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The Role of Financial Vulnerability in Mediating Innovation and Firm Performance

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ABSTRACT

Businesses face significant issues related to inconsistency in performance. These issues can be resolved through innovation because innovation is a strategic tool used for the development of firms to enhance the firm performance (FP) and lower the financial vulnerability (FV) of firms. So, the purpose of this study is to investigate the impact of innovation on FP as well as the mediating role of FV in Pakistani non-financial firms. Data was collected from annual reports of 138 firms out of 418 listed at the Pakistan Stock Exchange (PSX) from the study period of 2016 to 2023. Innovation is measured through product innovation (PI) and market innovation (MI). FV is measured through four proxies: equity ratio (ER), revenue concentration ratio (RCR), administrative cost ratio (ACR), and operating margins (OM). FP is measured through return on assets (ROA) and return on equity (ROE). To add more strength to the model, control variables firm size (FS) and leverage (Lev) are used in this study. Regression tests (fixed effect and random effects) are used. Findings show that innovation has significant positive effects on FP, and also, innovation decreases the FV of firms. FV mediates this relationship between innovation and FP. The resource-based view (RBV) theory supports these findings. This study has implications for managers, investors, and stakeholders of firms to reduce the FV and increase FP. According to the researcher's knowledge, this is the pioneer study that checked the impact of innovation FP as well as on FV and the mediating role of FV between innovation and FP.

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1. Introduction

Two powerful processes that are strongly tied to one another and that influence global economic trends are modernization and innovation (Ahmed et al., 2024). Businesses that innovate can take on a new perspective to identify new prospects and the best solutions for existing issues (Naeem et al., 2025). Consequently, businesses that adopt higher degrees of innovation often acquire a competitive advantage in the market, which may lead to a future rise in the return on investment (Jingwen et al., 2025). On the other hand, a lack of innovation and modern technology will make businesses more vulnerable financially because they will have less elastic production and be less prepared to deal with future market shocks (Magistro et al., 2025). FV, which involves a sudden and unexpected loss of income due to an uncontrollable increase in expenses, is the result of future unanticipated shocks. The performance of the company will thereafter decline. As a result, to account for the possible financial risk that the companies may encounter, they must consistently pursue more inventive endeavors.

Previous studies (Ullah et al., 2025; Gidage & Bhide, 2025; Wong & Ngai, 2024; Shah et al., 2024) focused on innovation with FP and found inconsistency in results. Studies ignore the mediating effect of FV between innovation and FP. FV as a mediator is crucial in influencing how effectively innovation translates into improved FP. In Pakistani contexts, firms' high FV can weaken the positive impact of innovation, making it essential to address for sustainable performance outcomes. Apart from those studies, the study answers the questions of whether innovation reduces the risk of FV and increases the FP. Does FV mediate the relationship between innovation and FP?

This study is suitable for developing countries, especially Pakistan, because Pakistani firms face significant issues related to FP. Secondary data is collected from the annual reports of 138 firms listed at the PSX from 2016 to 2013. Innovation is measured through two proxies, PI and MI. FV is measured through the model of Tuckman and Chang (1991). FP is measured through two proxies, ROE and ROA. To increase the strength of the model, some control variables (firm size and leverage) are also included. Baron and Kenny's (1986) approach is used in this study. Panel data techniques re employed for data analysis. Hausman test confirmed that fixed effects is suitable for this data analysis. The results show that PI and MI lower the firm's FV and increase FP. It also shows that FV mediates this relationship. The Sobel test is used for robustness. Robustness results are aligned with panel data methods. RBV theory supports these findings.

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The following are the contributions of our study. Firstly, the research contributes to the current empirical discussion about the relationship between innovation and FP. Secondly, this study contributes to the literature of innovation and FV. Through these relationships, firms can reduce the risk of loss. Thirdly, findings of this study contribute to the literature in the form of the FV and FP relationship. Fourthly, this study contributes to the literature in the form of the mediating role of FV between innovation and FP. This study has implications for stakeholders, i.e., owners, managers, and policymakers. Managers and policy-makers can focus on innovation to use the resources of firms to decrease the FV and increase FP.

The paper is organized as follows: Section 2 contains the literature review and hypotheses development; Section 3 consists of methodology. Section 4 consists of the results and their discussion. Section 5 discusses the conclusion of this study.

