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RESEARCH ARTICLE

Examining the Interactive Effect of Digital Transformation on Explaining the Relationship Between Managerial Overconfidence and Corporate Innovation

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ABSTRACT

This study aims to examine the interactive effect of digital transformation on explaining the impact of managerial overconfidence on corporate innovation. Technological advancements and the development of digital technologies have significantly influenced the characteristics of economies and businesses, driving organizations to adopt technologies such as artificial intelligence, big data, and the Internet of Things. Managerial overconfidence, as a key behavioral trait, can impact strategic decision-making and organizational innovation. Data was collected from 113 companies listed on the Tehran Stock Exchange from 2016 to 2023. Models were estimated using Generalized Least Squares (GLS) regression with two-way fixed effects. The results indicate that: 1) Managerial overconfidence significantly enhances corporate innovation, with overconfident managers showing a greater tendency to support creative projects; 2) Digital transformation is positively and significantly related to corporate innovation, boosting investment in innovative activities; 3) An increase in managerial overconfidence reduces digital transformation, as decisions lacking thorough analysis can impair transformation efficiency; 4) Digital transformation acts as a full mediator in the impact between managerial overconfidence and corporate innovation (Sobel test: $t = 2.306$, $p = 0.0132$). This study elucidates the mediating role of digital transformation in the interplay between managerial overconfidence and corporate innovation, offering a comprehensive theoretical framework. The findings provide valuable guidance for policymakers and managers on leveraging digital technologies and managing behavioral risks.

Introduction

The characteristics of the economy and businesses have been significantly affected by technological progress and the development of digital technologies (Cheri et al., 2023; Feng & Nie, 2024). Organizations have adopted emerging technologies such as artificial intelligence, big data, the Internet of Things, and cloud computing to enhance their efficiency, develop new business models, and build innovation as a way of life in their operational processes (Dekamini et al., 2024; Mattos & Novais Filho, 2024; Sestino et al., 2020). In this context, a key managerial challenge is to understand how the behavioral traits of decision-makers influence organizational outcomes. One such trait is managerial overconfidence, which refers to the tendency of managers to overestimate their knowledge and capabilities (Fawehinmi et al., 2024).

Managerial overconfidence is a tendency of managers to overestimate their decision-making ability. Those managers who are overconfident are typically more risk-seeking and bold in their decisions (Kommalapati, 2024; Pourmansouri et al., 2023). However, on the one hand, this trait can help an organization to be more innovative, as overconfident managers are more likely to invest in creative projects and adopt new technologies (Jin et al., 2024). On the contrary, overconfidence may lead to ignoring risks, making incorrect decisions, and the misallocation of resources, which can potentially negatively affect organizational innovation (Jory et al., 2025; Zhang & Song, 2025). Thus, the impact of managerial overconfidence on corporate innovation may be either positive or negative, depending on the environment and the organization (Jin et al., 2024; Zhang et al., 2024).

This dual nature suggests the presence of a mediating mechanism that can explain when overconfidence leads to innovation and when it leads to failure. One promising mediator is digital transformation, which can shape how managerial traits manifest in organizational outcomes (Zareie et al., 2024). Unlike previous studies that have treated digital transformation as a direct driver of innovation (e.g., Li & Zhang, 2022; Zareie et al., 2024), this study positions digital transformation as a mediator that channels the behavioral effects of managerial overconfidence into either positive or negative innovation outcomes. This perspective adds novelty by combining behavioral and technological constructs in a unified model. On one hand, digital technologies can improve information accuracy, reduce uncertainty, and support transparent, data-driven decision-making (Wang et al., 2025; Zareie et al., 2024). While such factors can help to dampen the negative effects of managerial overconfidence or amplify its positive effects on innovation, it is unclear whether managers are aware of these (Gu, 2023; Jin et al., 2024). These features may amplify the positive impact of overconfidence or buffer its negative consequences. On the other hand, if digital transformation is poorly implemented, it can increase the complexity of decision-making, heighten risk exposure, and exacerbate the negative effects of overconfidence (Kunz & Sonnenholzner, 2023; Wang & Guo, 2022).

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The theoretical foundation of this study integrates two major frameworks. First, the Behavioral Theory of the Firm emphasizes bounded rationality and cognitive biases—such as overconfidence—as key factors affecting strategic decision-making. Second, the Dynamic Capabilities Framework views digital transformation as a strategic capability that enables organizations to adapt to environmental changes through resource reconfiguration. By combining these two perspectives, this study seeks to clarify how digital transformation influences the relationship between managerial behavior and innovation outcomes. This research contributes to multiple areas. It enhances our understanding of how behavioral traits, particularly overconfidence, interact with technological advancement to shape innovation in the digital era. It also provides practical insights for executives and policymakers looking to manage behavioral risks and promote innovation through digital transformation. Furthermore, it opens up new directions for future research on the integration of managerial psychology, digitalization, and strategic innovation. Given the increasing complexity of the business environment, this study aims to develop a comprehensive theoretical model explaining how digital transformation can channel the effects of managerial overconfidence in either a positive or negative direction. Additionally, it explores the contextual conditions under which digital transformation becomes most effective in shaping this dynamic. The findings are expected to offer practical guidance for developing behavioral-technological alignment strategies that enhance innovation and competitive advantage in today's digital economy.

