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Digital Transformation, Green Innovation, and Managerial Myopia: Evidence from Manufacturing Firms under Robust Endogeneity and Selection-Bias Controls

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ABSTRACT

This study investigates the impact of digital transformation on green innovation and examines whether managerial myopia constrains digital innovation activities. Grounded in Upper Echelons, Resource Based, and Dynamic Capability theories, the research addresses critical gaps regarding causal identification and the interplay between technological capabilities and managerial cognition. Utilizing a longitudinal dataset of Chinese listed manufacturing firms from 2011 to 2022, the analysis employs rigorous endogeneity-correction techniques, including lagged variable estimation, Two-Stage Least Squares instrumental variable approaches, and Propensity Score Matching combined with Difference in Differences. The findings consistently demonstrate that digital transformation exerts a significant positive causal effect on green innovation, with results remaining robust across all identification strategies. Conversely, managerial myopia exhibits no statistically significant impact on digital innovation, suggesting that digital initiatives are largely insulated from short-term managerial orientations due to competitive pressures, institutional mandates, and relatively rapid operational payoffs. These results challenge conventional assumptions that managerial short-termism uniformly suppresses innovation, highlighting the strategic necessity of digital transformation in modern manufacturing instead. The study contributes to sustainability and corporate governance literature by providing robust empirical evidence on how digital capabilities drive environmental innovation while clarifying the limited role of managerial cognition. In practice, the findings underscore the importance of policy support for digital infrastructure and technology adoption as effective pathways to achieving long-term corporate sustainability and green technological advancement.

Keywords: Digital Transformation, Green Innovation, Managerial Myopia, Digital Innovation, Upper Echelons Theory, Dynamic Capability Theory, Endogeneity, Propensity Score Matching, Corporate Sustainability

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1. Introduction

The pursuit of sustainable economic development has become one of the most significant challenges facing modern enterprises. Growing environmental concerns, increasing regulatory pressures, climate change commitments, and heightened stakeholder expectations have compelled firms to incorporate sustainability objectives into their strategic decision making processes. Among the various approaches available to organizations, green innovation has emerged as a critical mechanism through which firms can simultaneously achieve environmental responsibility and long term competitive advantage. Green innovation encompasses the development of environmentally friendly products, processes, technologies, and management practices that reduce ecological impacts while enhancing organizational performance. Consequently, understanding the factors that facilitate or hinder green innovation has become an important research priority in both management and sustainability literature.

In recent years, digital transformation has attracted considerable scholarly and managerial attention as a powerful driver of organizational change and innovation. Digital transformation refers to the integration of advanced digital technologies including big data analytics, artificial intelligence, cloud computing, the Internet of Things (IoT), blockchain, and intelligent automation into business operations, strategic processes, and governance structures. Beyond improving operational efficiency, digital transformation enables firms to collect, process, and utilize information more effectively, thereby enhancing decision quality, organizational agility, and innovation capabilities. As organizations increasingly adopt digital technologies, researchers have begun examining whether digital transformation can contribute to environmental sustainability objectives and stimulate green innovation activities.

Existing studies provide substantial evidence that digital transformation positively influences green innovation through multiple channels. Digital technologies improve information transparency, facilitate resource optimization, strengthen environmental monitoring capabilities, and support sustainable production processes. [1, 2] Enhanced data integration and real time information sharing enable firms to identify inefficiencies, reduce waste, improve energy utilization, and accelerate the development of environmentally sustainable technologies. Furthermore, digital transformation strengthens organizational learning capabilities, encourages knowledge integration across departments, and supports research and development activities that contribute to green technological advancement. These mechanisms collectively suggest that digital transformation may function as a critical enabler of sustainable innovation.

Despite the growing evidence linking digital transformation and green innovation, the effectiveness of digital technologies ultimately depends on managerial decision making. Organizational resources and technological capabilities do not operate independently; rather, they are deployed and shaped by managers whose cognitive characteristics influence strategic priorities and resource allocation decisions. This perspective is consistent with Upper Echelons Theory, which argues that organizational outcomes reflect the values, experiences, perceptions, and cognitive orientations of top executives. Consequently, managerial characteristics may significantly influence whether firms successfully translate digital capabilities into innovation outcomes.

Among various managerial characteristics, managerial myopia has emerged as a particularly important construct for understanding strategic decision making. Managerial myopia refers to the tendency of managers to prioritize short term performance objectives at the expense of long term organizational value creation. Managers exhibiting myopic behavior often focus on immediate financial results, quarterly earnings, short-t

erm market expectations, and rapidly observable outcomes. Such short-term orientations can discourage investments in projects characterized by uncertain returns, extended development horizons, and substantial upfront costs. As a result, managerial myopia has been associated with reduced investment in research and development, lower innovation quality, diminished organizational learning, and weaker long term competitiveness.

The implications of managerial myopia are especially relevant in the context of green innovation. Unlike conventional innovation activities, green innovation often requires substantial financial investment, extensive technological experimentation, and prolonged development periods before economic benefits can be realized. Environmental innovations frequently involve higher levels of uncertainty, regulatory complexity, and technological risk. Consequently, managers focused primarily on short term performance metrics may be reluctant to allocate resources to green innovation initiatives despite their long term strategic importance. Recent studies have therefore begun investigating the influence of managerial short termism on sustainable innovation outcomes, reporting generally negative effects on innovation investment and quality.

At the same time, digital transformation may interact with managerial cognition in complex ways. On one hand, digital technologies can reduce information asymmetry, improve decision quality, and enhance organizational transparency, potentially mitigating some of the adverse consequences of managerial short-termism. On the other hand, digital transformation itself requires significant investments and strategic commitment, raising questions regarding whether managerial myopia constrains firms' willingness to pursue digital innovation initiatives. Although previous studies have examined digital transformation and managerial myopia separately, relatively little attention has been paid to understanding their combined influence on innovation outcomes within a unified empirical framework.

