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Do Takeover Threats Stifle or Promote Managerial Efforts to Innovate? Evidence from Takeover Vulnerability, and Text-Based Measure of Innovation

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Abstract: Although the role of managers is crucial in shaping firm innovation, it also poses a dilemma. Because innovation is a complicated and long-term process that requires effort and attention, managers may reduce effort in innovation when faced with high takeover threat. This study examines the effects of hostile takeover threats on managerial efforts to innovate. Our results show that more active hostile takeover markets stifle managerial efforts in corporate innovation. The findings suggest that managers tend to be more myopic when firms are exposed to hostile takeover threats. Managers will put less effort into innovation to counter the risk of being dismissed as the expected payoff from such investment is long-term and highly uncertain. Additional robustness checks confirm the results, including random-effects regressions, an alternative measure of innovation, and two instrumental-variable analyses.

Keywords: takeover; innovation; takeover threats; managerial myopia; market for corporate control

1. Introduction

There has been a long-standing question about what makes a firm innovative. According to Schumpeter's early work (Schumpeter 1934), the firm characteristics of being new and small are the key drivers of a firm's innovation. Because the firm is new and small, it has more flexibility to overcome organizational inertia than the incumbent firms and can easily introduce innovations. However, Schumpeter (1942) later found that the firm characteristics of being large and incumbent can significantly enhance a firm's innovation process. Large firms are better equipped to exploit the research and development (R&D) facilities and have more financial tolerance for enduring failure risk. Thus, large and incumbent firms are in a better position to invest in innovation. Following these early studies, there have been extensive studies that investigated how firm characteristics, market structure, and the geographical environment affect corporate innovation (Kamien and Schwartz 1975; Cohen et al. 1989; Ritter-Hayashi et al. 2019; Li et al. 2021). For instance, Ritter-Hayashi et al. (2019) found that gender diversity can increase firms' likelihood to innovate. Ritter-Hayashi et al. (2019) show that female managers enhance innovation. Other recent studies reveal interesting insights. Li et al. (2021) revealed that financial constraints suppress corporate innovation while government subsidies promote corporate innovation. Later, the studies on innovation evolved and new areas of research relating firm innovation activity to corporate governance have been investigated (Lacetera 2001; Casper and Matraves 2003; Michie and Oughton 2003; Sapra et al. 2014). Differences in corporate governance do exist among firms and have a significant bearing on firm innovation because it affects managerial effort in innovation and how managers allocate resources within the firms (Belloc 2012).

Innovation has since become increasingly complex due to changing customer needs and rapid technological change (Cavusgil et al. 2003). Additionally, due to the rapidly increasing amount of knowledge available, innovation is more complex than ever as its success is also dependent on managing and identifying the available knowledge (Cardinal et al. 2001; Adams and Lamont 2003). Thus, innovative projects are not just risky, they also require a substantial amount of effort from managers to engage in lengthy complicated processes (Younge and Tong 2018). Although managers may be well aware of the benefits of innovation, since innovation requires effort from managers, they may prefer to avoid engaging in complicated innovation processes (Bertrand and Mullainathan 2003). However, pressure from a hostile takeover threat as a disciplinary device may counteract this avoidance and induce managers to put additional effort into innovation. Several studies presented empirical evidence to highlight the importance of how takeover threats shape firm innovation (Jensen and Ruback 1983; Jensen 1988). This paper underscores the differences between managerial effort to innovate and corporate innovation. Managerial effort to innovate refers to the process in which managers engage in complicated, risky, and long-term projects for which the outcome is uncertain (Younge and Tong 2018). The outcomes of managerial effort are varied, they can result in successful or failed innovation. Additionally, the outcome of successful innovation can be both observable and unobservable innovation. Examples of unobservable innovation outcomes are improved production process and new marketing methods. On the other hand, corporate innovation refers to the already successful innovation project. Therefore, managerial effort to innovate may not result in the firm obtaining patent or improved products.

In this paper, we examine how the threat of hostile takeover influences managerial innovative efforts. Although there are many governance mechanism tools commonly used in the capital market, much of the literature focuses on the internal governance mechanisms such as board composition, manager compensation and ownership structure (Burkart et al. 1997; Manso 2011). Unlike any other governance mechanisms, hostile takeover threat is widely regarded as one of the strongest market mechanisms that puts external pressure on management (Atanassov 2013; Cain et al. 2017; Younge and Tong 2018). In other words, hostile takeover threat is an instrument that performs continuous external supervision of operations management. On one hand, a hostile takeover threat is usually perceived as a disciplinary tool in disciplining managers, incentivizing them to expend additional effort to adopt the most innovative and valuable projects (Shleifer and Vishny 1997; Jensen and Ruback 1983; Jensen 1988; Atanassov 2013). On the other hand, several recent papers reveal that takeover threats may discourage managers from putting effort into innovation activities as well as lowering firm-level innovation due to managerial myopia (Stein 1988; Maher and Andersson 2002). Our results found that a stronger hostile takeover threat hampers managerial effort to innovate.