Literature Review and Research Hypotheses

Today, managers and organizations face new challenges in today's world due to rapid changes in business environments and technological advancements (Orieno et al., 2024). Managers' behavioral traits are one of the most important aspects of these challenges as they play a crucial role in strategic decision-making and the innovative performance of companies (Abubakar et al., 2019; Kim & Nguyen, 2023). One such trait is managerial overconfidence, which refers to a manager's tendency to overestimate their abilities, judgment, or control over outcomes (Pourmansouri et al., 2023). At the same time, this trait may encourage managers to invest in innovative projects and adopt new technologies, but on the other hand, it may result in poor decision-making and taking unnecessary risks. Research has consistently shown that managerial overconfidence and corporate innovation have a strong impact. CEOs who are overconfident tend to engage in innovative activities, and higher R&D expenditures and innovation productivity are likely to be associated with innovative activities (Li & Zhang, 2022; Zavertiaeva et al., 2018). In particular, it is very pronounced when non-state-owned enterprises are explored or when new technological areas are explored (Li & Zhang, 2022). In contrast to the typical situation of family businesses being weak in their innovation tendency, managerial overconfidence could enhance this tendency when there is a low deviation between control rights and ownership (Chang et al., 2013). However, a direct impact between overconfidence and innovation doesn't exist. Nevertheless, overconfident managers invest more in R&D, and such investments may not be always efficient and may even hurt firm value (Zavertiaeva et al., 2018). This implies that managerial overconfidence is moderated by institutional support for innovation in corporate innovation (Wen et al., 2023). The theoretical foundation of this relationship lies in the Behavioral Theory of the Firm, which emphasizes that strategic decisions are shaped by bounded rationality and cognitive biases. Overconfidence is one such bias that influences how managers perceive risks and opportunities in innovation. Given this background, and in light of both the enabling and potentially harmful effects of overconfidence on innovation, this study examines the directional impact of managerial overconfidence on corporate innovation.

H1: There is a significant impact between managerial overconfidence and corporate innovation.

Recent research has increasingly emphasized the pivotal role of digital transformation in enhancing corporate innovation. Digital transformation refers to the integration of digital technologies—such as artificial intelligence, big data, cloud computing, and IoT—into all aspects of business operations, leading to fundamental changes in value-creation processes (Cui, 2023; Pu et al., 2024). This impact is especially significant when large enterprises, state-owned enterprises, and high-tech companies are taken into consideration (Cui, 2023). This is the case for both radical and incremental innovation, and the benefits are greater in labor-intensive and technology-intensive industries (Liu et al., 2023). Furthermore, the comparability of accounting information has been identified as a mediating mechanism through which digital transformation promotes innovation quality (Xie, 2024). The theoretical foundation for this relationship is drawn from the Dynamic Capabilities Framework, which views digital transformation as a strategic capability that enables firms to adapt, reconfigure resources, and respond effectively to changing environments. In this view, digital technologies are not merely tools but dynamic enablers of innovation and sustained competitive advantage. High-quality innovation output is the main manifestation of the innovation-promoting effect (Pu et al., 2024). These findings provide valuable implications for businesses and policymakers that digital transformation strategies are essential to spur innovation and improve competitiveness in the digital economy era (Cui, 2023; Xie, 2024). Although prior research has established a positive association between digital transformation and innovation (e.g., Cui, 2023; Pu et al., 2024), this study advances the literature by situating digital transformation not only as an independent driver of innovation but also as a behavioral-environmental mediator in the overconfidence–innovation relationship. This perspective is particularly novel in the context of emerging markets.

H2: There is a significant impact between digital transformation and corporate innovation.

A growing body of research highlights a significant and positive relationship between managerial overconfidence and a firm's digital transformation efforts (Cheri et al., 2023; Pourmansouri et al., 2023). Overconfident managers are more inclined to allocate resources to R&D and embrace transformative technologies, often seeing themselves as visionary leaders capable of driving strategic change (Jin et al., 2024). R&D investment, in this context, plays a mediating role between overconfidence and digital adoption. This relationship appears to be especially strong in non-state-owned enterprises, where managers typically face fewer bureaucratic constraints and have greater autonomy in resource allocation (Khattak et al., 2024). Furthermore, the development of a digital culture and education in digital competencies can enhance this relationship. In such settings, overconfident managers often accelerate digital initiatives to improve operational efficiency and gain a competitive edge. Other studies emphasize that overconfident CEOs are more likely to retain excess cash due to optimism bias, but digital transformation efforts may moderate this tendency by channeling financial resources into technological infrastructure (Bo, 2024). In addition, organizational factors such as the presence of a Chief Information Officer (CIO) or board members with IT expertise further strengthen the link between managerial overconfidence and digital transformation (Zhang et al., 2024). Theoretically, this relationship is explained by combining the Behavioral Theory of the Firm—which emphasizes cognitive biases like overconfidence in shaping decision-making—with the Dynamic Capabilities Framework, where digital transformation is viewed as a strategic mechanism enabling firms to innovate, respond to uncertainty, and sustain performance. Overconfident managers, driven by their belief in superior judgment, may initiate digital strategies as part of their long-term vision for competitiveness. While previous research has identified the behavioral antecedents of digital transformation,

this study contributes by empirically testing the direct, directional effect of overconfidence on digital transformation, especially in emerging market contexts where such mechanisms remain underexplored. Given this foundation, the study proposes the following directional hypothesis:

H3: There is a significant impact between managerial overconfidence and digital transformation.

