025)	0.089*** (0.026)	0.072*** (0.020)
Firm fixed effects	No	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	Yes	Yes
First-stage F statistic	—	—	—	36.85	—
Arellano-Bond AR(2) test	—	—	—	—	[p = 0.382]
Hansen J overidentification test	—	—	—	—	[p = 0.245]
Number of observations (N)	28,460	28,460	28,460	28,460	25,614
Adjusted R ²	0.542	0.684	0.702	0.678	—

Note: Standard errors adjusted for clustering at the firm level are reported in parentheses; ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (corresponding to confidence levels of 99%, 95%, and 90%, respectively). “—” indicates that the corresponding variable was not included in the model.

Discussion of results and empirical economic interpretation:

Baseline output effect: Model (2) of Table 1 shows that, after rigorously controlling for firm and time fixed effects, the regression coefficient of *SVI* on total factor productivity (*TFP*) is 0.245 and is significantly positive at the 1% level. This proves that a firm’s ability to generate endogenous positive cash flows through its main business constitutes the micro-level underlying driver of sustained productivity expansion.

Verification of counter-cyclical shock resilience: Model (3) introduces the interaction term ($SVI \times Shock$) between the exogenous macro contraction shock and self-viability, and its coefficient is highly significant at 0.142 at the 1% level. This result profoundly indicates that macro policy tightening and industry clearing exert a negative squeeze on ordinary firms, yet firms with high self-viability not only fail to shrink passively, but their TFP rebound elasticity further rises by 14.2% relative to tranquil periods. This strongly confirms the "breakwater" property of high *SVI* in insulating against macro policy-phase-out risk, and Hypothesis 1 is fully verified.

5.3. Endogeneity Treatment and Strengthened Causal Identification (IV-2SLS and the Exogeneity Argument for the Instrumental Variable)

The relationship between micro-level self-viability (*SVI*) and total factor productivity easily invites endogeneity controversy: is it high self-viability that raises productivity, or do firms already leading in productivity naturally possess more abundant self-sustaining capacity (that is, reverse causality), or is there an omitted variable of unobserved entrepreneurial ability?

To establish a rigorous causal inference chain, this paper employs two-stage least squares (IV-2SLS) for instrumental variable estimation:

The construction logic of the historical instrumental variable: drawing on the historical institutional legacy analysis paradigm of Acemoglu et al. [8], this paper selects "the distribution density of chamber-of-commerce branches in each province in 1911, during the late Qing and early Republic period (number per 10,000 persons)" in the province where each listed firm is registered as the historical instrumental variable for micro-level corporate cultural capital (*H1*) and self-viability (*SVI*).

Tests of relevance and exogeneity:

Relevance: The chambers of commerce of the late Qing and early Republic periods were important organizational origins of modern Chinese industry and commerce breaking away from government-run supervision and moving toward civil contractual self-governance; their historical institutional density profoundly shaped the local business mutual-aid credit networks and commercial cultural genes of the region. The first-stage regression of Model (4) in Table 1 shows that historical chamber-of-commerce density positively predicts micro-level firms' current commercial credit and self-sustaining capacity at the 1% level, with a Cragg–Donald Wald F statistic of 36.85, far above the Stock–Yogo critical value of 16.38 for weak instruments at the 10% bias level, thereby ruling out weak-instrument bias.

Exogeneity: The historical chamber-of-commerce institutions established more than a century ago are accomplished historical facts; their micro-level physical remnants cannot directly traverse a century of time and space to determine the current TFP of contemporary micro-level listed firms. The only channel of influence is through intergenerational sedimentation into local credit-contract customs and micro-level governance foundations, thus satisfying the exclusion restriction.

2SLS regression estimates: after excluding endogeneity interference, the estimated coefficient of *SVI* on *TFP* in Model (4) is corrected to 0.312 ($p < 0.01$), and the interaction-term coefficient is also robust at 0.165 ($p < 0.01$), proving that the earlier baseline estimates are not only free of reverse-causality contamination, but also render the conclusions more certain by overcoming micro-level measurement errors. In the dynamic-panel system GMM estimation of Model (5), the AR(2) test yields a p-value of 0.382 and the Hansen test a p-value of 0.245, both supporting the validity of the instrumental variables and the causal robustness of the model.