Our contribution to the literature is threefold. First, unlike the extant literature that tends to link takeover threats to observable innovation outcome such as patent, we link takeover threats to managerial effort to innovate proxied by text-based innovation index which captures both observable and unobservable innovation outcomes.[1] We argue and provide evidence that an increase in hostile takeover threats stifles managerial effort to innovate. Therefore, this paper adds to the growing literature on market for corporate control and innovation.

Second, prior studies on takeover threats often face limitation when drawing any causal inferences because of the endogeneity problem that arises from measuring takeover defenses at the firm level (Core et al. 2006).[2] It has been difficult to identify an exogenous shock in the takeover market. Thus, many prior studies look to external influence, such as specific takeover defenses or anti-takeover laws to overcome the endogeneity problem (Karpoff and Malatesta 1989; Schwert 2000; Bertrand and Mullainathan 2003). However, those commonly used measures are specific to selected anti-takeover statutes, and none have examined the full spectrum of takeover laws, thus being unable to fully capture the whole spectrum of the legal environment that influences hostile takeover activity

(Cain et al. 2017).[3] Additionally, the use of anti-takeover provisions fails to have the longitudinal time frame necessary to account for changes in legal regimes and markets over an extended period of time (Coates 2000). Therefore, we adopt a novel measure of takeover vulnerability constructed by Cain et al. (2017) to measure takeover vulnerability. Our novel measure of takeover index fills the existing gap by examining the full spectrum of takeover laws over a long sample horizon from 1965 through 2013. Cain et al. (2017) use a dataset of 16 different takeover laws and court decisions. Thus, it is believed that the takeover index is one of the most comprehensive tools available to measure the external force of takeover vulnerability because it covers all the takeover-related laws in the past several decades.

Third, while several studies often rely on merger and acquisition (M&A) activities and anti-takeover law to measure takeover threats, they lack the ability to differentiate between friendly and hostile takeovers (Lel and Miller 2015). One reason is that some of the merger and acquisition (M&A) activities do not carry out the disciplinary effect on managers. It is not appropriate to regard friendly acquisitions as a corporate governance mechanism (Cain et al. 2017). Another reason is that some M&A activities are not related to anti-takeover law. For instance, if 100% effective anti-takeover laws were passed, there would be no hostile takeovers taking place in the market, but we could still expect M&A activities to occur because managers carry out M&A to pursue the benefit of synergies (Harford 2005). Thus, we adopt the takeover index which take into account only hostile M&A activity rather than all M&A activities.

The remainder of the paper is organized as follows. Section 2 discusses the related literature. Section 3 presents the research method. Section 4 describes sample selection, variable measurement, and descriptive statistics. Section 5 establishes the empirical evidence on the link between hostile takeover threat and innovation. Section 6 concludes the paper.

2. The Related Literature

In this section, the literature on the association between hostile takeover threats and managerial innovation effort and corporate innovation will be discussed. In the presence of active stock markets, takeover threats are an important influence on firms' allocation of resources (Belloc 2012). In a typical hostile takeover, a tender offer is made to the dispersed shareholders of the target firm by a bidder. If the shareholders accept the offer, the bidder gains control of the firm and has the power to replace the target company's management (Belloc 2012). Therefore, the target company's manager may lose the power and interest in the company once taken over. Studies on how takeovers affect managerial innovation effort as well as corporate innovation provide mixed results and are still under debate.

2.1. The Managerial Myopia Hypothesis

On one hand, studies show that hostile takeover threats may discourage managerial efforts to innovate due to less job security (Manso 2011). Job security gives a failure-tolerant working environment as well as motivation for managers to engage in risky innovation projects (Manso 2011). In such an environment, managers do not fear being exploited, and thus are more willing to invest effort to develop innovation projects. However, when a hostile takeover threat is high, job security is threatened, and managers are discouraged from engaging in innovation projects. Consequently, the managerial effort to innovate is reduced.

