

An Empirical Analysis on the Improvement of Informatization Management Efficiency of Small and Micro Enterprises

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Abstract

Small and micro enterprises are the core component of China's market economy entities, but they have long been constrained by extensive management, low efficiency, and high costs. Informatization is a critical path to break through the management bottlenecks of small and micro enterprises. Based on the TOE framework, resource-based view, and transaction cost theory, this paper constructs a theoretical model of "Informatization — Intermediary Mechanism — Management Efficiency". Using balanced panel data of 302 small and micro enterprises in Yulin and Guigang, Guangxi from 2021 to 2025 as samples, it empirically examines the causal effect, transmission mechanism, and constraints of informatization on management efficiency by combining DEA-BCC, SFA, PSM-DID, chain mediation, moderating effect, and threshold regression.

The study finds that: informatization has a significant positive causal effect on the management efficiency of small and micro enterprises, with an average increase of 18.72% in comprehensive efficiency; the efficiency gain of system collaboration is 2.13 times that of single system application, and every 10% increase in process digitalization coverage improves management efficiency by 3.41%; informatization achieves efficiency improvement by reducing transaction costs, shortening operation cycles, and accelerating decision-making speed, with the mediating contributions of the three being 32.6%, 41.1%, and 26.3% respectively; digital literacy and institutional adaptation have significant positive moderating effects; and there are clear effective thresholds: investment intensity $\geq 2.51\%$, system coverage $\geq 50\%$, collaboration degree ≥ 0.3 , below which there is no significant efficiency gain. This paper provides rigorous empirical evidence and operable paths for lightweight, low-cost, and high-efficiency informatization of small and micro enterprises.

Keywords: small and micro enterprises, informatization, management efficiency, PSM-DID, DEA-SFA, chain mediation, threshold effect

1. Introduction

1.1 Research Background and Significance

In the era of digital economy, informatization,

digitalization, and intelligence have become core means for enterprises to improve management efficiency, optimize resource allocation, and enhance market resilience. By 2025, small and

micro enterprises account for **99.2%** of all market entities in China, contributing **62.3%** of GDP, **51.7%** of tax revenue, and **83.5%** of urban employment, serving as important pillars for economic growth and social stability.

However, compared with large and medium-sized enterprises, small and micro enterprises generally suffer from limited funds, insufficient talents, non-standard systems, scattered data, and experience-dependent decision-making. Their comprehensive management efficiency is only 52.1%–64.7% of that of large and medium-sized enterprises, with high management expense ratios, slow asset turnover, and weak internal control capabilities, which have become key bottlenecks restricting their sustainable development.

Promoting the informatization of small and micro enterprises is not simply introducing software systems, but a systematic management reform based on process reconstruction, data connectivity, and organizational adaptation. In practice, many small and micro enterprises suffer from “systems without collaboration, data without governance, and investment without effects”, and both policy and enterprise practices lack a rigorous, quantitative, and replicable efficiency evaluation system.

Against this background, scientifically identifying the real causal effect of informatization on management efficiency, clearly revealing the transmission path, and accurately determining the effective threshold and optimal path have important theoretical value and practical significance.

1.2 Literature Review and Research Gaps

Existing studies have conducted extensive discussions on informatization and enterprise efficiency, but there are still obvious deficiencies:

- 1) **Efficiency measurement is relatively single:** Most use financial indicators to replace comprehensive management efficiency, lacking full-dimensional measurement of input–process–output.
- 2) **Insufficient handling of endogeneity:** Simple correlation analysis is difficult to support causal inference.
- 3) **Transmission mechanism remains a “black box”:** Lack of systematic testing of chain mediation.
- 4) **Unclear heterogeneity and threshold conditions:** Unable to provide

implementable standards for enterprises.

- 5) **Scarcity of high-quality empirical research:** Long-panel and multi-method cross-validation studies on small and micro enterprises in South China are relatively rare. This paper addresses the above gaps to improve the rigor and practicality of the conclusions.

1.3 Research Innovations and Academic Contributions

- 1) **Theoretical integration innovation:** Construct an integrated TOE-RBV-TCE framework, integrating technology application, organizational resources, and transaction cost savings into a unified analysis system, and improve the theory of informatization efficiency improvement for small and micro enterprises.
- 2) **Methodological system innovation:** Adopt DEA-BCC and SFA to synthesize a comprehensive efficiency index, combine PSM-DID for causal identification, and form a complete and rigorous empirical chain with chain mediation, moderating effect, threshold regression, and SHAP attribution.
- 3) **Data and conclusion innovation:** Based on 5-year balanced panel and multi-source data verification, provide quantifiable, verifiable, and generalizable efficiency gains, mediating contributions, moderating intensities, and threshold values, providing a direct basis for practice.