Several important gaps therefore remain in the existing literature. First, while numerous studies have documented the positive relationship between digital transformation and innovation performance, fewer have rigorously evaluated whether this relationship remains robust after accounting for endogeneity, reverse causality, and selection bias. Second, although managerial myopia has been widely investigated in financial and investment contexts, empirical evidence regarding its influence on digital innovation remains limited and inconclusive. Third, relatively few studies simultaneously examine digital transformation, managerial cognition, and innovation outcomes using comprehensive causal identification strategies that strengthen the validity of empirical conclusions.

To address these gaps, the present study investigates the relationships among digital transformation, managerial myopia, green innovation, and digital innovation using a longitudinal dataset of Chinese listed manufacturing firms. Specifically, the study examines whether digital transformation promotes green innovation and whether managerial myopia influences firms' digital innovation activities. To establish robust empirical evidence, the analysis employs multiple endogeneity correction techniques, including lagged-variable estimation, instrumental variable Two Stage Least Squares (2SLS) estimation, and Propensity Score Matching combined with Difference in Differences (PSM-DID) analysis.

The study contributes to the literature in several ways. First, it extends research on digital transformation by providing robust evidence regarding its causal impact on green innovation. Second, it enriches the managerial cognition literature by examining whether managerial myopia affects digital innovation performance within a large sample of manufacturing firms. Third, by integrating perspectives from Upper Echelons Theory, Resource Based Theory, and Dynamic Capability Theory, the study offers a comprehensive framework for understanding how managerial characteristics and digital capabilities jointly influence sustainable innovation outcomes. Finally, the application of multiple endogeneity control approaches enhances the credibility and reliability of the findings, providing stronger empirical support for managerial and policy recommendations.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature and develops the theoretical background. Section 3 presents the research framework and research design. Section 4 describes the dataset and variables. Section 5 outlines the empirical methodology. Section 6 reports the endogeneity

and robustness analyses, while the final section discusses the implications of the findings and concludes the study.

2. Literature Review and Research Background

From a direct perspective, digital transformation reduces information asymmetry and improves the efficiency of internal communication processes. It enhances supply chain transparency, product traceability, and financial information disclosure, thereby creating a more efficient and environmentally responsible operational environment [3, 4]. Digital technologies also facilitate operational process visualization, dynamic monitoring, efficient resource allocation, and pollution control activities, all of which contribute to improved environmental performance.

Indirectly, digital transformation promotes green technological innovation by strengthening the corporate human capital structure, improving managerial efficiency, increasing research and development (R&D) investment intensity, and reducing organizational risks [5, 6]. Furthermore, scholars have explored the heterogeneous effects of digital transformation on green innovation, emphasizing the moderating roles of firm-specific characteristics and external conditions, including technological capabilities, environmental regulations, market competition, and international business opportunities [7, 8].

Parallel to the growing literature on digital transformation, a substantial body of research has examined the determinants of corporate green innovation. Green innovation is widely recognized as essential for achieving long term sustainability objectives; however, managerial behavior can significantly influence its effectiveness [9]. Existing studies identify both environmental and organizational factors as major determinants of green innovation performance.

Environmental influences include coercive environmental regulations [10, 11], incentive-based policies such as tax and credit support [12, 13], competitive pressures from consumers, suppliers, and rival firms [13, 14], institutional pressures [15], green knowledge sharing among supply chain partners [16] and evolving market demand for environmentally sustainable products and services [17]. At the organizational level, green innovation performance is influenced by innovation capabilities and resource availability [18, 19], sustainable human capital development [19], green organizational identity [20], state ownership structures [21], and market orientation [22].

Despite extensive research on the drivers of green innovation, comparatively less attention has been devoted to the role of managerial cognition and temporal orientation. Managerial myopia, rooted in Upper Echelons Theory, refers to the tendency of managers' personal characteristics, perceptions, and cognitive biases to shape organizational strategies and outcomes [23]. Managers exhibiting myopic tendencies generally have a limited decision making horizon and place disproportionate emphasis on short-term performance indicators, such as current earnings and stock market outcomes [24].

Early studies on managerial myopia primarily focused on investment behavior. These studies suggest that myopic managers prefer projects characterized by short maturity periods and rapid financial returns, often at the expense of long term strategic value creation [25, 26, 27]. The concept is also closely associated with the social psychological theory of time orientation, which argues that decision makers with a short term orientation prioritize immediate benefits over the long-term development and sustainability of the organization [28, 29].

Although managerial myopia has been widely studied in financial and investment contexts, its implications for green innovation remain relatively underexplored [30] [Qingchang Lu]. Green innovation typically requires substantial investment, long development cycles, and uncertain returns, making it particularly vulnerable to short-term managerial thinking. Recent research has therefore begun to investigate the relationship between managerial short-termism and sustainable innovation outcomes.

For example, Xu [31] used data from Chinese A-share listed companies covering the period from 2001 to 2021

and employed panel fixed effects and moderating effect models to examine the influence of managerial short-termism on corporate green innovation. The study further explored the moderating role of digital transformation in the relationship between managerial short termism and green innovation. Similarly, Jian employed machine learning based textual analysis techniques to construct a managerial myopia index using data from A-share listed companies on the Shanghai and Shenzhen Stock Exchanges between 2015 and 2020 [32].

More recent studies have expanded the scope of managerial myopia research beyond financial manipulation and earnings management, highlighting its broader consequences for organizational capabilities, innovation quality, and corporate social responsibility. Using text analysis methods to quantify managerial myopia among Chinese publicly listed firms, Yu et al. [33] found that a short term managerial orientation significantly reduces R&D investment and weakens innovation quality by narrowing the breadth of patent knowledge and lowering the proportion of substantive innovations [34]. These negative effects are particularly pronounced in firms characterized by weak governance mechanisms, high financing dependence, and elevated environmental uncertainty, supporting the predictions of agency cost theory.