Recent studies have begun to uncover the complex and dynamic interplay between managerial overconfidence, digital transformation, and firm-level innovation. Research suggests that managerial overconfidence can positively influence corporate digital transformation, particularly when mediated by investments in R&D (Jin et al., 2024). In turn, this enhanced digital capacity significantly boosts innovation outcomes—especially in developing economies where firms often face resource constraints (Wen et al., 2023). Moreover, digital transformation has been shown to promote open innovation by facilitating cross-functional collaboration, rapid experimentation, and external partnerships (Xu et al., 2024). However, behavioral limitations such as managerial myopia or overreliance on past success can undermine these benefits. Some studies suggest that while overconfident managers are likely to hold excess cash due to over-optimism, digital transformation can help reallocate such idle resources more productively toward innovation-related activities (Bo, 2024). This body of literature emphasizes that the relationship between overconfidence and innovation is not purely direct, but is instead shaped and channeled through digital transformation capabilities. Overconfident leaders may initiate innovation, but the depth and quality of those outcomes depend on the firm's ability to leverage digital tools and systems. Furthermore, the presence of IT governance mechanisms—such as CIO involvement and digitally skilled board members—can strengthen this mediating channel (Zhang et al., 2024). Theoretically, this mediating relationship integrates the Behavioral Theory of the Firm, which highlights the cognitive limits of decision-makers, with the Dynamic Capabilities Framework, where digital transformation serves as a strategic capability that enables firms to sense, seize, and reconfigure resources in response to managerial impulses and market demands. Together, these frameworks suggest that digital transformation conditions the effect of overconfident managerial behavior on innovation outcomes. While previous studies have independently explored the effects of overconfidence and digital transformation on innovation, few have empirically tested digital transformation as a mediating mechanism. This study addresses that gap by proposing and testing a mediation model that links behavioral traits to organizational innovation through digital capabilities. Based on this conceptual framework, the final directional hypothesis is as follows:

H 4: Digital transformation influences the impact between managerial overconfidence and corporate innovation.

Methodology

The statistical population consists of subjects that share a set of homogeneous and measurable characteristics. The boundaries of each research population are determined based on its definition. The statistical population of this study includes companies listed on the Tehran Stock Exchange that have received government subsidies during 2016–2023. The data required to calculate the research variables were extracted from the website of the Research, Development, and Islamic Studies Management of the Securities and Exchange Organization. Ultimately, 113 companies met the criteria for inclusion in the study.

Variables

- Digital Transformation (DT) is the independent variable in this study, derived from the research of Peng & Tao (2022). This variable primarily explains the use of the digital economy sector by employing the disaggregation of intangible assets as a proxy for digital transformation (Peng & Tao, 2022). For each company across all years, a pivot table is created to aggregate the digital economy components of intangible assets. This includes keywords such as mobile internet, Internet of Things, big data, cloud computing, artificial intelligence, digital technology, digitalization, digital marketing, digital techniques, digital operations, digital terminals, digital economy, digital commerce, digital systems, digital supply chain, information age, information, information technology, information integration, information communication, computer technology, and e-commerce. After conducting a textual analysis of the annual reports of companies listed on the Tehran Stock Exchange to extract the frequency of each keyword, the extracted keywords are cleaned. The logarithm of (digitalization keyword frequency + 1) is then used to measure corporate digital transformation. A higher obtained value indicates a greater degree of digital transformation within the company (Chen & Xu, 2023).
- CEO overconfidence (CEO Over): This study adapts the indices used in Campbell & Miller (2011) and employs the following two indicators:

  a) The first index is based on the number of stock price change days. If, during the fiscal year, the number of days with stock price increases exceeds the number of days with stock price decreases, it is assumed that the CEO exhibits overconfidence, and the variable is assigned a value of 1. Otherwise, it is assigned a value of 0 (Campbell & Miller, 2011).

  b) The second index considers stock price growth. If the percentage increase in the company's stock price exceeds the percentage decrease, it is assumed that the CEO is overconfident, and the variable is assigned a value of 1; otherwise, it is assigned a value of 0 (Campbell & Miller, 2011).

In this study, only the stock price growth index is used to measure CEO overconfidence. The data on stock price increases and decreases are obtained from the Tehran Stock Exchange website. It is acknowledged that the proxy for CEO overconfidence—based on stock price performance—may be influenced by external factors such as market volatility, macroeconomic shocks, or sectoral trends. While such broader market-level influences are not directly controlled for in this study, firm-level control variables such as ROA, firm size, and leverage are included in the models to help account for company-specific effects. Corporate Innovation (Inn) is measured using both innovation input and innovation output:

- Innovation Input: Measured as R&D expenses divided by operating revenue.
- Innovation Output: Measured by the number of patent applications.

Companies typically apply for patents in the year they develop new technologies, while the patent approval year may lag behind the application year. Additionally, unlike patents, the value of new products should be adjusted for the fact that companies do not apply for patents anonymously. Therefore, patent applications provide a more comprehensive measure of innovation output and better reflect the market

acceptance of new products, thereby capturing the return on corporate innovation more effectively. To quantify corporate innovation performance, this study uses the natural logarithm of R&D expenses. The R&D expense data is collected from reports available on the Codal website, including board activity reports, explanatory notes, and financial statements of the studied companies.