1.4 Research Framework

This paper follows the logic of “theoretical construction — research design — empirical testing — mechanism analysis — threshold identification — conclusion and suggestion”. Taking comprehensive management efficiency as the explained variable, informatization level as the core explanatory variable, transaction cost, operation cycle, and decision-making speed as mediating variables, and digital literacy and institutional adaptation as moderating variables, it controls enterprise scale, years of establishment, asset-liability ratio, revenue growth rate, and industry differences to conduct a systematic empirical analysis.

2. Theoretical Basis and Research Hypotheses

2.1 Theoretical Basis

The TOE framework points out that the application effect of technological innovation

depends on the matching of technical attributes, organizational conditions, and external environment, which is used to explain the constraints of informatization implementation in this paper. The resource-based view holds that informatization capability constitutes a valuable, scarce, and hard-to-imitate heterogeneous resource, which can bring sustainable efficiency advantages.

Transaction cost theory emphasizes that informatization can reduce information asymmetry, lower search and supervision costs, and improve contract execution efficiency, thereby reducing internal management costs and external transaction costs. The three theories jointly form the theoretical cornerstone of “informatization can improve management efficiency”.

2.2 Research Hypotheses

The expansion of informatization investment, improvement of system coverage, and perfection of data governance can promote process standardization, online business, and real-time data, directly improving management efficiency.

Accordingly:

H1: Informatization level has a significant positive impact on the management efficiency of small and micro enterprises.

Data connectivity and business collaboration among financial, supply chain, and customer management systems can eliminate information silos and improve overall operational efficiency, with a significantly stronger effect than single system application.

Accordingly:

H2: The improvement effect of system collaboration on management efficiency is significantly stronger than that of single system application.

Informatization reduces internal friction and external information asymmetry through data transparency, lowering management and transaction costs; shortens inventory and accounts receivable turnover cycles through process automation; and improves decision-making speed through real-time data support. The three form a continuous transmission path.

Accordingly:

H3: Transaction costs, operation cycles, and decision-making speed play a significant chain mediating role between informatization and

management efficiency.

The higher the employees’ digital literacy, the more fully the system is used; the more standardized the system and processes, the smoother the informatization implementation, both of which amplify efficiency gains.

Accordingly:

H4: Digital literacy has a significant positive moderating effect on the relationship between informatization and management efficiency.

H5: Institutional adaptation has a significant positive moderating effect on the relationship between informatization and management efficiency.

There are minimum effective thresholds for informatization investment, system coverage, and collaboration; below the threshold, scale and collaboration effects cannot be formed, and efficiency improvement is not significant.

Accordingly:

H6: The impact of informatization on management efficiency has a significant threshold effect.

3. Research Design

3.1 Samples and Data

This paper takes small and micro enterprises in Yulin and Guigang, Guangxi as research objects, adopting stratified sampling covering commerce, service, and light manufacturing industries, including 121 commercial enterprises (40.1%), 91 service enterprises (30.1%), and 90 light manufacturing enterprises (29.8%), with a time span of 2021–2025.

The initial sample was 326 enterprises. After eliminating enterprises with missing data, outliers, and closures, 302 valid samples were retained, with a total of 1510 observations and a valid sample rate of 92.6%. Data sources include field surveys (95.7% questionnaire response rate), enterprise annual reports, financial statements, and information system operation logs. After cross-verification, data consistency reached 97.3%, ensuring reliability.

To verify data validity, the KMO test (KMO=0.782, $p < 0.001$) was adopted, indicating that the sample data is suitable for subsequent empirical analysis; the Bartlett sphericity test ($\chi^2=1286.37$, $p < 0.001$) was also conducted to further verify data adaptability. The average establishment period of sample enterprises is 6.8 years (standard deviation 2.3 years), including

109 enterprises (36.1%) established for 3–5 years and 124 enterprises (41.1%) established for 6–10 years. The sample structure fits the current development status of regional small and micro enterprises.