Furthermore, external market forces appear to exert complex and sometimes contradictory effects. While pressure from equity analysts may partially offset reductions in R&D expenditures, intense product market competition can encourage firms to accelerate the introduction of lower quality innovations, thereby creating what has been described as an "innovation bubble" [35]. These findings suggest that managerial myopia affects not only the quantity of innovation activities but also their quality and long term sustainability.

Against this backdrop, the present study investigates the impact of managerial myopia on green innovation among Chinese listed companies during the period 2001–2021. Specifically, it examines how managerial short-termism influences sustainable innovation outcomes at both firm and industry levels. Utilizing Management Discussion and Analysis (MD&A) textual data and corporate patent information, the study employs high-dimensional fixed-effects models and a series of robustness tests to evaluate the relationship between managerial myopia and green innovation. In addition, heterogeneity analyses and mediation models are conducted to identify variations across firm characteristics and to explore potential transmission mechanisms, including R&D investment, digital transformation, and environmental, social, and governance (ESG) management practices [36].

3. Research Framework/Design

3.1 Conceptual Framework

The present study is grounded in the intersection of Upper Echelons Theory, Resource Based Theory, and Dynamic Capability Theory. Upper Echelons Theory suggests that managerial cognitive characteristics influence strategic decision making and organizational outcomes. Managerial myopia, characterized by excessive focus on short term performance objectives, may discourage investments whose benefits materialize only in the long term. Green innovation, which often requires substantial financial commitment, technological experimentation, and extended development horizons, is therefore particularly vulnerable to managerial short termism.

Conversely, Resource Based Theory and Dynamic Capability Theory suggest that digital transformation provides firms with technological capabilities that facilitate information processing, organizational learning, resource integration, and innovation activities. Through enhanced data analytics, intelligent decision support systems, and improved coordination mechanisms, digital transformation can strengthen a firm's ability to pursue environmentally sustainable innovations.

Building on these theoretical perspectives, this study proposes that digital transformation positively influences green innovation, whereas managerial myopia may constrain innovation-oriented investments. Furthermore, digital transformation may operate as a strategic organizational capability that mitigates the adverse effects of managerial short termism by improving information transparency, reducing uncertainty, and enhancing long-term planning capabilities.

Accordingly, the conceptual framework examines two primary relationships:

1. The effect of digital transformation on green innovation.

2. The effect of managerial myopia on digital innovation and innovation related outcomes.

The framework also recognizes the presence of firm level heterogeneity and endogeneity concerns that may affect observed relationships. Therefore, multiple robustness and causal identification strategies are incorporated into the empirical design.

3.2 Research Design

The study adopts a longitudinal panel data research design using Chinese listed manufacturing firms observed over the period 2011–2022. The panel structure enables the examination of temporal relationships between managerial characteristics, digital transformation initiatives, and innovation outcomes while controlling for unobserved firm specific heterogeneity.

The empirical design proceeds in four stages.

First, descriptive and exploratory analyses are conducted to understand the distribution and variation of key variables across firms and time.

Second, baseline panel regression models are estimated to examine the relationships among digital transformation, managerial myopia, and innovation outcomes. Industry, province, and year fixed effects are incorporated to account for sectoral, regional, and temporal influences.

Third, several endogeneity correction approaches are employed. Lagged variable models address potential reverse causality by ensuring temporal precedence. Instrumental variable estimation using Two Stage Least Squares (2SLS) addresses omitted variable bias and simultaneity concerns. Propensity Score Matching combined with Difference in Differences (PSM-DID) further mitigates self selection bias by comparing observationally similar firms.

Finally, robustness analyses are performed to assess the consistency and stability of empirical findings across alternative specifications and identification strategies.

Figure 1 illustrates the overall research framework that links managerial cognition, digital transformation, and innovation outcomes within the proposed causal structure.

4. Dataset Description

The dataset employed in this study, titled ”Disruptive_Manufacturing_Firms” (Oliveira, 2026), is publicly accessible via the Kaggle repository. The data were constructed from an analysis of listed enterprises in China spanning 2011 to 2022.

The primary purpose of the dataset is to investigate the influence of digital transformation on corporate governance, with a specific focus on governance efficiency for minority shareholders. Key variables derived from the data include measures of digital transformation extent, agency costs incurred from related party transactions (specifically the second type of agency costs), shareholder meeting attendance, minority shareholder exit threats, ownership structure (state owned vs. non state owned), regional location (eastern, central, western China), and the effectiveness of equity checks and balances.

The dataset is provided as a single comma separated values file named data0326.csv, with a file size of 3.87 MB. It contains 18 columns (features) and an unspecified number of firm year observations. The dataset’s

license and expected update frequency are not specified in the available metadata. A Digital Object Identifier (DOI) citation for the dataset is also not provided on the webpage. The author notes that the dataset is expected to be updated annually.

4.1 Data Dictionary

While specific column names are not listed, the documented variables include:

- Extent of digital transformation
- Agency costs from related party transactions (second type)
- Shareholders' meeting attendance rates
- Minority shareholder exit threat indicators
- Ownership type (state owned vs. non state owned enterprises)
- Geographic region (eastern, central, western)
- Equity checks and balances metrics
- Firm level identifiers and year (2011–2022)

5. Methodology

5.1 Variable Construction

Dependent Variables

Two innovation related outcomes are examined in this study.