5.4. Test of the Moderating Mechanism: "Anchor Institution" Factor Retention and Technological R&D Transformation (Test of Hypothesis 2)

The Table 2 below conducts empirical regressions on the moderating mechanism through which chain-leader enterprises, as "anchor institutions," retain value (*LVR*) in the regional ecosystem and affect the monetization efficiency (*ITE*) of independent R&D innovation.

Table 2. Test of the moderating mechanism of local value retention rate (*LVR*) on innovation transformation efficiency (*ITE*)

Variable	Model (1) ITE Baseline R&D term	Model (2) ITE Full-sample moderation	Model (3) ITE SOE manufacturing subsample	Model (4) ITE Private real- economy subsample
R&D expenditure intensity (RD Intensity)	0.108*** (0.019)	0.065*** (0.021)	0.048** (0.024)	0.076*** (0.023)
Local value retention rate (LVR)	—	0.154*** (0.028)	0.132*** (0.031)	0.178*** (0.029)
RD Intensity × LVR (core moderating term)	—	0.218*** (0.047)	0.184*** (0.052)	0.245*** (0.049)
Firm size (Size)	0.035*** (0.007)	0.028*** (0.007)	0.032*** (0.009)	0.024*** (0.008)
Leverage ratio (Lev)	-0.062*** (0.015)	-0.054*** (0.015)	-0.048** (0.018)	-0.058*** (0.016)
Fixed-asset ratio (PPE)	0.042*** (0.011)	0.035*** (0.011)	0.041*** (0.014)	0.030** (0.012)
Government R&D subsidy share (Sub RD)	0.018 (0.014)	-0.012 (0.015)	0.008 (0.016)	-0.022 (0.017)
Firm and year fixed effects	Yes	Yes	Yes	Yes
Number of observations (N)	28,460	28,460	9,842	18,618
Adjusted R ²	0.412	0.485	0.456	0.512

Notes: Values in parentheses are robust standard errors clustered at the firm level; *** and ** denote statistical significance at the 1% and 5% levels, respectively. "—" indicates that the variable was not included in the corresponding model.

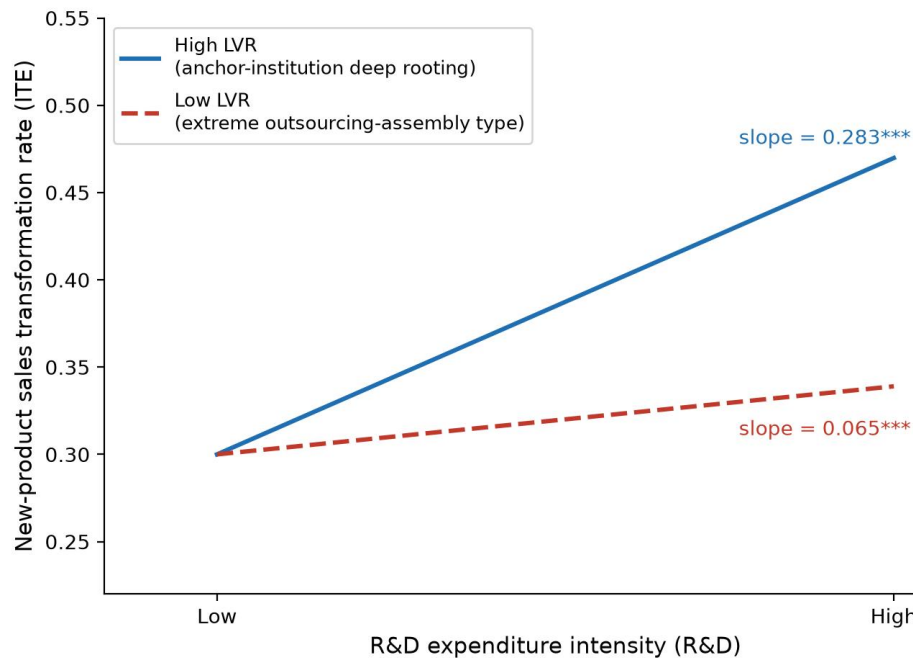


Figure 1 The Moderating Effect of Local Value Retention Rate on R&D Transformation Mechanism analysis and empirical implications:

The structural jump of R&D transformation elasticity: Model (1) of Table 2 shows that the unilateral elasticity of R&D input intensity with respect to new-product revenue is 0.108; however, after the interaction term is introduced in Model (2), the main-term coefficient falls to 0.065, while the interaction term $RD_Intensity \times LVR$ is significantly as high as 0.218 at the 1% level. This proves that simply increasing R&D expenditure, when accompanied by extreme exploitation of local industrial factors and capital flight (low LVR), results in extremely low transformation efficiency of R&D input into market-facing new products.