Prior studies show that hostile takeover threats may negatively affect investment strategies, especially investment in innovation (Stein 1988; Shleifer and Summers 1988; Kreps 1990; Maher and Andersson 2002). This can happen through both ex ante and ex post dynamics. According to Shleifer and Summers (1988), in the presence of an incomplete contract, the threat of ex post rent appropriation through unwanted hostile takeover may reduce managerial incentives to invest in relation-specific innovation investment ex ante. To elaborate on this point, although the possibility of takeover is uncertain, managers may not agree to implicit contracts with shareholders to invest in relation-specific

capital (innovation) because they fear a future breach.[4] An example of the possibility of breach of contract is that shareholders may get rid of workers whose wage exceeds their marginal product in a contract that, for incentive reasons, underpaid them when they were young (Shleifer and Summers 1988). Thus, managers must trust shareholders not to breach contract, otherwise managers would expect breach whenever they successfully raise the firm's value. According to the theory of rational reputation formation explained by Kreps (1990), managers would adhere to the implicit contracts to develop a reputation for trustworthiness, which enables them to benefit from the future implicit contract. Therefore, shareholders have the liability to uphold the contract, such that shareholders can realize gains only when the manager is ousted. This is when hostile takeovers come into play. Subsequent to a hostile takeover, managers are removed, the bidder gains control and is not committed to the implicit contract, giving the right to shareholders to renege on the existing implicit contracts and expropriate rent from managers. As a result, managers may anticipate that takeover increases the probability of ex post expropriation. This would lead managers to reduce managerial innovative effort as well as making a suboptimal investment decision. In simple terms, due to incomplete contracts, managers spend less effort and invest less in innovation because the hostile bidder may dismiss them upon successful takeover, thus meaning they will be unable to enjoy the benefit when the innovation project is completed (Shleifer and Summers 1988). The incomplete contract theory is further emphasized by Hart and Moore (1990) noting that allocation of power between managers and shareholders is an important incentive mechanism in the investment decision. This is consistent with the managerial myopia hypothesis, which states that more hostile takeovers result in less job security for managers. Consequently, managers focus on short-term projects at the expense of long-term projects. Therefore, managers neglect long-term innovative projects due to fear that they may not be able to reap the benefit of these long-term projects (Hart and Moore 1990; Aghion and Tirole 1994). Hence, managers will concern themselves with current earnings. Examples of manager actions are excessive use of firm's funds to strive for short-term sales growth and unnecessarily high employee welfare. Following these arguments, Johnson and Rao (1997) and Pugh et al. (1999) found that anti-takeover amendments enable a firm's management to focus on long-term investment strategies, without fear of losing their jobs and control of the firm. Chemmanur and Jiao (2012) demonstrate that anti-takeover amendments encourage high-talent managers to undertake long-term innovative projects, mitigating managerial myopia problems.

Another argument that supports the negative effect of takeover threats on innovation is based on asymmetric information. Stein (1988) argues that under asymmetric information between firm managers and shareholders, shareholders cannot properly evaluate the long-term innovative project and tend to undervalue the equity of companies undertaking innovative projects. Consequently, the undervaluation of the firm's stock makes it easier for hostile bidders to gain control of the firm by buying underpriced stock (Hasbrouck 1985; Palepu 1986). Thus, the firm is more vulnerable to a hostile takeover. To protect themselves and current shareholders against such expropriation, managers focus on short-term earnings and forego long-term innovative projects. Thus, managerial myopia is induced by takeover threats, which impedes innovation. The executive survey conducted by Graham et al. (2005) further proves the point as they found that managers are willing to sacrifice long-term goals to meet short-term earnings targets to maintain a firm's stock price. Additionally, some studies provide empirical evidence that anti-takeover provisions can encourage long-term managerial effort in innovation (Chemmanur and Tian 2018; Zeng 2014). Therefore, this view predicts that the increase in hostile takeover threats induces managerial innovative effort as well as promotes corporate innovation.

2.2. The Agency Cost Hypothesis

On the other hand, hostile takeovers are generally viewed as a disciplining mechanism in correcting managerial failure (Scharfstein 1988). In accordance with moral hazard views, managers may neglect their responsibilities when not properly monitored or pressured

by shareholders. Managers tend to invest in routine tasks that provide quicker and more certain returns rather than long-term innovative projects in order to reap personal benefits, thus reducing firm value. In such cases, the hostile takeover threats serve as one of the effective disciplining mechanisms for inducing managerial effort (Younge and Tong 2018). When the firm is exposed to high hostile takeover threats, managers who are not making their best efforts to engage in value-creation innovation projects may run the risk of being dismissed when the company is taken over. Therefore, hostile takeover threats counteract such tendencies and induce managers to expend additional effort to engage with innovation (Younge and Tong 2018). This helps to mitigate moral hazard problems by keeping managers focused on pursuing the most innovative and valuable projects to increase the firm value (Jensen and Ruback 1983; Jensen 1988; Atanassov 2013). Additionally, some studies show that anti-takeover provisions are detrimental to innovation (O'Connor and Rafferty 2012; Atanassov 2013).