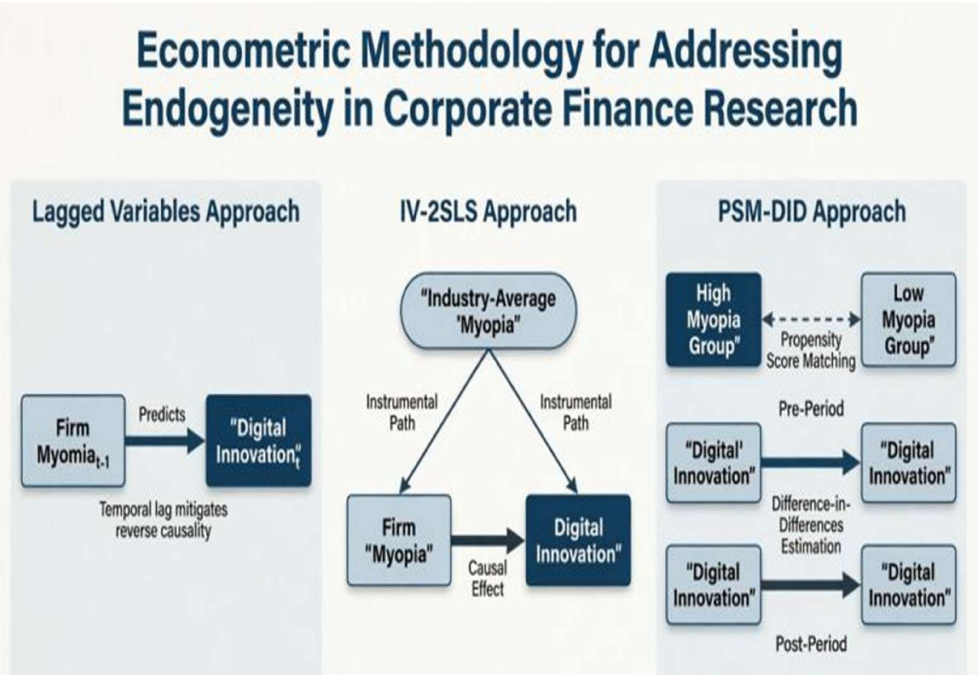

Figure 1. Methodological Framework

Green Innovation (GI): Green innovation is measured using green patent outputs, which capture environmentally oriented technological innovation activities undertaken by firms. Patent-based measures are widely used in sustainability and innovation research because they reflect both innovation effort and technological outcomes.

Digital Innovation (DI): Digital innovation represents the firm's ability to develop, adopt, or integrate dig- ital technologies into business processes and innovation activities.

Independent Variables

Digital Transformation (DT): Digital transformation measures the extent to which firms adopt and integrate digital technologies into organizational operations, governance mechanisms, and strategic decision-making processes.

Managerial Myopia (MM): Managerial myopia captures the degree to which managers exhibit short-term strategic orientation. Consistent with recent literature, the construct reflects managerial tendencies to prioritize immediate performance outcomes over long-term value creation.

Control Variables

Following prior studies on corporate innovation and digital transformation, several firm-level controls are included:

- Firm Size (SIZE)
- Financial Leverage (LEV)
- Tobin's Q (TobinQ)
- Firm Age (AGE)
- Asset Turnover Ratio (ATO)
- Ownership Concentration (TOP10)
- Board Characteristics (BD)

These variables account for organizational resources, growth opportunities, governance quality, and operational efficiency that may influence innovation activities.

5.2 Baseline Econometric Model

To examine the impact of digital transformation on green innovation, the following baseline fixed-effects model is estimated:

$$GI\_it = \beta_0 + \beta_1 DT\_it + \beta_2 Controls\_it + IndustryFE + Province\ FE + YearFE + \in\_it$$

where GI represents green innovation output, DT denotes digital transformation, and Controls refers to the vector of firm level control variables.

To investigate the effect of managerial myopia on digital innovation, the following model is estimated:

$$DI\_it = \alpha_0 + \alpha_1 MM\_it + \alpha_2 Controls\_it + IndustryFE + Province\ FE + YearFE + \mu\_it$$

Firm level observations are indexed by *i* and time periods by *t*. Fixed effects absorb unobserved heterogeneity across industries, regions, and years.

5.3 Endogeneity Identification Strategy

Because digital transformation and innovation may be jointly determined, three complementary identification strategies are employed.

Lagged Variable Estimation

All explanatory variables are lagged by one period to ensure temporal ordering and reduce concerns about reverse causality. The lagged specification assumes that current innovation outcomes cannot influence past managerial or digitalization decisions.

Instrumental Variable Estimation

To address omitted variable bias and simultaneity, Two Stage Least Squares (2SLS) estimation is employed.

The instrument is defined as the industry year average digitalization level excluding the focal firm. This instrument satisfies the relevance condition because industry wide digitalization pressures strongly influence firm level adoption decisions. At the same time, it is plausibly exogenous to individual firms' innovation outcomes.

The first stage model is specified as:

$$DT\_it = \gamma_0 + \gamma_1 IV\_it + \gamma_2, Controls\_it + v\_it$$

The predicted values obtained from the first stage are then used in the second-stage innovation equation.

Propensity Score Matching Difference-in-Differences

To mitigate selection bias, firms are classified into treatment and control groups according to digitalization intensity. Propensity scores are estimated using pre-treatment firm characteristics, and nearest neighbor matching is performed to construct comparable groups.

The matched sample is subsequently analyzed using a Difference-in-Differences framework:

$$GI\_it = \delta_0 + \delta_1 (Treat\_i \times Post\_t) + \delta_2, Controls\_it + \eta\_it$$

where Treat identifies highly digitalized firms and Post represents the post-treatment period.

5.4 Robustness Evaluation

The robustness of findings is evaluated through three complementary approaches:

1. Temporal robustness using lagged specifications.

2. Endogeneity robustness using instrumental-variable estimation.

3. Selection bias robustness using matched Difference-in-Differences analysis.

Consistency across these approaches strengthens confidence in the causal interpretation of the results.