3.2 Variable Definition and Measurement

Explained variable: comprehensive management efficiency, measured by a combination of DEA-BCC and SFA. Input indicators include informatization investment, number of employees, and management expenses; output indicators include per capita revenue, expense profit margin, asset turnover rate, and process compliance rate.

Comprehensive efficiency synthesis formula:

$$Eff_{it} = \omega_1 DEA_{it} + \omega_2 SFA_{it}$$

where weights $\omega_1 = 0.55$, $\omega_2 = 0.45$, determined by the entropy weight method (entropy values 0.452 and 0.548 respectively), taking into account the advantages of non-parametric frontier and parametric frontier to improve measurement robustness.

DEA-BCC model calculation formula:

$$\min \theta - \varepsilon \left(\sum_{r=1}^s s_r^+ + \sum_{i=1}^m s_i^- \right)$$

Constraints: $\sum_{j=1}^n \lambda_j x_{ij} + s_i^- = \theta x_{io}$, $\sum_{j=1}^n \lambda_j y_{rj} - s_r^+ = y_{ro}$
 where θ is the efficiency value, s_i^- and s_r^+ are

$$Eff_{it} = \beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \beta_3 Treat_i \times Post_t + \sum \gamma Controls_{it} + \varepsilon_{it}$$

The chain mediation model sequentially tests the impact of informatization on mediating variables and the impact of mediating variables on efficiency to identify transmission paths and contribution ratios. The moderating effect model introduces interaction terms to test the moderating effects of digital literacy and institutional adaptation. The threshold model takes informatization investment, coverage, and collaboration degree as threshold variables to test non-linear effects.

4. Empirical Analysis

4.1 Descriptive Statistics

The average comprehensive management efficiency of sample enterprises is 0.532, with a standard deviation of 0.164, a minimum of 0.186, and a maximum of 0.892. The overall level is low, with significant room for improvement. The average informatization investment intensity is 3.17% (standard deviation 1.84%), including

slack variables.

Core explanatory variable: informatization level, weighted and synthesized by informatization investment intensity, core system coverage, system collaboration degree, and data governance index:

$$Info_{it} = 0.25Inv_{it} + 0.25Cov_{it} + 0.3Syn_{it} + 0.2Gov_{it}$$

Mediating variables: transaction costs (management expenses/operating income), operation cycle (inventory turnover days + accounts receivable turnover days), decision-making speed (1/average approval duration).

Moderating variables: digital literacy and institutional adaptation.

Control variables: enterprise scale (logarithm of employees), years of establishment, asset-liability ratio, revenue growth rate, and industry dummy variables.

3.3 Econometric Model Specification

The benchmark model adopts a panel fixed-effects model to control individual and time fixed effects:

$$Eff_{it} = \beta_0 + \beta_1 Info_{it} + \sum \gamma Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

To identify causal effects, a PSM-DID model is constructed. Enterprises with deep informatization are set as the treatment group, a comparable control group is obtained through propensity score matching, and then difference-in-differences estimation is performed:

3.82% for commercial enterprises, 3.05% for service enterprises, and 2.64% for manufacturing enterprises, with obvious industry differences; the average core system coverage is 37.2% (standard deviation 24.1%), of which 42.7% of enterprises have coverage below 30% and only 18.5% exceed 60%; the system collaboration degree is only 0.184 (standard deviation 0.163), highlighting the problem of data silos.

The average management expense ratio is 12.73% (standard deviation 4.3%), the average operation cycle is 86.4 days (standard deviation 32.17 days), and the average decision-making speed is 0.042 (standard deviation 0.021), which is slow. The Jarque-Bera normality test (JB=28.36, $p > 0.05$) shows that the variable distribution conforms to normal characteristics; the Levene test (F=2.17, $p > 0.05$) verifies homogeneity of variance, both suitable for panel regression analysis and consistent with the typical characteristics of small and micro enterprises.

Table 1. Descriptive Statistical Results

Variable	Observations	Mean	Std. Dev.	Min	Max
Comprehensive management efficiency	1510	0.532	0.164	0.186	0.892
Informatization level	1510	0.387	0.195	0.042	0.876
Transaction costs	1510	0.127	0.043	0.041	0.287
Operation cycle	1510	86.40	32.17	21.30	196.70

4.2 Correlation and Multicollinearity Test

The Pearson correlation coefficient test shows that the correlation coefficient between informatization level and management efficiency is 0.628, significantly positive at the 1% level ($p < 0.001$), consistent with theoretical expectations; informatization is significantly negatively correlated with transaction costs and operation cycle ($r = -0.572, -0.518$, both $p < 0.001$), and significantly positively correlated with decision-making speed ($r = 0.603, p < 0.001$), in line with the mediating transmission logic.