According to the theoretical foundations and previous research, both domestic and international, there are many factors that influence corporate innovation. Therefore, to reduce the deviation in the research results, some of these factors, which have a greater impact on corporate social responsibility, are considered as control variables in this study:

- Financial Leverage (LEV): Financial leverage is defined as the ratio of the book value of long-term debt to the book value of total assets for company i in year t (Pourmansouri et al., 2022).

$$LEV = \frac{Total\ Book\ Value\ of\ Liabilities}{Total\ Assets} \quad (1)$$

- Firm Size (Size): The firm size variable is measured using indicators such as the logarithm of total assets (Pourmansouri et al., 2022).
- Return on Assets (ROA): This variable is calculated as earnings before tax and interest expenses (operating net income) divided by the average total assets of the company (Pourmansouri et al., 2022).

$$ROA = \frac{Net\ Operating\ Profit}{Total\ Assets} \quad (2)$$

Models

In examining the impacts between variables with the presence of a mediating variable, direct effects, indirect effects, and total effects must be considered (Fallah et al., 2024). The total effect is obtained by summing the direct and indirect effects. If the indirect effect is greater than the direct effect, the mediating role of the mediating variable is accepted. In most research, the Baron and Kenny (1986) approach is used to test the mediating effect of variables (Baron & Kenny, 1986). According to the Baron and Kenny approach, the mediating variable must meet three conditions:

1. The independent variable(s) must affect the dependent variable;
2. The independent variable(s) must affect the mediating variable;
3. The mediating variable must affect the dependent variable in a regression of the independent variables and the mediating variable on the dependent variable.

If these three conditions are met, and if the effect of the variable "overconfidence of managers" on the variable "company innovation" in the third equation is less than in the first equation, one can conclude, using the significance level, that the mediating effect has been established. Therefore, Baron and Kenny (1986) state that a full mediating effect is established when the independent variable(s) in the third equation does no effect on the dependent variable (Baron & Kenny, 1986). However, if the independent variable has a lesser effect on the dependent variable in the third equation compared to the first, then the mediating effect is partial. Although one can test the significance of the mediation hypothesis through this method, this approach has low statistical power. A more appropriate method is to directly test the significance of the coefficient of "overconfidence of managers" and "company innovation performance." One of the most commonly used methods for this purpose is the Sobel test. In the Sobel test, one can use the normal estimation to check the significance of the impact. With the standard error estimate of the indirect effect, one can test the null hypothesis against the alternative. In the Sobel test, a Z-value is obtained through the following formula, and if this value exceeds 1.96, it confirms the mediating effect of a variable at a 95% significance level.

$$\text{z-value} = \frac{a \times b}{\sqrt{(b^2 \times sa^2) + (a^2 \times sb^2) + (sa^2 + sb^2)}}$$

a: The path coefficient value between the independent variable and the mediating variable.
b: The path coefficient value between the mediating variable and the dependent variable.
sa: The standard error associated with the path between the independent variable and the mediating variable.
sb: The standard error associated with the path between the mediating variable and the dependent variable.

Model of the First Main Hypothesis:

$$Inn_{i,t} = \beta_0 + \beta_1\ CEO\ Over_{i,t} + \beta_2\ ROA_{i,t} + \beta_3\ Size_{i,t} + \beta_4\ LEV_{i,t} + \varepsilon_{i,t}$$

Model of the Second Main Hypothesis:

$$Inn_{i,t} = \beta_0 + \beta_1\ DT_{i,t} + \beta_2\ ROA_{i,t} + \beta_3\ Size_{i,t} + \beta_4\ LEV_{i,t} + \varepsilon_{i,t}$$

Model of the Third Main Hypothesis:

$$DT\ i,t = \beta 0 + \beta 1\ CEO\ Over_{i,t} + \beta 2\ ROA_{i,t} + \beta 3\ Size_{i,t} + \beta 4\ LEV_{i,t} + \varepsilon_{i,t}$$

Model of the Fourth Main Hypothesis:

$$Inni,t = \beta 0 + \beta 1\ CEO\ Over_{i,t} + \beta 2\ DT_{i,t} + \beta 3\ ROA + \beta 4\ Size_{i,t} + \beta 5\ LEV_{i,t} + \varepsilon_{i,t}$$

Results

Descriptive statistics

Table I presents the descriptive statistics of the study variables.

Table I: Descriptive statistics of study variables

Variables	Mean	Median	Maximum	Minimum	Standard Deviation
Company Innovation (Inn)	985.8	613.8	6171.4	981.5	561.1
Digital Transformation (DT)	344.0	0.0	1.0	0.0	475.0
Manager Overconfidence (CEO Over)	601.0	1.0	1.0	0.0	490.0
Return on Assets (ROA)	166.0	138.0	830.0	-404.0	169.0
Company Size (SIZE)	15114.0	1488.0	2109.0	906.0	1728.0
Financial Leverage (LEV)	523.0	520.0	1273.0	13.0	224.0

As can be seen in Table I, the mean value of executive innovation in companies is 985.8 percent, which is due to the high monetary amount in various companies. The moderating variable of the research is digital transformation. Based on the results from the descriptive statistics test, it can be said that in the companies under study, on average, about 34 percent show a strong inclination towards increasing the use of new information and communication technologies, and evaluating strategic assets over a reasonable time period for digital transformation in organizations. The independent variable of the research is the overconfidence of managers. Based on the results from the descriptive statistics test, it can be said that in the companies under study, on average, about 60.0 percent show that, considering market conditions, the managers of the surveyed companies have high confidence. On the other hand, the descriptive statistics in Table I indicate that the variable of the company's return on assets has a relatively high standard deviation compared to its mean value, which suggests a high degree of variability in this variable across the sample. Meanwhile, the variables related to company size have a lower standard deviation relative to their mean, indicating that the company size in this research sample is homogeneous and has low variability.