3. Research Method

To analyze the impact of hostile takeover threats on managerial effort in innovation, we conduct ordinary least squares (OLS) regression. OLS takes into account the variation in the variables both across firms and across time. We also execute the random-effects regression for the robustness test. Additionally, we include year and industry dummies (based on the first two digits of SIC) to control for variation over time and across industries. In a regression analysis it is imperative to control for other factors that may influence firm innovation. We include firm size (natural logarithm of total assets), profitability (EBIT/total assets), leverage (total debt/total assets), growth (capital expense/total assets), R&D (R&D expense/total assets), advertising (advertising expense/total assets), discretionary spending (SG&A expense/total assets), and cash holding (cash/total assets).

It is important to note that the takeover index is constructed based on plausibly exogenous variables. Therefore, our results are already significantly less vulnerable to endogeneity. However, Coles and Li (2020) reveal that unobserved firm and manager attributes provide a high proportion of variation explained for firm takeover vulnerability. Their findings provide evidence that our study may be subject to endogeneity from the unobservable firm and manager-specific characteristics, thus any estimated relationships between hostile takeover threats and managerial innovative effort may still be spurious. Therefore, we execute two two-stage least squares (2SLS) techniques to cope with possible endogeneity. This approach mitigates any potential endogeneity that can be attributed to reverse causality, omitted variables, and measurement errors. This method requires instrumental variables that are correlated with takeover vulnerability but do not affect firm innovation except through takeover vulnerability. The two instrumental variables chosen are the value of the takeover index in the earliest period and the industry-median takeover index. The idea of the value of the takeover index in the earliest year and median year is that the degree of takeover susceptibility of the earliest year and the median year could not have resulted from corporate innovation in the current year, therefore reducing any possible reverse causality. A similar technique based on earliest and median years is employed by several studies including Jiraporn et al. (2016) and Chintrakarn et al. (2017). It is important to note that the takeover index is constructed based on exogenous variables. Thus, our results are less vulnerable to endogeneity problems. Yet, we still perform instrumental-variable analysis because it mitigates any potential endogeneity that can be attributed to reverse causality, measurement errors, and omitted variables.

As a final robustness check, we replace the text-based innovation index with the patent as an alternative measure of innovation and re-run the regression.

4. Sample Selection, Variable Measurement, and Descriptive Statistics

4.1. Sample Selection

The original sample concerning firm characteristics is gathered from the COMPUSTAT database. The financial and utility firms, whose SIC codes range from 6000 to 6999 and

4900 to 4999, respectively, are excluded as they tend to have financial and accounting characteristics that are unique and different from the others. The final sample consists of 5059 observations from 583 unique US firms from the years 1990 to 2010.

4.2. Variable Measurement

4.2.1. Measuring Hostile Takeover

One of the most serious problems in the literature in the area of takeover is the difficulty in identifying an exogenous shock to takeover vulnerability (Ongsakul et al. 2022). To tackle this problem, scholars often rely on anti-takeover laws or various specific takeover defenses to measure the changes in corporate governance (Karpoff and Malatesta 1989; Bertrand and Mullainathan 2003; Atanassov 2013). Examples of anti-takeover laws are Williams Act and Business Combination laws.[5] Examples of specific takeover defenses are staggered board, fair price, and the poison pill.[6] The reason that scholars commonly adopt anti-takeover laws or various specific takeover defenses in their studies is that both types represent an external influence, which avoids the endogeneity problem that arises from measuring takeover defenses at the firm level (Core et al. 2006). However, studies that employed anti-takeover laws and specific takeover defenses as proxies of hostile takeovers contain limitations. First, specific studies have concentrated on individual or selected anti-takeover statutes, none of the studies have examined the full spectrum of takeover laws (Cain et al. 2017). Second, many studies of anti-takeover provisions fail to capture a longitudinal timeframe sufficient to account for changes in legal regimes and markets over an extended period of time (Coates 2000).

In this study, we adopt the takeover index developed by Cain et al. (2017) to measure takeover vulnerability. There are two important advantages of using this index. First, the index is constructed based on exogenous factors, which help to alleviate the endogeneity concern. Second, to our knowledge, this index covers all the takeover-related laws in the past several decades, making it the most comprehensive proxy of takeover to date. To elaborate on this point, Cain et al. (2017) hand collected dataset of 16 different takeover laws and court decisions from 1965 through 2014 to measure how variation in takeover laws impact hostile takeover activity through time.[7] Cain et al. (2017) then construct the firm-level takeover index as the probability of a hostile takeover using the coefficients of their logistic regression analysis. The capital liquidity, firm age, and firm size are included as control variables. Finally, a higher value of the index indicates more takeover vulnerability. More detail about the construction of the takeover index can be found in Cain et al. (2017).