2. Literature Review

2.1 Theoretical Framework

Prior studies (Ali et al., 2022; Farooq & Ahmad, 2023; Farooq et al., 2023; Anser et al., 2024) on innovation, FV, and FP used different theories, such as agency theory or dynamic capabilities theory, and the Resource-Based View (RBV) theory. RBV is a more suitable foundation for this study. RBV emphasizes that businesses gain and sustain competitive advantage through the strategic utilization of their valuable, rare, inimitable, and non-substitutable resources (Sun et al., 2024). According to Naeem et al. (2024b), innovation, as a core intangible asset, aligns with RBV's assertion that internal capabilities are critical drivers of FP. However, the presence of FV can impair a firm's ability to leverage these innovative resources effectively. Therefore, this study adopts RBV to investigate whether innovation contributes to FP and how FV mediates this relationship, reflecting the objective of exploring internal strengths and constraints within Pakistani non-financial firms.

2.2 Hypotheses Development

This section contains the hypotheses development, which is based on Baron and Kenny's (1986) approach.

2.2.1 Innovation and Firm Performance

According to Distanont (2020), innovation refers to an organization's ability to develop and apply new ideas, processes, products, or services that enhance its competitive advantage and market

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responsiveness. It consists of product and process innovation. FP represents the overall success of a business in achieving its strategic and financial objectives. It's measured through different proxies, i.e., ROA, ROE, and earnings per share (Naeem *et al.*, 2023).

Innovation is globally recognized as an important tool of FP, enabling businesses to enhance productivity, distinguish their products from competitors, and adjust to dynamic market conditions. RBV theory explains that innovation is a strategic resource that enables firms to enhance FP. Still, empirical findings on this relationship remain inconsistent. While some studies report a strong positive link between innovation and FP (Ferreira et al., 2024; Shah et al., 2024), others find weak or indeed negative associations (Yan et al., 2024; Liu, 2024). This inconsistency in results motivates us to fill this gap. Thus, on based on the above literature following hypothesis is formulated;

H1: Innovation has a significant effect on Firm Performance.

2.2.2 Innovation, Financial Vulnerability, and Firm Performance

FV refers to a business's vulnerability to financial distress due to factors like low liquidity, high debt situations, and unstable cash flows (Ali *et al.*, 2023). It captures the extent to which an establishment's fiscal sins can undermine its capacity to invest in, support, or benefit from invention. According to Ferreira *et al.* (2020), innovation is crucial for a company to maintain its performance in the market. Innovation enhances the performance and lessens the company's financial suffering (Cefis & Marsili, 2012; Fernandes & Paunov, 2015; Naeem et al., 2024). Innovative businesses that experience a crisis and have a high failure rate typically charge a premium for innovation to survive (Cefis *et al.*, 2020). According to Columbelli *et al.* (2016), Børing (2015), and Howell (2015), it has a positive impact on the survival of businesses.

Some studies (Nugroho et al., 2021; Xie *et al.*, 2019) found a positive association between PI and FV and lessened the financial hardship the company faces. To be more precise, a highly inventive company can introduce new products to attain the market share and consumers' attention. When customers take advantage of these new offerings, earnings rise and financial distress falls (Giebel & Kraft, 2020). In terms of FV, MI also has a positive relationship with financial development (Umar *et al.*, 2020). According to the aforementioned empirical data, innovation can help a company lower FV (Burlamaqui & Kregel, 2005; Nkundabanyanga *et al.*, 2020). Thus, innovative businesses encounter less FV.

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To improve operational performance, a company can engage in more innovative operations. A company may have increased financial gains as a result of using innovative initiatives (Naeem *et al.*, 2025). Generally speaking, a company's operational and financial risks are reduced when it engages in more innovative operations, which also improves the firm's FV. Some studies (Nugroho *et al.*, 2021; Xie *et al.*, 2019; Ferreira *et al.*, 2020; Mendoza & Thelen, 2008; De Oliveira *et al.*, 2018) found an inverse relationship between innovations and FV. These studies claim that a firm's FV can be raised by innovation. Literature shows that those firms who less on innovative ideas face more financial issues, and these firms are financially disturbed. This situation ultimately affects the performance of firms. So FV mediates the relationship between innovation and FP. Thus, based on the above discussion, we created the following hypotheses.

H2: Innovation has significant effects on Financial Vulnerability.
H3: Financial Vulnerability has a significant effect on Firm Performance.
H4: Financial Vulnerability mediates the relationship between Innovation and Firm Performance.