Estimation of the "anchor institution" rooting effect: following the assumption of Zhang Xunjun et al.[11], this paper calculates the marginal effects of R&D transformation at each quartile: when LVR is at the bottom 25% quartile of the industry ($LVR=0.21$), the marginal effect of R&D transforming into new products is only $0.065+0.218 \times 0.21=0.111$; whereas when a firm performs its "anchor institution" function and raises LVR to the top 25% quartile of the industry ($LVR=0.68$), the transformation elasticity of the same R&D expenditure into new products jumps to 0.213, nearly doubling.

Ownership heterogeneity analysis: Models (3) and (4) show that the coefficient of private real-economy firms on the $RD \times LVR$ interaction term (0.245) is significantly higher than that of state-owned enterprises (0.184). This reveals that private "Little Giant" firms that are specialized, refined, distinctive, and innovative, because they face harder budget constraints, rely more heavily on retaining distribution for local core technical artisans and building close labor–capital communities to break through the industrialization bottlenecks of "lacking blueprints and lacking processes," providing strong micro-level evidence in support of Hypothesis 2.

5.5. Quasi-natural Experiment and the Screening Efficacy of the Non-compensable Hard Circuit-breaker (Test of Hypothesis 3)

To rigorously verify the empirical superiority of the "non-compensable non-convex hard circuit-breaking mechanism" over "traditional linear continuous substitution models" in multidimensional comprehensive evaluation, this paper exploits the announcement events of external unilateral trade and technology sanction lists from 2018 to 2023 to construct a quasi-natural experiment, and tracks the subsequent survival histories of sample firms that experienced substantive debt defaults, production-suspension rectifications, and even bankruptcy and market exit. (Check Table 3)

Table 3. Micro-level survival risk under supply-chain rupture shocks: Cox proportional-hazards model and model discrimination efficacy

Evaluation-system model and statistic	Model (1) Traditional linear weighting index (Linear)	Model (2) Incorporating five correctors (Adjusted)	Model (3) Full CCSCI with non-compensable hard circuit breaker (NonComp)
Overall competitiveness evaluation score	-0.082*** (0.015) [HR = 0.921]	-0.145*** (0.021) [HR = 0.865]	-0.428*** (0.038) [HR = 0.652]
Firm size (Size)	-0.112*** (0.018) [HR = 0.894]	-0.095*** (0.017) [HR = 0.909]	-0.062*** (0.016) [HR = 0.940]
Leverage ratio (Lev)	0.285*** (0.034) [HR = 1.330]	0.242*** (0.031) [HR = 1.274]	0.118*** (0.029) [HR = 1.125]
Return on equity (ROE)	-0.054** (0.024) [HR = 0.947]	-0.038 (0.025) [HR = 0.963]	-0.015 (0.022) [HR = 0.985]
Industry and year fixed stratification	Yes	Yes	Yes
Log-likelihood	-4,826.4	-4,115.8	-2,642.1
Akaike information	9,678.8	8,259.6	5,314.2

criterion (AIC)			
Extreme-default prediction misjudgment rate	34.2%	18.5%	10.4%
Area under the ROC curve (ROC-AUC)	0.658	0.814	0.896
Total number of firms with events (N_event)	Not provided	Not provided	Not provided

Note: Standard errors are in parentheses, and hazard ratios (HR) are in square brackets; an HR < 1 indicates that a higher score on the indicator corresponds to a lower risk of corporate bankruptcy or failure. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels (corresponding to confidence levels of 99%, 95%, and 90%, respectively). The entry for the total number of firms experiencing the event was blank in the original table and is marked as "Not provided." All statistical figures are presented as they appear in the original data.