6. Endogeneity and Robustness Analysis

6.1 Rationale for Endogeneity Testing

The relationship between digital transformation, managerial behavior, and innovation outcomes may be affected by several endogeneity problems. Firms with strong innovation capabilities may invest more heavily in digital technologies, creating reverse causality. Similarly, unobserved organizational characteristics, managerial quality, or industry specific factors may simultaneously influence both digitalization and innovation performance, resulting in omitted variable bias. Furthermore, firms adopting digital strategies may systematically differ from non adopters, generating selection bias.

To address these concerns, three complementary econometric approaches were implemented: (1) lagged-variable estimation, (2) instrumental variable estimation using Two Stage Least Squares (2SLS), and (3) Propensity Score Matching combined with Difference in Differences (PSM-DID). Together, these methods provide a rigorous framework for assessing whether the observed relationships remain robust after controlling for alternative explanations.

6.2 Digitalization and Green Innovation

Lagged Variable Model

To mitigate reverse causality, all explanatory variables were lagged by one year. The logic behind this approach is that future green innovation cannot influence past digitalization decisions. By ensuring that digitalization precedes innovation temporally, the model strengthens causal interpretation.

To ensure temporal precedence i.e., that past digitalization drives future innovation rather than current innovation requiring digital infrastructure the independent variable and all controls were lagged by one year (t-1).

The structural model is formulated as follows:

$$GP_{i,t} = \alpha_0 + \beta_1 \ DI_{i,t}\text{-}1 + \Sigma_{rk} \ Controls_{k,i,t-1} + \text{Industry}_{FE} + \text{Province}_{FE} + \text{Year}_{FE}$$

6.3 Remaining

The analysis was conducted using 15,866 observations after accounting for the loss of the first observation for each firm resulting from lag construction. Industry, province, and year fixed effects were incorporated to control for structural heterogeneity across sectors and regions.

The estimated coefficient for lagged digitalization was 9.4895, with a t-statistic of 36.52 and a significance level below 0.001.

The magnitude and significance of the coefficient indicate that digital transformation exerts a substantial positive influence on subsequent green innovation activities. Specifically, firms exhibiting higher levels of digitalization in the previous period tend to generate significantly more green patents in the following period.

The exceptionally high t-statistic demonstrates that the relationship is not only statistically significant but also highly stable across firms and years. This finding supports the argument that digital technologies improve information processing, facilitate knowledge integration, enhance environmental monitoring, and accelerate innovation processes that contribute to environmentally sustainable technologies.

The persistence of the effect after controlling for industry, regional, and temporal heterogeneity suggests that the relationship is not merely a reflection of sectoral innovation trends or regional development differences.

6.4 Instrumental Variable and 2SLS Analysis

To account for potential unobserved firm level dynamics that simultaneously impact digitalization strategies and green innovation, a 2SLS Instrumental Variable approach was deployed. Following standard corporate finance literature, the instrument (IV_{i,t}) is defined as the industry year average of digitalization across all other firms within the same sector and year:

Stage 1: $DI_{i,t} = \alpha_0 + \delta_1 IV_{i,t} + \Sigma\ rk\ Controls_{k,i,t}$ + Province *FE* + Year *FE*

Stage 2: $GP_{i,t} = \theta_0 + \beta_1 \widehat{DI}_{i,t} + \Sigma\ \lambda k\ Controls_{k,i,t}$ + Province *FE* + Year *FE*

First Stage Diagnostics:

- IV Coefficient (δ_1) : 0.7144
- *t*-statistic: 19.39 ($p < 0.001$)

Weak Instrument Check: The effective F-statistic is well above the traditional threshold of 10 (F ≈376), validating that the industry year trend is an exceptionally strong predictor of a firm's individual digitalization choice.

Although lagged estimation reduces concerns about reverse causality, unobserved factors may still affect both digitalization and green innovation. To address this issue, a Two-Stage Least Squares framework was implemented.

The instrument was constructed as the industry-year average digitalization level excluding the focal firm. This variable captures industry wide digitalization pressures while remaining plausibly exogenous to the innovation outcomes of any individual firm.

The first-stage diagnostics indicated a strong instrument, with an effective F-statistic substantially exceeding the conventional threshold value of 10.

The second-stage estimation produced a coefficient of 42.1077 with a t-statistic of 22.57 and a p-value below 0.001.

The IV coefficient is considerably larger than the coefficient obtained in the lagged specification. This result suggests that conventional estimators may underestimate the true effect of digitalization due to measurement error or attenuation bias.

After isolating the exogenous component of digitalization, the analysis reveals a strong causal impact on green innovation. The persistence of significance indicates that the relationship cannot be explained solely by omitted firm characteristics.

From a theoretical perspective, the findings support resource-based and dynamic capability theories, which posit that digital technologies enhance organizational learning, improve resource allocation, and create capabilities necessary for sustainable innovation.

The strong IV results therefore provide compelling evidence that digital transformation is not merely correlated with green innovation but actively contributes to it.

6.5 Propensity Score Matching Difference-in-Differences

To address selection bias, firms were classified into treatment and control groups based on their digitalization levels.

To address potential self selection bias (i.e., that inherently high-performing firms are more likely to digitalize), a PSM-DID setup was executed:

1. Treatment Group Definition (*Treat_i*): Firms whose average digitalization index over the sample period was above the median were assigned to the treatment group (*Treat*=1). Others served as controls (*Treat*=0).

2. Timeline Threshold (*Post_t*): The midpoint year of 2019 was defined as the temporal boundary (*Post*=1 for Year ≥ 2019}).