2.3 Conceptual Framework

The conceptual framework of this study is given below in Figure 1.

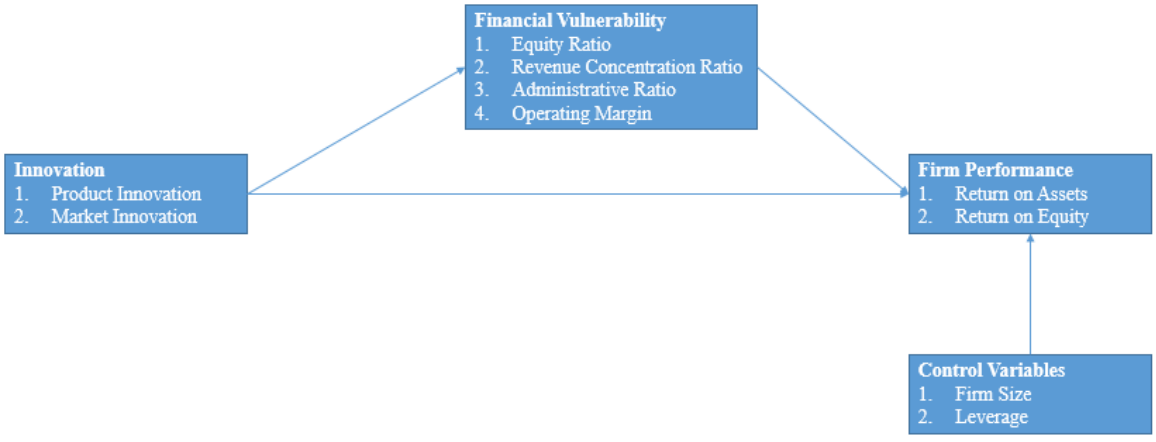

Figure 1

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3. Research Methodology

3.1 Data:

The study focused on non-financial firms listed at PSX from 2016 to 2023. Total listed firms in this duration were 418, out of which 138 firms were selected as a sample. This research excluded those firms who was unlisted from 2016 to 2023 and did not contain the data of the studied variables. The study also excluded those firms that merged with others or were acquired by other firms. Secondary data was collected from annual reports of firms, and analyses were performed through STATA software.

3.2 Variable Measurements

Measurements of variables (dependent, independent, mediator, and control) are given below.

3.2.1 Dependent Variable

Dependent variables are measured through ROA and ROE. ROA is measured through net income divided by total assets, and ROE is measured through net income divided by total equity. This measurement is used by (Ali et al., 2022; Farooq & Ahmed, 2023; Farooq et al., 2023; Naeem et al., 2024).

3.2.2 Mediator

The FV model, created by Tuckman and Chang (1991), is used in this study. This model contained four indicators. The following are these indicators:

3.2.2.1 Equity Ratio

A firm with a larger equity balance may be in a better position to handle unforeseen financial shocks and may be able to leverage its assets. Conversely, a lower equity level indicates greater FV for the company. Divide the total equity by the total revenue to get the equity ratio.

ER = Total Equity/Total Revenue

Where: ER = Equity Ratio

3.2.2.2 Revenue Concentration Ratio

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Businesses with diverse revenue streams are less susceptible to financial shocks. The Herfindahl Index can be used to calculate the revenue concentration ratio by adding the squared percentages of each source of revenue.

RCR = Revenue Source/Total Revenue

Where: RCR= Revenue Concentration Ratio

3.2.2.3 Administrative Cost Ratio

Financial crises are more likely to affect companies with higher administrative costs. ACR is calculated using this formula.

ACR= Administrative Expenses/Total Revenue

Where: ACR = Administrative Cost Ratio

3.2.2.4 Low or Negative Operating Margin

Comparatively speaking to companies with high operating margins, those with low operating margins may be more susceptible to financial disturbances. If a company has a financial shock, it could be able to function with a lower operating margin instead of discontinuing a product or sector.

OM = Total Revenue − Total Expenses/ Total Revenue

Where: OM = Operating Margin

This model is easy to understand and is based on empirical data. So this model is better to measure FV.

3.2.3 Independent Variable

The independent variable used in this study is the following.