Test of variance heterogeneity

The results presented in Table II, which pertains to the variance heterogeneity test, indicate that heteroscedasticity is present in the error terms across all tested models (First to Fourth). This conclusion is drawn based on the test statistics (3.43, 2.95, 2.71, and 16.02, respectively) and significance levels (p-values) below 5% (0.0086, 0.0119, 0.0190, and 0.0000, respectively). These p-values, all lower than the 0.05 threshold, reject the null hypothesis of homoscedasticity, confirming that the variance of the errors in these models is not constant. The presence of heteroscedasticity could negatively impact the accuracy of estimates in standard regression analysis; however, the researchers have addressed this issue by employing the Generalized Least Squares (GLS) method in the final model estimation. This approach adjusts for variance heterogeneity, ensuring more reliable results and improving the efficiency of the estimates. Thus, while heteroscedasticity was observed in all models, it has been successfully managed through the application of GLS.

Table II: Results of the Variance Heterogeneity Test

Model	Test Statistic	Significance Level (p-value)	Test Result
First	3.43	0.0086	Presence of heteroscedasticity
Second	2.95	0.0119	Presence of heteroscedasticity
Third	2.71	0.0190	Presence of heteroscedasticity
Fourth	16.02	0.0000	Presence of heteroscedasticity

Regression Results

To account for the impact of industry heterogeneity over time and to address potential issues arising from the possible exclusion of important time-varying firm characteristics, we employed the two-way fixed effects regression for all of our research models. Additionally, we utilized generalized least squares (GLS) to control for variance heteroskedasticity effects. To address the impact of serial correlation on the regression, we used the "coefficient covariance method" to calculate robust residuals. We also checked for multicollinearity among explanatory variables using the Variance Inflation Factor method. As the VIF value for all variables in all models was less than 5, multicollinearity is not a concern.

Hypothesis 1. The results in Table III correspond to the test of Hypothesis 1, which examines the relationship between managerial overconfidence (CEO Overconfidence) and firm innovation. Based on Model 1, the coefficient of the explanatory variable “CEO Overconfidence” is positive at 0.996 and statistically significant with a p-value of 0.0002, which is well below the 0.05 threshold. This confirms a positive and significant direct effect of managerial overconfidence on firm innovation at the 95% confidence level. The positive sign of the coefficient suggests that higher levels of managerial overconfidence are associated with increased innovation within firms. This supports the view that overconfident managers tend to adopt more optimistic and long-term strategies, which may foster a more innovative organizational environment. This result satisfies the first condition of the Baron and Kenny (1986) approach, which requires that the independent variable (CEO Overconfidence) significantly affects the dependent variable (Firm Innovation). Hence, this relationship provides a foundation for further testing of the mediating role of Digital Transformation in subsequent models.

Among the control variables, Return on Assets (ROA) has a strong positive effect on innovation, with a coefficient of 7.98 and a p-value of 0.0000. Similarly, Financial Leverage (LEV) shows a significant positive effect with a coefficient of 2.80 and a p-value of 0.0000, suggesting that greater access to financial resources may support risk-taking and innovation. On the other hand, Firm Size (SIZE) is not statistically significant (coefficient = -0.009; p-value = 0.9379), indicating that larger firms in the sample do not necessarily exhibit higher levels of innovation, potentially due to bureaucratic rigidity or lower adaptability.

Overall, the model diagnostics support the reliability of these results. The F-statistic of 9.12 (p-value = 0.0000) confirms the model's overall significance. The Durbin-Watson statistic of 2.10 falls within the acceptable range (1.5–2.5), indicating no autocorrelation among residuals. The adjusted R-squared value of 0.510 implies that approximately 51% of the variance in firm innovation is explained by the model. In conclusion, Hypothesis 1 is supported, showing that managerial overconfidence significantly and positively influences firm innovation. The findings confirm the first requirement of mediation analysis according to Baron and Kenny (1986), providing a valid basis to examine whether this effect is transmitted through the mediating variable of digital transformation in the next steps of the analysis.

In summary, the results from Table III strongly support Hypothesis 1, demonstrating that managers' overconfidence significantly drives firm innovation, with the effect amplified by positive contributions from financial leverage and return on assets. The lack of significance for firm size highlights that innovation may depend more on managerial traits and financial strategies than on organizational scale. The model's statistical robustness, as evidenced by the F-statistic, Durbin-Watson statistic, and adjusted R-squared, underscores the validity of these conclusions, providing a solid foundation for further analysis of mediating effects as per Baron and Kenny's framework.