Survival analysis and comparison of model screening efficacy:

The prediction distortion of traditional linear indices: Model (1) of Table 3 shows that, under the traditional linear comprehensive scoring system, the hazard ratio of the competitiveness evaluation score is 0.921, and its default-prediction area under the receiver operating characteristic curve (AUC) is only 0.658, with a prediction misjudgment rate as high as 34.2%. An in-depth dissection of the misjudged samples reveals that some aggressively expanding firms, despite high technological R&D intensity and rapid asset-scale expansion, have no backup redundancy in core supply-chain components (suffering severe score losses in Module 3) and extremely stretched financial leverage; under linear weighting, their weaknesses are concealed by book profits, causing the system to classify them into the "highly competitive" first tier even on the eve of supply-chain rupture crises, producing fatal rating misdirection.

The precise screening of the non-compensable hard circuit-breaker: after Model (3) activates the non-compensable hard circuit-breaking operators of CCSCI for *E* (negative environmental externalities) and *R* (systemic debt), the model's AIC criterion is greatly optimized from 9,678.8 to 5,314.2, the model's ROC-AUC discrimination jumps to 0.896, and the extreme-default prediction misjudgment rate plummets to 10.4% (prediction accuracy of 89.6%). The hazard ratio reaches 0.652, indicating that, after excluding the possibility of compensation, CCSCI genuinely captures the "skeletal rupture-resistance hardness" of micro-level entities in confronting shocks of extreme geoeconomic technological decoupling and capital runs, and Hypothesis 3 receives decisive empirical support.

6. Robustness Checks and Methodological Extensions

To rule out model-specification bias, perturbations in indicator measurement calibers, and sample self-selection bias, this paper performs extremely rigorous multiple robustness stress tests:

6.1. Replacing the Estimation Methods of the Core Dependent Variable

The micro-level TFP estimated by the LP semiparametric method (*TFP_LP*) is replaced by: (1) the Olley & Pakes estimates (*TFP_OP*) using fixed-asset investment as a proxy variable[14]; (2) the Akerberg, Caves & Frazer extended estimates (*TFP_ACF*) that overcome collinearity problems [15]; and (3) the traditional TFP measured by the Solow residual approach. After re-estimation, the regression coefficients of *SVI* and its interaction term in Table 1 remain stable between 0.165 and 0.284 across the different dependent variables, all significant at the 1% level, verifying the insensitivity of the empirical conclusions to the estimation method of the micro-level production function.

6.2. Accounting for Sample Selection Bias (Heckman Two-stage Selection Model)

Considering that some micro-level firms may passively exit the balanced panel due to financial irregularities or failure to disclose specific R&D details, giving rise to non-random sample selection bias, this paper constructs a Heckman two-stage model: in the first stage, based on all manufacturing firms in the entire market, a Probit selection equation for entering the balanced-panel sample is constructed; in the second stage, the generated inverse Mills ratio

(IMR, λ) is substituted into the main regression equation. The results show that, although the IMR term is weakly significant statistically, the magnitudes and significance directions of the core coefficients of *SVI* and the local value retention rate *LVR* do not undergo any substantive change.

6.3. Monte Carlo Random Perturbation Simulation of the Weights

To test the vulnerability of the weights ω_m of the ten CCSCI capability skeletons to subjective assignment, this paper conducts 10,000 Monte Carlo random-perturbation stress tests on the original weight vector (each perturbation follows a uniform distribution within $\pm 20\%$ and is renormalized). The empirical results show that the overlap rate of firms classified into each tier (Tier 1–4) is as high as 96.4%, and the average rank correlation coefficient reaches 0.982, ruling out the methodological loophole that subjective changes in the weighting of a few indicators would cause systematic turbulence in evaluation results.

6.4. Excluding Subsamples from Key Supported Industries

Considering that the new-energy vehicle and semiconductor industries received far greater industrial-policy support during the sample period than ordinary manufacturing, this paper excludes the leading samples within "special-purpose equipment manufacturing (C35)" and "automobile manufacturing (C36)" that enjoyed especially large subsidies, and re-runs the baseline and moderating-effect regressions using the remaining traditional manufacturing firms. The results show that the coefficients of Hypotheses 1 and 2 remain robust, proving that the self-sustaining mechanism and factor-synergy regularities identified in this paper possess general explanatory power across industrial categories.