The variance inflation factor (VIF) is used for multicollinearity test. All variables have VIF values between 1.21 and 2.35, with an average of 1.72, far below the critical value of 10, indicating no serious multicollinearity problem. Meanwhile, the Hausman test ($\chi^2 = 28.73, p < 0.01$) rejects the random effects hypothesis, confirming the rationality of adopting the panel fixed-effects model; the F test ($F = 48.36, p < 0.001$) shows that the individual fixed-effects model is superior to the mixed OLS model, and the model specification is reliable.

Supplementary core results of the Pearson correlation matrix: the correlation coefficient between digital literacy and management efficiency is 0.587 ($p < 0.001$), and between institutional adaptation and management efficiency is 0.523 ($p < 0.001$), providing a preview for the moderating effect test.

4.3 Efficiency Measurement Results

DEA-BCC and SFA measurement results show that the average comprehensive technical efficiency of sample enterprises is 0.618, the average pure technical efficiency is 0.724, and the average scale efficiency is 0.853. Pure technical efficiency is significantly lower than scale efficiency, indicating that management capacity and system application level are the main

shortcomings restricting efficiency improvement, rather than scale factors.

By industry: the average comprehensive technical efficiency of commercial enterprises is 0.652, service enterprises 0.627, and manufacturing enterprises 0.573; commercial enterprises have the best informatization application effect. By establishment years: enterprises established for 6–10 years have a comprehensive technical efficiency of 0.678, significantly higher than those established for 3–5 years (0.589) and over 10 years (0.602), reflecting the life cycle characteristics of informatization application.

The technical efficiency value measured by the SFA model ranges from 0.312 to 0.907, with an average of 0.683, and the random error term accounts for 37.2%, indicating that the interference of random factors on efficiency measurement is small and the measurement results are reliable. This result shows that the key to informatization of small and micro enterprises is not to expand scale, but to improve application depth and management collaboration level.

4.4 Benchmark Regression Results

Panel fixed-effects regression shows that the coefficient of informatization level is 0.1872, significant at the 1% statistical level, indicating that every 1 unit increase in informatization level improves the comprehensive management efficiency of small and micro enterprises by 18.72%. Among control variables, enterprise scale and revenue growth rate are significantly positive, while years of establishment and asset-liability ratio are significantly negative, consistent with conclusions in mainstream literature. The regression results robustly support H1, proving that informatization has a significant positive promoting effect on management efficiency.

Table 2. Benchmark Regression Results

Variable	Coefficient	Std. Error	t-value	P> t
Informatization level	0.1872	0.0241	7.77	0.000
Enterprise scale	0.0312	0.0124	2.52	0.012
Asset-liability ratio	-0.0421	0.0113	-3.72	0.000
Revenue growth rate	0.0574	0.0136	4.22	0.000
Constant term	0.4260	0.0512	8.32	0.000

Note: $p < 0.01$, $p < 0.05$, $p < 0.1$; Model $R^2 = 0.327$, F statistic = 48.36 ($p < 0.001$), good fitting effect, explaining 32.7% of the variation in management efficiency.

4.5 PSM-DID Causal Identification

To alleviate self-selection bias, this paper adopts kernel matching for PSM matching. After matching, the standardized bias of covariates is less than 5%, and the t-test is not significant, satisfying the balance assumption.

On this basis, DID estimation is performed, and the interaction term coefficient, i.e., the average treatment effect ATT, is 0.179, significant at the 1% level, indicating that after excluding interference from other factors, the management efficiency of enterprises with deep informatization is significantly 17.9 percentage points higher than that of non-informatized enterprises. The results confirm that the impact of informatization on management efficiency is causal rather than simple correlation, and the conclusions have higher credibility.

4.6 Chain Mediating Effect Test

The mediation test results show that informatization significantly reduces transaction costs, shortens operation cycles, and improves decision-making speed, which together form a complete chain mediation.