Table III: Results of Testing Hypothesis 1

Variables	Coefficients	Standard Error	t-Statistic	Significance Level (p-value)
CEO	0.996	0.266	3.73	0.0002
ROA	7.98	0.938	8.507	0.0000
SIZE	-0.009	0.125	-0.077	0.9379
Lev	2.80	0.224	12.47	0.0000
C	-0.964	1.74	-0.553	0.5801
R-squared	0.573	Adjusted R-squared	0.510	
F-Statistic	9.12	Significance Level	0.0000	
Durbin-Watson Statistic		2.10		

Hypothesis 2. The findings presented in Table IV pertain to Hypothesis 2, which proposes a significant relationship between financial digital transformation and firm innovation. In this model, the key explanatory variable, "financial digital transformation" (DIG), exhibits a positive coefficient of 0.991 with a p-value of 0.0002, which is well below the 5% significance threshold. This confirms a positive and statistically significant effect of digital transformation on firm innovation at the 95% confidence level. The positive sign of the coefficient indicates that greater engagement in digital transformation initiatives—such as the adoption of automation technologies, big data analytics, and digital financial systems—enhances a firm's innovation performance. This result satisfies the second condition of the Baron and Kenny (1986) mediation model, which requires that the independent variable (in this case, Digital Transformation) must have a significant effect on the dependent variable (Firm Innovation). Having now met the first two conditions of mediation (via Hypotheses 1 and 2), the study is well-positioned to evaluate the potential mediating role of digital transformation in the subsequent hypothesis.

Control variables in the model further enrich the interpretation. Return on Assets (ROA) displays a large positive coefficient of 7.974 with a p-value of 0.0000, reinforcing that higher profitability significantly contributes to firm innovation. Likewise, Financial Leverage (LEV) is positively associated with innovation (coefficient = 2.808; p-value = 0.0000), possibly reflecting increased access to capital or a risk-tolerant financing strategy that encourages innovation. Firm Size (SIZE), on the other hand, has a negative coefficient of -0.012 and a p-value of 0.9201, indicating no statistically significant effect. This suggests that larger firms may not inherently be more innovative, possibly due to internal complexity or reduced agility. Model diagnostics confirm the statistical reliability of the analysis. The F-statistic of 8.97 with a p-value of 0.0000 confirms the overall significance of the regression model. The Durbin-Watson statistic of 2.10 indicates no autocorrelation among residuals, and the adjusted R-squared of 0.508 reveals that approximately 50.8% of the variance in firm innovation is explained by the model. Hypothesis 2 is supported by the data: financial digital transformation exerts a positive and significant impact on firm innovation. This result satisfies the second requirement of the Baron and Kenny framework, supporting the case for a mediation effect. The consistency and strength of the findings—together with the solid performance of the model—offer practical and theoretical implications regarding the innovation-enabling role of digital transformation in firms.

Table IV: Results of Testing Hypothesis 2

Variables	Coefficients	Standard Error	t-Statistic	Significance Level (p-value)
DIG	0.991	0.267	3.699	0.0002
ROA	7.974	0.983	8.108	0.0000
SIZE	-0.012	0.125	-0.100	0.9201
Lev	2.808	0.225	12.473	0.0000
C	-0.917	1.73	-0.528	0.5970
R-squared	0.572	Adjusted R-squared	0.508	
F-Statistic	8.97	Significance Level	0.0000	
Durbin-Watson Statistic		2.10		

Hypothesis 3. Hypothesis 3 examines the relationship between managerial overconfidence and digital transformation. As shown in Table V and based on Model 3, the regression results reveal a negative and statistically significant effect of managerial overconfidence on digital transformation. Specifically, the coefficient of the "CEO Overconfidence" variable is -3.44 with a p-value of 0.0000, which is below the 5% significance level. This confirms a significant inverse relationship between the two variables at the 95% confidence level. The negative sign of the coefficient suggests that as managers exhibit higher levels of overconfidence, the likelihood or extent of digital transformation adoption in the firm decreases. This could be attributed to overconfident managers underestimating the value of technological innovation or believing their traditional decision-making and leadership approaches are sufficient without technological upgrades.

This result satisfies the third condition of the Baron and Kenny (1986) mediation framework, which requires the independent variable (CEO Overconfidence) to significantly influence the mediator (Digital Transformation). When combined with the previous findings from Hypotheses 1 and 2, all three preconditions for mediation are now met, justifying to proceed with evaluating the full or partial mediating role of digital transformation in Hypothesis 4. Among the control variables, Return on Assets (ROA) shows a positive and significant effect (coefficient = 0.473; p-value = 0.0000), suggesting that firms with higher profitability are more likely to invest in digital technologies. Financial Leverage (LEV) also shows a positive and significant relationship with digital transformation (coefficient = 0.097; p-value = 0.0040), indicating that firms with higher debt ratios may seek efficiency through technological upgrades. Firm Size (SIZE), however, has a negative but statistically insignificant coefficient (–0.005; p-value = 0.2804), suggesting that larger companies do not have a systematic advantage in digital adoption. The overall model diagnostics confirm the robustness of the findings. The F-statistic of 9.12 with a p-value of 0.0000 indicates the model is statistically significant. The Durbin-Watson statistic of 1.96 is within the acceptable range (1.5–2.5), showing no autocorrelation in the residuals. The adjusted R-squared value of 0.508 implies that approximately 50.8% of the variance in digital transformation is explained by the model's variables. Hypothesis 3 is supported. The significant negative effect of CEO overconfidence on digital transformation satisfies the third condition of the Baron and Kenny mediation test. Alongside the results from Hypotheses 1 and 2, this finding supports further exploration of the mediating role of digital transformation in the relationship between managerial traits and firm innovation.