3.2.4 Innovation

Innovation, as defined by Morgan et al. (2009), is a company's ability to design and integrate the most efficient and effective use of its current resources to meet changing market demands. To reflect a firm's dynamic capacity for innovation, we used two proxies, PI and MI, in this research.

According to Mohan et al. (2021), PI is a new product development, new production techniques, innovative technical launches, and the incorporation of new product elements. According to Krammer and Jimenez (2020), it is the development of novel products, services, and procedures.

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We adopted the measurement technique used by Ahmed et al. (2024). PI is measured in binary form 1 when a company creates new products, innovates technologically, or adds new features to an existing product during a given year; PI equals 0 in the absence of such activity. MI is also measured in binary form. MI is 1 when products are introduced into a new market; otherwise, a value 0.

3.2.5 Control Variables

To increase the strength of the model, this study used control variables and carefully selected from the current literature. According to Lenihan et al. (2019) and Naeem et al. (2024), the FS is determined by taking the natural log of the total assets. Lev stands for a company's financial leverage ratio, which is determined by dividing total debt by total assets (Kou et al., 2020; Naeem et al., 2023).

3.3. Econometric Model

Based on the literature and hypotheses, the following models are created.

3.3.1. Innovation and Firm Performance

This model consists of the impact of innovation on FP.

$$FPit = \beta0 + \beta1PIit + \beta2MIit + \beta3FSit + \beta4Levit + \varepsilon it \quad (1)$$

3.3.2. Innovation and Financial Vulnerability Performance

This model consists of the impact of innovation on FV.

$$FVit = \beta0 + \beta1PIit + \beta2MIit + \beta3FSit + \beta4Levit + \varepsilon it \quad (2)$$

3.3.3. Financial Vulnerability and Firm Performance

This model consists of the impact of FV on FP.

$$FPit = \beta0 + \beta1ERit + \beta2RCRit + \beta3ACRit + \beta4OMit + \beta5FSit + \beta6Levit + \varepsilon it \quad (3)$$

3.3.4. Innovation, Financial Vulnerability, and Firm Performance

This model consists of the mediating role of FV between innovation and FP.

$$FPit = \beta0 + \beta1PIit + \beta2MIit + \beta3ERit + \beta4RCRit + \beta5ACRit + \beta6OMit + \beta7FSit + \beta8Levit + \varepsilon i \quad (4)$$

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4. Results

4.1 Descriptive Result

Table I contains the descriptive statistics of the variables. This result shows that the total observation of this study is 1104. Mean values have explained the measure of central tendency. The mean values of FP (ROA and ROE) are 0.243 and 0.475, respectively. FV proxies mean values are 0.55, 0.84, 0.51, and 0.44, respectively. It shows that sample firms are more focused on their performance and minimizing their vulnerability. PI and MI mean values are 0.45 and 0.79, respectively. It means that sample firms are more focused on innovation. FS and Lev's mean values are 7.198 and 0.477, respectively.

Table I: Descriptive Statistics

Variables	Obs	Min	Max	Mean	Std. Dev
ROA	1104	0.014	0.788	0.243	0.284
ROE	1104	-0.022	0.840	0.475	0.378
ER	1104	0.008	0.991	0.553	0.298
RCR	1104	0.208	0.729	0.842	0.131
ACR	1104	0.008	0.661	0.516	0.204
OM	1104	0.031	0.886	0.443	0.165
PI	1104	0.000	1.000	0.459	0.196
MI	1104	0.000	1.000	0.794	0.525
FS	1104	5.234	9.102	7.198	0.676
Lev	1104	0.001	1.049	0.477	0.195

4.2 Correlation Result

Table II reports the correlation analysis of independent, mediator, and control variables. All the variables' values are less than 0.70, so this analysis does not have a multicollinearity issue.

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Table II: Correlation Statistics

Variables	**ER**	**RCR**	**ACR**	**OM**	**PI**	**MI**	**FS**	**Lev**
ER	1							
RCR	0.043	1						
ACR	0.076	0.577	1					
OM	0.017	0.106	-0.047	1				
PI	0.02	0.051	0.059	0.052	1			
MI	0.052	0.63	0.538	0.009	0.197	1		
FS	0.014	0.03	0.02	0.046	0.001	0.025	1	
Lev	0.056	0.028	0.031	0.029	-0.031	-0.037	0.035	1

4.3 Regression Analysis

The study employed a Hausman test to select the test from fixed and random effects that is suitable for analysis. Table III shows the Hausman test result. The result reveals that fixed effects are more suitable.