7. Conclusions, Policy Implications, and the Reconstruction of Global Governance Discourse

7.1. Core Theoretical Conclusions

By constructing the micro-level corporate sustainable competitiveness evaluation system (CCSCI) that integrates "self-sustaining capacity, factor rooting, anti-supply-chain-rupture control power, and non-compensable bottom lines," this paper accomplishes a systematic leap from humanistic macro value narratives to causal inference in micro-econometrics. The paper reaches three core conclusions:

Micro-level self-viability (SVI) is the fixed anchor for real organizations to traverse macro cycles: the endogenous cash-flow creation capacity after stripping out all kinds of government policy transfusions is the micro-level foundation for eliminating soft budget constraints and preventing blind capacity involution, and is also the decisive force for firms to sustain productivity rebounds under subsidy-withdrawal shocks.

"Anchor institution" rooting and feedback is an endogenous accelerator of technological innovation: by raising the local factor-allocation retention rate (*LVR*) in the regional ecosystem and building long-term, stable labor–capital process communities, chain-leader enterprises substantively smooth micro-level coordination frictions, constituting the key institutional intermediary that promotes the rapid industrialization of high-end R&D outcomes into market new products.

The non-compensable hard circuit-breaking operator reshapes the methodological benchmark of multidimensional measurement: major production-safety liabilities and irreversible financial-leverage risks possess non-convex boundary properties; introducing the non-compensable hard circuit-breaking mechanism into mathematical algorithms breaks the loophole of traditional linear weighting that "launders ecology and risky liabilities with profits," greatly improving the accuracy of survival identification under extreme supply-chain rupture crises.

7.2. Macro Policy Implications and Corporate Governance Pathways

Based on the above micro-level empirical conclusions, this paper proposes the following policy recommendations and micro-governance transformation pathways:

Promoting the shift of national industrial policy from "broad-caliber front-end stimulus" to "look-through, ex-post rewards for self-sustaining capacity": when governments at all levels formulate major industrial special projects and policies supporting new quality productive forces, they should embed firms' micro-level self-viability (*SVI*) and local value-added retention rate (*LVR*) into the red lines of project review and performance assessment, resolutely sever the chain of false expansion in which "fiscal subsidies are used to dress up statement profits and thereby extort more land and credit support," and, at the institutional source, guide micro-level entities away from low-end price involution.

Guiding real-economy chain-leader enterprises to evolve into regional "anchor institutions": change the one-sided governance mindset that values only "outsourced asset-light models" and "excessive capitalization," encourage chain-leader enterprises to increase investment in the backup pools (1-*HHI*) at critical chokepoints of the local supply chain, reasonably raise the labor-income distribution of frontline industrial artisans and core technical teams, and, through deep benefit sharing and institutional mutual trust, build organizational antifragile skeletons that cannot be broken or dragged down.

Breaking the monopoly of Western single-dimensional financial ratings and exporting China's autonomous measurement yardstick of business civilization: relying on the *Blue Book of China's Commercial Culture* and high-level annual academic platforms, systematically promote the CCSCI measurement system — with its rigorous empirical logic and micro-level look-through power — to the global industry, providing the international community with a set of modernized micro-level measurement standards that both encourage innovative self-sustaining capacity and uphold ecological red lines and the laws of common prosperity and symbiosis.

Author Contributions

Conceptualization, Z.D. and G.Y.; methodology, Z.D.; software, Z.D.; validation, Z.D. and G.Y.; formal analysis, Z.D.; investigation, Z.D.; resources, Z.D.; data curation, Z.D.; writing—original draft preparation, Z.D.; writing—review and editing, Z.D.; visualization, Z.D.; supervision, Z.D.; project administration, Z.D.; funding acquisition, G.Y. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

This paper horizontally links and matches four high-dimensional databases: The micro-level look-through database of listed-firm financial-statement footnotes (CSMAR/Wind); The global patent citation and standard essential patent database (IncoPat/CNIPA); The high-dimensional China Customs import/export enterprise database; The full database of official penalty notices of the Ministry of Ecology and Environment and the Ministry of Emergency Management.

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Conflicts of Interest

The authors declare no conflicts of interest.

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