Table V: Results of the Fourth Hypothesis Test

Variables	Coefficients	Standard Error	t-Statistic	Significance Level (p-value)
CEO	-3.44	0.000	-2.70	0.0000
ROA	0.473	0.086	5.44	0.0000
SIZE	-0.005	0.004	-1.08	0.2804
Lev	0.097	0.033	2.88	0.0040
C	-0.139	0.049	-2.838	0.0046
R-squared	0.571	Adjusted R-squared	0.508	
F-Statistic	9.12	Significance Level	0.0000	
Durbin-Watson Statistic		1.96		

Hypothesis 4. Hypothesis 4 investigates whether digital transformation mediates the relationship between managerial overconfidence and corporate innovation. The results, presented in Table VI and derived from Model 4, provide the final step in assessing the mediating role of digital transformation in the causal pathway established through the Baron and Kenny (1986) framework. According to the results, both CEO overconfidence and financial digital transformation have positive and statistically significant effects on firm innovation. The coefficient for managerial overconfidence (CEO) is 1.00 with a p-value of 0.0002, and for digital transformation (DIG), the coefficient is 0.002 with a p-value of 0.0082, both well below the 5% significance threshold. This suggests that both variables positively contribute to innovation performance, supporting the hypothesis at the 95% confidence level.

However, when comparing the coefficient of managerial overconfidence in Model 4 (1.00) to its coefficient in Model 1 (0.996), it is evident that the effect of the independent variable (CEO Overconfidence) on the dependent variable (Firm Innovation) has not decreased after including the mediating variable (Digital Transformation). In fact, the coefficient has slightly increased. According to Baron and Kenny's framework, this pattern does not support full mediation—as full mediation would require the effect of the independent variable to become statistically insignificant or notably reduced in the presence of the mediator. Moreover, since both the independent variable (CEO Overconfidence) and the mediator (Digital Transformation) remain significant, this result is better interpreted as evidence of partial mediation. That is, digital transformation plays a supportive but not exclusive role in explaining the relationship between CEO overconfidence and

innovation. Control variables reinforce the model's credibility. Return on Assets (ROA) shows a large positive and significant effect (coefficient = 7.977; p-value = 0.0000), indicating that more profitable firms are better positioned to drive innovation. Financial Leverage (LEV) also has a significant positive effect (coefficient = 0.763; p-value = 0.0000), supporting the idea that debt-financed firms may pursue innovative strategies more aggressively. Firm Size (SIZE), on the other hand, remains statistically insignificant (coefficient = –0.007; p-value = 0.9513), implying that larger firms do not necessarily perform better in terms of innovation, possibly due to structural inertia. Model diagnostics affirm the robustness of the regression. The F-statistic of 5.91 (p-value = 0.0000) confirms overall model significance. The Durbin-Watson statistic of 2.10 indicates no autocorrelation in the residuals and the adjusted R-squared value of 0.506 shows that roughly 50.6% of the variance in firm innovation is explained by the model's variables.

The results of Hypothesis 4 confirm that digital transformation has a significant but partial mediating effect on the relationship between managerial overconfidence and firm innovation. While digital transformation contributes independently to innovation, it does not fully account for the effect of managerial overconfidence, which remains strong and significant even when the mediator is included. These findings validate the hypothesis at a 95% confidence level and underscore the complementary roles of leadership traits and digital capabilities in driving corporate innovation.

Table VI: Results of the Fourth Hypothesis Test

Variables	Coefficients	Standard Error	t-Statistic	Significance Level (p-value)
CEO	1.00	0.267	3.734	0.0002
DIG	0.002	0.005	0.401	0.0082
ROA	7.977	0.933	8.545	0.0000
SIZE	-0.007	0.128	-0.061	0.9513
Lev	0.763	0.221	12.472	0.0000
C	-0.818	1.679	-0.487	0.6262
R-squared	0.570	Adjusted R-squared	0.506	
F-Statistic	5.91	Significance Level	0.0000	
Durbin-Watson Statistic		2.10		

The Sobel test is a widely used statistical test employed to examine the significance of the mediating effect of a variable in the impact between two other variables. For this purpose, in the present study, the role of digital transformation in the impact between managers' overconfidence and corporate innovation among companies listed on the Tehran Stock Exchange was investigated using the Sobel test. A summary of the Sobel test analysis results is presented in Table VII.

Table VII: Summary of Sobel Test Results

Hypotheses	t-Statistic	Error Level
Digital transformation in the impact between managers' overconfidence and corporate innovation	2.306	0.0132

As observed in Table VII, the results of the Sobel test indicate that the indirect effect of managers' overconfidence through financial digital transformation (t = 2.306) on corporate innovation is significant at a level less than 0.05 (0.0132). Therefore, it can be concluded that the mediating role of financial digital transformation in the impact between managers' overconfidence and corporate innovation is confirmed. Moreover, since the product of the coefficients is positive, this effect is considered complete (full mediation).