Table III: Hausman test results of

Variables	**Model 1**		**Model 2**				**Model 3**		**Model 4**	
	ROA	**ROE**	**ER**	**ROA**	**ROA**	**OM**	**ROA**	**ROE**	**ROA**	**ROE**
Chi2(6)	22.17	19.01	27.13	15.17	10.34	23.65	15.17	17.21	19.35	24.31
Prob>chi2	0.000	0.006	0.007	0.000	0.002	0.000	0.012	0.000	0.003	0.001
Model	Fixed effect	Random effect	Random effect	Fixed effect	Fixed effect	Fixed effect	Fixed effect	Fixed effect	Fixed effect	Fixed effect

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Table IV: Regression results

Variables	**Model 1**		**Model 2**			
	ROA	**ROE**	**ER**	**RCR**	**ACR**	**OM**
PI	0.0092*	0.0012**	0.0002***	0.0031**	0.0056*	0.0000***
	(0.048)	(0.001)	(0.004)	(0.009)	(0.049)	(0.002)
MI	0.000***	0.0590*	0.0011**	0.0012**	0.0006***	0.0030*
	(0.010)	(0.0640)	(0.002)	(0.001)	(0.002)	(0.004)
ER						
RCR						
ACR						
OM						
FS	0.3130**	0.0630	0.0013**	0.0370	0.0080	0.0069
	(0.005)	(0.108)	(0.012)	(0.032)	(0.009)	(0.040)
Lev	-0.000***	-0.0020**	-0.0152	-0.0550	-0.0440	0.0000***
	(0.047)	(0.364)	(0.019)	(0.049)	(0.049)	(0.001)
Constant	0.007**	0.0019**	0.0652	0.1780	0.0022**	0.0000***
	(0.043)	(0.005)	(0.059)	(0.212)	(0.002)	(0.001)
Model	**Fixed effect**	**Random effect**	**Random effect**	**Fixed effect**	**Fixed effect**	**Fixed effect**
Obs.	1104	1104	1104	1104	1104	1104
R-squared	0.18	0.26	0.20	0.11	0.13	0.04
No. of coid	138	138	138	138	138	138

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Model 1: Table IV reports the regression results of Model 1, the impact of PI and MI on FP (ROA and ROE). The result reveals that PI and MI significantly positively affect ROA and ROE. Higher innovation contributes to the FP. FS has a positive significant effect on ROA and an insignificant effect on ROE. FS's positive effect on ROA indicates that firms use their resources to enhance performance. Lev has a significant negative effect on ROA and ROE. It shows that those firms that depend on more debt ultimately affect their performance. R-squared values are 0.18 and 0.26, respectively. It indicates that PI and MI bring an 18% change in ROA and a 26% change in ROE.

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Model 2: Table IV presents the regression result of Model 2, which consists of the innovation and FV relationship. Consistent with the conclusions drawn from the body of existing literature, the empirical data shows that a rise in innovation is linked to a fall in FV (Ahmad et al., 2024). FS also positively and significantly affects FV proxy ER. This means that when any firm has more resources, it can use them to reduce FV, while Lev has a significant negative effect on FV. When firms rely more on debt financing, they are enhancing FV. So, it's dangerous for firms.

Table V: Regression results

Variables	**Model 3**		**Model 4**	
	ROA	**ROE**	**ROA**	**ROE**
PI			0.034***	0.0432***
			(0.002)	(0.003)
MI			0.047	0.174***
			(0.064)	(0.051)
ER	0.0090	0.0012**	0.0004***	0.0045
	(0.048)	(0.001)	(2.690)	(0.660)
RCR	0.003***	0.0361***	0.0007**	0.0067**
	(0.001)	(0.004)	(0.010)	(1.770)
ACR	0.549***	0.172***	0.0069***	0.1918**
	(0.012)	(0.020)	(7.650)	(5.020)
OM	0.005	0.0284**	0.167***	0.213***
	(0.017)	(0.023)	(0.045)	(0.041)
FS	0.0000***	0.0590	0.1066**	0.0280
	(0.010)	(0.0640)	(2.042)	(0.640)
Lev	-0.3130	0.0630	-0.1824*	-0.4277**
	(0.005)	(0.108)	(11.600)	(6.230)
Constant	0.0000***	0.0020**	-0.1149***	-1.5269***
	(0.047)	(0.364)	(0.940)	(3.000)
Model	Fixed effect	Fixed effect	Fixed effect	Fixed effect
Obs.	1104	1104	1104	1104
R-squared	0.37	0.26	0.23	0.32
No. of coid	138	138	138	138