Propensity Score Matching: A logistic regression modeled the probability of entering the high-digitalization group using baseline covariates (SIZE, LEV, GROW, AGE, TOP10, ATO, BD). Treated firms were paired with control firms using a 1:1 nearest-neighbor algorithm.

This reduced the unique corporate count from 3,169 firms down to a tightly matched cohort of 2,245 comparable firms. The matched panel was then evaluated via the DID specification:

$$GP_{i,t} = \beta_0 + \beta_1 (Treat_i \times Post_t) \beta_2 Treat_i + \beta_3 Post_t \Sigma rk\ Controls_{k,i,t}$$

Firms exhibiting above-median digitalization were designated as the treatment group, while those below the median formed the control group. A propensity score matching procedure using firm level financial and governance characteristics ensured comparability between groups.

The matching process reduced the sample from 3,169 firms to 2,245 highly comparable firms.

The DID interaction coefficient was estimated at 0.1304, with a t-statistic of 3.14 and a p-value of 0.0017.

The positive DID coefficient indicates that highly digitalized firms experienced a greater increase in green patent production after 2019 compared with otherwise similar firms.

Because the matched firms share comparable observable characteristics, the estimated effect is less likely to be driven by pre-existing differences between firms.

This result strengthens the causal interpretation of the digitalization green innovation relationship and demonstrates that digital transformation generates tangible innovation benefits over time.

The convergence of findings across lagged models, IV estimation, and PSM-DID provides strong evidence of robustness.

6.6 Managerial Myopia and Digital Innovation

6.6.1 Lagged Variable Analysis

A separate robustness investigation examined whether managerial myopia influences digital innovation outcomes.

The lagged specification estimated the effect of managerial myopia measured in the previous period on current digital innovation performance.

Variable	Coefficient	Std. Err.	t-statistic	P-value
L_Myopia	-0.0021	0.0025	-0.848	0.396
L_SIZE	0.0059	0.0008	7.852	0.000
L_LEV	-0.0048	0.0015	-3.186	0.001
L_TobinQ	0.0005	0.0001	3.641	0.000

The coefficient for lagged managerial myopia was “0.0021, with a t-statistic of “0.848 and a p-value of 0.396.

Although the estimated coefficient is negative, the effect is statistically insignificant. Consequently, there is insufficient evidence to conclude that managerial myopia systematically reduces digital innovation.

This finding suggests that digital innovation decisions may be driven more strongly by organizational capabilities, technological resources, and competitive pressures than by short term managerial orientations.

The positive and significant effects observed for firm size and Tobin's Q imply that larger and more growth-oriented firms are more likely to invest in digital innovation.

6.7 Instrumental Variable Analysis

To address omitted variable bias, managerial myopia was instrumented using the industry year average level of managerial myopia.

The 2SLS results produced a coefficient of -0.0178 with a p-value of 0.152.

The coefficient remains negative but statistically insignificant.

Importantly, the consistency between the lagged model and the IV estimation suggests that the insignificant effect is not due to omitted variables or endogeneity.

This finding implies that managerial short termism is not a major determinant of digital innovation performance among the sampled Chinese manufacturing firms.

6.8 PSM-DID Analysis

The final robustness assessment employed a matched DID design.

1. Treatment Definition: Firms with Myopia above the sample median in the base year (2014) are assigned to the Treatment group (Treat=1), and those below to the Control group (Treat=0).

2. Matching: We calculated propensity scores using a Logit model based on base-year characteristics (SIZE, LEV, AGE, TobinQ, ATO, TOP10). We then performed 1-to-1 nearest neighbor matching to pair high-myopia firms with statistically similar low-myopia firms.

3. DID Regression: We defined the Post period as years after the median year (2018). We ran a TWFE DID regression on the matched sample to isolate the treatment effect (Treat x Post).

Matched Sample Statistics:

- Total Matched Firms: 1,174 (587 Treated, 587 Control)

DID Regression Results:

Variable	Coefficient	Std. Err.	t-statistic	P-value
Treat_Post (DID Estimator)	-0.0001	0.0017	-0.065	0.948
SIZE	0.0068	0.0010	6.943	0.000
LEV	-0.0044	0.0025	-1.745	0.081
TobinQ	0.0008	0.0003	3.132	0.002

Following propensity score matching, the final sample comprised 1,174 firms, including 587 treated and 587 control firms.

The DID estimator was -0.0001 with a p-value of 0.948.

The coefficient is effectively zero and statistically insignificant. This indicates that firms characterized by high managerial myopia do not exhibit digital innovation trajectories that differ significantly from those of comparable low myopia firms.

The near-zero effect suggests that managerial myopia has limited explanatory power once observable firm characteristics are controlled.

Furthermore, the result indicates that digital innovation investments may be sufficiently strategic and long-term to be insulated from short-term managerial tendencies.

7. Discussion

The findings provide important insights into the relationship between digital transformation, managerial cognition, and sustainable innovation in Chinese manufacturing firms.

First, the results consistently demonstrate that digital transformation significantly promotes green innovation. Across lagged variable models, instrumental-variable estimation, and PSM-DID analyses, digitalization exhibits a positive and statistically significant impact on green patent production. The consistency of these findings suggests that digital transformation functions as a strategic capability that enables firms to improve information processing, facilitate organizational learning, strengthen environmental monitoring, and accelerate the development of environmentally sustainable technologies.

These findings are consistent with Resource-Based Theory, which argues that technological resources constitute valuable organizational assets capable of generating competitive advantages. They also support Dynamic Capability Theory by illustrating how digital technologies enhance firms' abilities to sense opportunities, integrate knowledge, and reconfigure resources for sustainable innovation.