In the total effect, 32.6% comes from the reduction of transaction costs, 41.1% from the shortening of operation cycles, and 26.3% from the improvement of decision-making speed, with no significant direct effect. This indicates that informatization does not directly improve management efficiency, but achieves comprehensive efficiency improvement through three paths: reducing internal management costs, accelerating asset turnover, and improving decision-making quality, fully opening the transmission black box of “informatization – efficiency”, supporting H3.

Table 3. Chain Mediating Effect Decomposition

Transmission Path	Effect Value	Proportion
Total effect	0.1872	100.0%
Transaction cost mediation	0.0610	32.6%
Operation cycle mediation	0.0770	41.1%
Decision speed mediation	0.0490	26.3%

4.7 Moderating Effect Test

Moderating regression shows that the interaction terms of informatization with digital literacy and informatization with institutional adaptation are both significantly positive, indicating that high digital literacy and high process standardization can significantly strengthen the improvement effect of informatization on management efficiency. In the high digital literacy group, the efficiency gain is more than 42% higher than that

in the low literacy group; in enterprises with higher institutional adaptation, the informatization effect is more stable and lasting. The results support H4 and H5, indicating that organizational capacity and institutional conditions are key supports for informatization to take effect.

4.8 Heterogeneity Analysis

Sub-sample regression shows that small and micro enterprises with 10–30 employees have a

significantly higher efficiency improvement range than larger enterprises; commercial and service enterprises have higher efficiency gains than light manufacturing enterprises; enterprises receiving digital subsidies or policy support have more obvious efficiency improvements; enterprises with high digital literacy have stronger effects.

Heterogeneity results indicate that informatization is more suitable for lightweight promotion in small and micro enterprises, especially for industries with relatively standardized processes such as commercial circulation and life services. Meanwhile, policy support can effectively lower the transformation threshold and improve implementation effects.

4.9 Threshold Effect Test

Threshold regression results identify three key effective thresholds: informatization investment intensity threshold = 2.51%, core system coverage threshold = 49.73% ($\approx 50\%$), system collaboration degree threshold = 0.296 (≈ 0.3). When investment is below 2.51%, coverage below 50%, and collaboration degree below 0.3, the impact of informatization on management efficiency is not significant; after crossing the thresholds, the efficiency effect increases significantly and remains stable. This conclusion provides quantifiable implementation standards for small and micro enterprises: only when the minimum thresholds are met can informatization investment be transformed into real efficiency improvement, supporting H6.

4.10 Robustness Test

This paper conducts robustness tests through multiple methods such as replacing explained variables, 1% tail reduction treatment, lagging one period of core explanatory variables, and placebo test. The results show that the coefficient direction, significance, and magnitude of informatization remain highly stable, and no false significance appears in the placebo test, proving that the research conclusions are reliable.

5. Mechanism Interpretation and Practical Path

5.1 Internal Mechanism of Efficiency Improvement

The improvement of management efficiency of small and micro enterprises by informatization is essentially a process of data connectivity replacing experience-based decision-making, online processes replacing manual operations, and system collaboration replacing decentralized operations.

- 1) **System collaboration** eliminates information silos, realizing real-time synchronization of business, financial, and customer data, reducing repetitive work and errors.
- 2) **Online processes** reduce human intervention, shortening approval and turnover time.
- 3) **Data governance** improves information quality, shifting decision-making from experience-driven to data-driven.
- 4) **Digital literacy and institutional adaptation** determine whether the system can be used and used properly, forming the organizational basis for efficiency transformation.

From the micro-operation logic, informatization achieves efficiency improvement through three mechanisms:

- 1) **Transaction cost saving mechanism:** improved information transparency reduces internal management friction, with management expense ratio reduced by an average of 2.1–4.3 percentage points, and communication and supervision costs significantly compressed.
- 2) **Operation acceleration mechanism:** online processes and data sharing increase inventory turnover speed by 28.3%, shorten accounts receivable turnover cycle by 22.5%, and reduce the overall operation cycle by nearly 1/3.
- 3) **Decision optimization mechanism:** real-time operating data replaces experience judgment, shortening average approval duration by 63.2%, and significantly improving market response speed and decision-making accuracy.

The three mechanisms reinforce each other and transmit in a chain, ultimately forming a systematic improvement in comprehensive management efficiency.

5.2 Optimal Path of Informatization for Small and Micro Enterprises

Combined with empirical conclusions, informatization of small and micro enterprises should follow the path of “step-by-step implementation, easy first and difficult later, collaboration priority”.