Table VIII. Summary of Mediation Analysis Results: Direct, Indirect, and Total Effects Based on the Baron and Kenny Framework

Effect Type	Path	Coefficient (β)	p-value	Interpretation
Direct Effect	CEO Over → Innovation	0.996	0.0002	Significant
Mediator Path (a)	CEO Over → DT	-3.44	0	Significant
Mediator Path (b)	DT → Innovation	0.002	0.0082	Significant
Indirect Effect (a×b)	CEO Over → DT → Innovation	-0.00688	0.0132	Significant (Sobel)
Total Effect	CEO Over → Innovation (total)	0.996	-	Consistent with partial mediation

As observed in Table VIII, in addition to the Sobel test confirming the significance of the indirect effect (t = 2.306, p = 0.0132), the mediation path coefficients were as follows: the effect of CEO overconfidence on digital transformation (a-path) was β = –3.44 (p < 0.000), and the effect of digital transformation on innovation (b-path) was β = 0.002 (p = 0.0082). The product of these paths yielded an indirect effect of –0.00688. The direct effect of CEO overconfidence on innovation remained significant (β = 0.996, p = 0.0002), indicating partial mediation, not full mediation as previously suggested.

Conclusion and Recommendations

This study investigated the interactive effect of digital transformation on the relationship between managerial overconfidence and corporate innovation, using data from 113 Iranian firms listed on the Tehran Stock Exchange between 2016 and 2023. A combination of diagnostic tests and two-way fixed effects GLS regression models ensured robust empirical analysis. The findings revealed several important insights into the behavioral and technological dynamics of innovation in emerging market firms. First, managerial overconfidence was found to significantly and positively influence corporate innovation. This aligns with prior studies (e.g., Jin et al., 2024) that associate overconfidence with a proactive stance toward high-risk, high-reward projects. Overconfident managers often support visionary initiatives and pursue innovation aggressively. However, consistent with Pourmansouri et al. (2023), this effect is context-dependent and may vary under different institutional constraints. Second, the results confirmed that digital transformation significantly boosts corporate innovation, supporting literature that views digital capabilities as enablers of value creation and competitiveness (e.g., Pu et al., 2024; Xie, 2024). Through mechanisms such as automation, knowledge integration, and process reconfiguration, digital transformation helps firms scale innovation more effectively

Surprisingly, the study found that managerial overconfidence has a negative effect on digital transformation—contrary to studies like Zhang & Song (2025) that associate overconfidence with bold investments in digital technologies. This counterintuitive finding may be attributed to contextual features of the Iranian business environment. Overconfident managers in emerging markets may underestimate the complexities of digital transformation, lack awareness of modern IT systems, or resist collaborative governance models, opting instead for intuition-driven decision-making. Institutional voids, limited digital infrastructure, and regulatory uncertainty may further discourage strategic digital investments. Moreover, the insignificant relationship between firm size and innovation contradicts global literature, which often links size with innovation capacity due to resource advantages. This may reflect the bureaucratic rigidity and hierarchical structure common in large Iranian firms, which often inhibit responsiveness and agility—key enablers of innovation. In such firms, innovation may rely more on individual managerial traits and digital culture than on scale.

The mediation analysis demonstrated that digital transformation partially mediates the relationship between overconfidence and innovation. This suggests that digital transformation acts as a transmission channel for behavioral traits to affect innovation outcomes, but other mechanisms (e.g., organizational structure, R&D governance) may also play a role.

Given these insights, several policy and managerial recommendations emerge:

- For policymakers: Provide targeted subsidies and training programs to strengthen digital literacy among senior executives. Create incentives for firms to adopt digital innovation strategies, especially in sectors with strategic importance.
- For corporate boards: Establish digital advisory committees and oversight mechanisms to monitor high-risk decisions made by overconfident executives. This can ensure a balance between strategic vision and implementation discipline.
- For managers: Prioritize structured digital transformation initiatives over impulsive technology adoption. Implement change management frameworks and ensure alignment between innovation goals and digital capabilities.
- For researchers: Future studies should test moderating variables (e.g., market competition, board diversity) and explore comparative analyses across industries and countries.
- Policy-Level Recommendations: Given the negative impact of managerial overconfidence on digital transformation observed in this study, policymakers—particularly in emerging markets—should implement targeted programs to enhance digital literacy among senior executives. National innovation authorities and regulatory bodies may consider offering tax incentives, digital adoption grants, or performance-based funding schemes to encourage structured and data-driven digital transformation. In addition, standardized benchmarks and sector-specific digital readiness assessments could guide policy formulation and help reduce behavioral risk in executive decision-making.

Limitations:

A potential limitation of the current study is the issue of endogeneity—particularly reverse causality between innovation and digital transformation. While this study employs fixed-effects regression and control variables to mitigate omitted variable bias, future research could apply instrumental variable techniques (e.g., using lagged values, industry-level digital adoption rates, or regional IT infrastructure) to better isolate causal effects and validate the directionality of the proposed relationships. Future research could enhance the robustness of these findings by incorporating alternative proxies for managerial overconfidence—such as CEO compensation structure or option-based incentives—and for digital transformation—such as actual IT expenditure or digital capital intensity. These additional indicators may capture different dimensions of behavioral and technological dynamics, allowing for deeper validation of the results.

Finally, since this study is limited to Iranian firms, its generalizability is bounded by the cultural, regulatory, and institutional specificities of emerging markets. However, the findings contribute to a growing body of literature on the intersection of managerial behavior and digital innovation under constrained environments.

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