Second, the instrumental variable results indicate that the causal impact of digital transformation may be stronger than suggested by conventional estimators. The larger coefficient obtained through 2SLS estimation implies that measurement error or omitted factors may suppress the estimated effect in standard regressions. This reinforces the argument that digitalization is not merely associated with innovation performance but actively contributes to it.

Third, the analysis reveals limited evidence that managerial myopia directly influences digital innovation activities. Although the estimated coefficients are consistently negative across the lagged, instrumental-variable, and matched DID specifications, none are statistically significant. This finding suggests that investments in digital innovation may be less sensitive to managerial short termism than initially expected.

One possible explanation is that digital transformation has become a strategic necessity rather than a discretionary investment choice. Competitive pressures, technological convergence, and government policies may compel firms to pursue digital initiatives regardless of managerial temporal orientation. Consequently, organizational and institutional forces may dominate individual managerial preferences in shaping digital innovation decisions.

Another explanation is that digital transformation projects often generate operational efficiencies and observable performance improvements within relatively short time horizons. Unlike green innovation, which often entails lengthy development cycles and uncertain returns, digital initiatives may offer more immediate

benefits, reducing resistance among managers with short-term performance concerns.

The findings also contribute to the emerging literature on managerial cognition and sustainable innovation. While previous studies have documented adverse effects of managerial myopia on R&D investment, innovation quality, and long-term value creation, the present results suggest that these effects may not extend uniformly across all forms of technological innovation. Digital innovation appears relatively resilient to managerial short-termism, particularly in highly competitive manufacturing environments.

From a managerial perspective, the results highlight the importance of digital transformation as a mechanism for achieving sustainability objectives. Investments in digital technologies can improve environmental performance while simultaneously enhancing operational efficiency and innovation capacity. Policymakers seeking to promote green innovation may therefore benefit from policies that encourage digital infrastructure development, technological adoption, and organizational digital capability building.

Overall, the evidence indicates that digital transformation serves as a powerful driver of sustainable innovation, whereas managerial myopia exerts limited influence on firms' digital innovation trajectories. These findings enhance our understanding of how technological capabilities and managerial characteristics jointly shape corporate sustainability outcomes.

8. Overall Robustness Conclusion

Taken together, the three endogeneity correction techniques provide highly consistent evidence.

For the Digitalization Green Innovation relationship, all models produce positive and statistically significant effects. The consistency of the findings across lagged estimation, instrumental-variables analysis, and matched DID designs strongly supports a causal interpretation: digital transformation enhances green innovation performance.

In contrast, for the Managerial Myopia Digital Innovation relationship, all three approaches yield statistically insignificant coefficients. The consistency of these results suggests that managerial myopia does not materially influence digital innovation outcomes after accounting for reverse causality, omitted-variable bias, and selection effects.

The convergence of evidence across multiple econometric frameworks substantially enhances the credibility, validity, and robustness of the study's conclusions and provides strong empirical support for the strategic importance of digital transformation in fostering sustainable innovation.

References

[1] Rai, A., Patnayakuni, R., Seth, N. (2006). Firm performance impacts of digitally enabled supply chain integration capabilities. *MIS Quarterly*, *30*(2), 225.

[2] Xu, Q., Li, X., Guo, F. (2023). Digital transformation and environmental performance: Evidence from Chinese resource-based enterprises. *Corporate Social Responsibility and Environmental Management*, *30*, 1816–1840. https://doi.org/10.1002/csr.2457.

[3] Lin, B., Xie, Y. (2023). Impacts of digital transformation on corporate green technology innovation: Do board characteristics play a role *Corporate Social Responsibility and Environmental Management*, 1–15. https://doi.org/10.1002/csr.2653.

[4] Wang, K., Chen, B., Li, Y. (2024). Technological, process or managerial innovation How does digital transformation affect green innovation in industrial enterprises *Economic Change and Restructuring*, *57*, 10. https://doi.org/10.1007/s10644-024-09598.

[5] Guo, Q., Geng, C., Yao, N. (2023). How does green digitalization affect environmental innovation The moderating role of institutional forces. *Business Strategy and the Environment*, *32*, 3088–3105. https://doi.org/10.1002/bse.3288.

[6] Tian, M., Chen, Y., Tian, G., Huang, W., Hu, C. (2023). The role of digital transformation practices in the operations improvement in manufacturing firms: A practice-based view. *International Journal of Production Economics*, *262*, Article 108929. https://doi.org/10.1016/j.ijpe.2023.108929.

[7] He, J., Su, H. (2022). Digital transformation and green innovation of Chinese firms: The moderating role of regulatory pressure and international opportunities. *International Journal of Environmental Research and Public Health*, *19*(20), 13321. https://doi.org/10.3390/ijerph192013321.

[8] Long, H., Feng, G. F., Chang, C. P. (2023). How does ESG performance promote corporate green innovation? *Economic Change and Restructuring*, *56*, 2889–2913. https://doi.org/10.1007/s10644-023-09536-2.

[9] Wang, H., Du, R. (2025). Managerial myopia and corporate green innovation: A managerial environmental attention perspective. *Technology Analysis & Strategic Management*, 1–16. https://doi.org/10.1080/09537325.2025.2547820.

[10] Yuan, B., Xiang, Q. L. (2018). Environmental regulation, industrial innovation and green development of Chinese manufacturing: Based on an extended CDM model. *Journal of Cleaner Production*, *176*, 895–908. https://doi.org/10.1016/j.jclepro.2017.12.034.

[11] Zhang, J., Liang, G., Feng, T., Yuan, C., Jiang, W. (2020). Green innovation to respond to environmental regulation: How external knowledge adoption and green absorptive capacity matter *Business Strategy and the Environment*, *29*(1), 39–53. https://doi.org/10.1002/bse.2349.