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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Model 3: Table V represents the regression result of the effect of FV on FP using the model equation 3. Proxies of FV have a significant positive effect on ROA and ROE. This shows that the higher the RCR, ACR, and OM, the more the FP. ER has a significant positive effect on ROE. RCR, ACR, and OM have significant effects on FP. This result indicates that a higher ER ratio increases the performance of firms. Higher RCR also has a positive and significant effect on ROA and ROE. Our results are aligned with our expectations that those firms that are financially disturbed face more issues and ultimately their performances decrease, while those firms that face fewer financial issues have higher FP.

Model 4: The result of the study indicates that innovation can help a corporation decrease its FV and increase its FP. The reduction in financial risk and the rise in FP may mean that innovative enterprises experience reduced FV. Slater et al. (2010) state that innovation is frequently produced with open technology and excellent open tools and that it is dependent on a specific type of knowledge and information system. Additionally, companies that prioritize PI and MI have a competitive advantage over rivals, which supports their financial viability in the market. Financial development and innovation are inversely correlated in terms of FV, as new methods reduce financial strain (Umar et al., 2020). As a result of the creative behavior, customers become more interested in making purchases, increasing sales and revenues, which in turn lowers the level of FV and eventually raises FP (Cefis et al., 2020). As a result, innovation leads to a rise in FP, whereas good customer relations and innovation cause a fall in FV. This result is consistent with RBV theory.

4.4 Robustness

The current study checks the robustness through the 2 SLS regression test. Results are consistent with panel data results. It shows that when firms bring innovation, then FV decreases and FP increases.

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Table VI: 2 SLS Regression results

Variables	**Full Model**	
	ROA	**ROE**
PI	0.0213***	0.012***
	(0.000)	(0.001)
MI	0.0173	0.0431***
	(0.031)	(0.049)
ER	0.0039***	0.0039
	(1.700)	(0.580)
RCR	0.0036**	0.0071**
	(0.011)	(0.690)
ACR	0.0072***	0.1918**
	(2.540)	(2.019)
OM	0.138***	0.203***
	(0.049)	(0.039)
FS	0.1170**	0.0253
	(1.039)	(0.509)
Lev	-0.271*	-0.4277**
	(1.592)	(2.1910)
Constant	-0.1732***	-0.4921***
	(0.688)	(2.029)

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5. Conclusion

The study examines the relationship between innovation, FV, and FP as well as the mediating role of FV between innovation and FP using a manually selected sample of 138 non-financial firms listed on the PSX between 2016 and 2023. Findings of this study show that innovation increases the FP and decreases FV. Moreover, FV acts as a mediator in the relationship between FP and innovation, strengthening the link between the two. Based on our empirical data, innovation can help a firms reduce its financial risk and boost FP. To control the FV encountered by a firm and improve FP, the study advises management to adopt creative product and marketing tactics in addition to hiring skilled

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and educated technical staff. This study has theoretical and practical implications for stakeholders (academic researchers, policymakers, managers, owners, potential investors, creditors, and all other stakeholders). Firms use their resources for innovations and development. These findings are helpful for managers to adopt innovative ideas to enhance the performance of firms and lower the risk of default or financial hardships.

Future studies in this field should address the shortcomings of this work. While there are numerous other ratios and non-financial variables that can be used to proxy for FV, the study only uses a small number of financial measures to analyze FV. Therefore, we propose that additional ratios can be used in future studies to reexamine the topic and serve as a proxy for FV. Future studies can also make use of the other FP proxies. Furthermore, we limited our research to PSX data due to data availability, thus, our findings might not apply to other nations. We might not be able to provide a clear picture of the variables under study as a result. Therefore, to do a more thorough investigation on the subject, we also recommend that future studies broaden the data to include new industries and nations. Furthermore, it is believable that excellent corporate governance may favorably influence innovation on FP and the mediating role of FV, given that it can aid in the development of a better operational environment and appropriate executive behaviors. Since this subject is outside the purview of this study, we advise that future research examine the impact of corporate governance through an empirical approach.

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