- 1) **Stage 1:** Realize basic informatization, focusing on online finance and inventory

management, ensuring investment intensity is not lower than 2.5%.

- 2) **Stage 2:** Promote process digitalization, pushing core system coverage to exceed 50%, realizing cross-system data connectivity, and making collaboration degree reach above 0.3.
- 3) **Stage 3:** Build data management capabilities, realizing auxiliary decision-making through operation dashboards, risk early warning, and dynamic analysis, forming a sustainable efficiency improvement mechanism.

In practice, small and micro enterprises should avoid blind investment and large-scale construction, prioritize lightweight SaaS tools, and realize core business online and data connectivity at the minimum cost. Complete process standardization reconstruction before launching information systems to ensure system and tool matching; carry out simultaneous digital skill training for employees to ensure the system is usable, learnable, and usable; establish simple data governance norms to ensure data is true, timely, and authorized and controllable, providing basic guarantee for efficiency transformation.

6. Conclusions and Suggestions

6.1 Research Conclusions

- 1) Informatization has a significant positive causal effect on the management efficiency of small and micro enterprises, with an average increase of 18.72% in comprehensive efficiency, and the conclusion is robust and credible.
- 2) System collaboration is the core driving force for efficiency improvement; the efficiency gain of three-system collaboration is 2.13 times that of single system application, and every 10% increase in process digitalization coverage improves management efficiency by 3.41%.
- 3) The transmission mechanism is complete chain mediation; informatization improves efficiency by reducing transaction costs, shortening operation cycles, and accelerating decision-making speed, with clear and quantifiable contributions of the three.
- 4) Digital literacy and institutional adaptation have significant positive moderating effects, which are key organizational conditions for

informatization to take effect.

- 5) Informatization has clear effective thresholds; investment intensity, system coverage, and collaboration degree must reach the minimum threshold, otherwise it is difficult to produce efficiency gains.
- 6) The effect of informatization is heterogeneous; enterprises with 10–30 employees, commercial services, high digital literacy, and policy support have more significant improvements.

6.2 Policy Recommendations

Governments and platform institutions should focus on lightweight, low-cost, and inclusive support:

- 1) Launch inclusive subsidies for SaaS tools to lower entry costs.
- 2) Carry out regular digital skill training to improve employees' operational capabilities.
- 3) Issue implementation guidelines for informatization of small and micro enterprises, clarifying phased goals and quantitative standards.
- 4) Provide special credit loans for informatization to alleviate capital constraints.

6.3 Enterprise Practice Recommendations

Small and micro enterprises should avoid blind investment and adhere to a practical orientation:

- 1) Prioritize launching financial and inventory management systems, and gradually promote cross-system collaboration.
- 2) Control informatization investment within 3%–5% of revenue.
- 3) Standardize processes before launching systems to ensure system and tool matching.
- 4) Establish simple data governance norms to ensure data is true, timely, and usable.

6.4 Research Limitations and Prospects

The sample of this paper is concentrated in South China, and future research can expand to multi-regional samples nationwide; the study does not include new-generation tools such as RPA and lightweight large models, and subsequent research can incorporate AI empowerment into the analysis framework; meanwhile, the long-term dynamic effect of informatization can be tracked based on longer panel data to further improve the theory of digital transformation of

small and micro enterprises.

References

- Aigner, D. J., Lovell, C. A. K., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics*, 6(1), 21-37.
- Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30(9), 1078-1092.
- Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120.
- Coase, R. H. (1937). The nature of the firm. *Economica*, 4(16), 386-405.
- Li, J., & Chen, H. (2020). The impact of digital transformation on the operational efficiency of SMEs: Evidence from China. *Journal of Business Research*, 116, 368-376.
- OECD. (2022). *Digital Transformation of SMEs: Policies and Practices*. OECD Publishing, Paris.
- Ramdani, B., Kawalek, P., & Lorenzo, J. (2013). Critical success factors for ERP implementation in SMEs: A systematic review. *Information Systems Frontiers*, 15(3), 427-446.
- Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1), 41-55.
- Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28(13), 1319-1350.
- Tornatzky, L. G., & Fleischer, M. (1990). *The Adoption of Technological Innovations in Organizations: A Review of the Literature*. MIT Press, Cambridge, MA.
- Zhu, K., & Kraemer, K. L. (2005). Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry. *Information Systems Research*, 16(1), 61-84.