[12] Lanoie, P., Laurent-Lucchetti, J., Johnstone, N., Ambec, S. (2011). Environmental policy, innovation and performance: New insights on the Porter hypothesis. *Journal of Economics Management Strategy*, *20*(3), 803–842. https://doi.org/10.1111/j.1530-9134.2011.00301.

[13] Cao, H., Chen, Z. (2019). The driving effect of internal and external environment on green innovation strategy: The moderating role of top management's environmental awareness. *Nankai Business Review International*, *10*(3), 342–361. https://doi.org/10.1108/NBRI-05-2018-0028.

[14] Wang, H., Khan, M. A. S., Anwar, F., Shahzad, F., Adu, D., Murad, M. (2021). Green innovation practices and its impacts on environmental and organizational performance. *Frontiers in Psychology*, *11*, Article 553625. https://doi.org/10.3389/fpsyg.2020.553625.

[15] Zhou, J., Sawyer, L., Safi, A. (2021). Institutional pressure and green product success: The role of green transformational leadership, green innovation, and green brand image. *Frontiers in Psychology*, *12*, Article 704855. https://doi.org/10.3389/fpsyg.2021.704855.

[16] Song, M., Yang, M. X., Zeng, K. J., Feng, W. (2020). Green knowledge sharing, stakeholder pressure, absorptive capacity, and green innovation: Evidence from Chinese manufacturing firms. *Business Strategy and the Environment*, *29*(4), 1517–1531. https://doi.org/10.1002/bse.2450.

[17] Horbach, J. (2008). Determinants of green innovation: New evidence from German panel data sources. *Research Policy*, *37*(1), 163–173. https://doi.org/10.1016/j.respol.2007.08.006.

[18] Cuerva, M. C., Triguero-Cano, A., Córcoles, D. (2014). Drivers of green and non-green innovation: Empirical evidence in Low-Tech SMEs. *Journal of Cleaner Production*, *68*, 104–113. https://doi.org/10.1016/j.jclepro.2013.10.049.

[19] Baeshen, Y., Soomro, Y. A., Bhutto, M. Y. (2021). Determinants of green innovation to achieve sustainable business performance: Evidence from SMEs. *Frontiers in Psychology*, *12*, Article 767968. https://doi.org/10.3389/fpsyg.2021.767968.

[20] Xu, B., Gao, X., Cai, W., Jiang, L. (2021). How environmental leadership boosts employees' green innovation behavior A moderated mediation model. *Frontiers in Psychology*, *12*, Article 689671. https://doi.org/10.3389/fpsyg.2021.689671.

[21] Pan, X., Chen, X., Sinha, P., Dong, N. (2020). Are firms with state ownership greener? An institutional complexity view. *Business Strategy and the Environment*, *29*(1), 197–211. https://doi.org/10.1002/bse.2358.

[22] Akhtar, S., Martins, J. M., Mata, P. N., Tian, H., Naz, S., Dâmaso, M., et al. (2021). Assessing the relationship between market orientation and green product innovation: The intervening role of green self-efficacy and moderating role of resource bricolage. *Sustainability*, *13*(20), 11494. https://doi.org/10.3390/su132011494.

[23] Hambrick, D. C., Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review*, *9*(2), 193–206.

[24] Ma, Y., Tao, P. (2023). A perspective on management myopia: The impact of digital transformation on carbon emission intensity. *Sustainability*, *15*(12), 9417. https://doi.org/10.3390/su15129417.

[25] Holmström, B. (1999). Managerial incentive problems: A dynamic perspective. *Review of Economic Studies*, *66*(1), 169–182.

[26] Narayanan, M. P. (1985). Managerial incentives for short-term results. *Journal of Finance*, *40*(5), 1469–1484.

[27] Stein, J. C. (1988). Takeover threats and managerial myopia. *Journal of Political Economy*, *96*(1), 61–80.

[28] Laverty, K. J. (1996). Economic "short-termism": The debate, the unresolved issues, and the implications for management practice and research. *Academy of Management Review*, *21*(3), 825–860.

[29] Stein, J. C. (1989). Efficient capital markets, inefficient firms: A model of myopic corporate behavior. *Quarterly Journal of Economics*, *104*(4), 655–669.

[30] Lu, Q., Deng, J., Chen, S., Hussain, Y. (2025). Managerial myopia and its barrier to green innovation in high-pollution enterprises: A machine learning approach. *Journal of Environmental Management*, *376*, 124477.

[31] Xu, X., Liu, Y. (2023). The association between managerial short termism and green innovation: The moderating role of firms' digital transformation. *Asia Pacific Journal of Innovation and Entrepreneurship*, *17*(3-4), 195–214. https://doi.org/10.1108/APJIE-07-2023-0147.

[32] Jian, J., Tian, H., Hu, D., Tang, Z. (2024). Manager myopia and green technology innovation. *Management Decision*, *62*(5), 1618–1644. https://doi.org/10.1108/MD-06-2023-0891.

[33] Yu, Y., Xie, B., Dou, Z., Fu, Q. (2024). Managerial myopia and corporate innovation strategy. *Finance Research Letters*, *67*, 105733. https://doi.org/10.1016/j.frl.2024.105733.

[34] Wei, M. (2025). Managerial myopia and digital innovation: The mechanism of deviant strategy. *Journal of East European Management Studies*, *30*(1), 38758. https://doi.org/10.31083/JEEMS38758.

[35] Xie, X. J., Gong, Y. K., Cheng, L. (2025). Managerial myopia and carbon emission: Evidence from China. *Pacific Basin Finance Journal*, *90*, 102614. https://doi.org/10.1016/j.pacfin.2024.102614.

[36] Zhou, M., Yang, S., Qiu, X., Zeng, Y., Zhu, K. (2026). Short-term thinking, long-term costs: How managerial myopia undermines green innovation. *South African Journal of Business Management*, *57*(1).