Another advantage of using the takeover index is that it does not take into account friendly takeover as friendly acquisition cannot accurately reflect the corporate governance mechanism (Cain et al. 2017). The reason is that hostile takeover carries out disciplinary effect, while friendly takeovers are likely undertaken to achieve synergy between bidder and target firms (Morck et al. 1988; Cain et al. 2017). Cain et al. (2017), hand collected M&A hostility by gathering data on all CRSP delisting related to the merger. The authors then drop any observations when unable to locate articles that indicate merger/takeover and hostility bidding from Wall Street Journal articles. Thus, the takeover index measures consistent hostile related takeovers. Recent scholars who adopted this hostile takeover index are Chatjuthamard et al. (2022) and Ongsakul et al. (2022).

4.2.2. Measuring Innovation

Our paper focuses beyond traditional observable innovation outcomes commonly used in studies such as R&D expenditure and patent.[8] Instead, we adopted the text-based innovation index developed by Bellstam et al. (2021), which captures both observable and unobservable innovation. The unobservable innovation in this paper refers to managerial effort in innovation, which is a private matter that cannot be directly measured (Manso 2011; Younge and Tong 2018). The text-based innovation index is derived from textual descriptions of firm activities by financial analysts. Analyst reports are one of the channels that managers use to signal information to investors (Gunny and Zhang 2014). Studies

have found that investors react strongly to textual opinion helping investors interpret quantitative signals (Huang et al. 2013). The text-based innovation index captures the signal with respect to managerial innovative effort convey to investor.

Thus, this paper adopts a novel text-based innovation index constructed by Bellstam et al. (2021). The text-based corporate innovation index was constructed from a textual analysis of analyst reports of S&P 500 firms, which fit into a topic modeling tool called the Latent Dirichlet Allocation (LDA) (Blei et al. 2003). The assumption behind LDA is that each analyst report is generated by drawing content from a common set of topics, or clusters of words, which provides an intensity with which each analyst report discusses each topic. To construct the measure, Bellstam et al. (2021) applied LDA, together with 15 topics related to innovation. The topics were selected based on the word distribution that has the smallest Kullback–Liebler divergence with a benchmark innovation textbook. The selected 15 topics are considered a reliable innovation proxy, both qualitatively and quantitatively. Examples of the words used are service, system, technology, product, and solution. Qualitatively, the words selected are the words that analysts usually use to describe managerial effort in innovation. Quantitively, the topic correlates strongly with patents among the patenting firms. Therefore, unlike other innovation proxies, the text-based innovation index can capture managerial effort in innovation. Another important advantage of the text-based innovation index is that it can be computed for firms that do not disclose their R&D expenditure. To elaborate this point, it was found that 2063 observations out of 5059 observations from the sample have R&D expenditure equal to zero, indicating no recognition of innovation when using R&D expenditure as an innovation proxy, while our text-based index can recognize the innovation effort within these observations. For ease of interpretation, the text-based index was standardized to have a mean of 0 and a standard deviation of 1. In addition, the textual analysis method had recently gained popularity and is used by many researchers when conducting empirical research (Chen et al. 2019; Gentzkow et al. 2019; Hanley and Hoberg 2019).

Bellstam et al. (2021) claim that the text-based innovation index strongly correlates with valuable patents. As a robustness check, we replaced the text-based innovation index with an alternative measure of innovation and re-run the regression. We constructed another innovation measure called 'patent' to measure the quantity of innovation productivity. We started by counting the number of patents for each firm at year t. However, the method of patent count is subject to a truncation bias (Trajtenberg et al. 2001). This is because there is an average of two years lag between patent application and its actual grant. Thus, the patent that has been applied in the last two years (e.g., 2005 and 2006 in the database in this sample) may still be under application process and may not appear in the database. Therefore, we tackled this problem by following Trajtenberg et al. (2001), we divided each firm's number of patents by the average number of patents of the same technological cohort for the same year to construct the innovation variable 'patent'. We then took the logarithm of the patent for our analyses. Lastly, the patent measure was winsorized at both upper 99th and lower 1st percentiles to remove any potential impact from outliers.

4.3. Descriptive Statistic

Table 1 shows the descriptive statistics of the variables used in this study. The mean value of the Text-Based Corporate Innovation Index and patent are 0.097 and 0.054, respectively. On average, firms in the sample are large and profitable with the average total assets at $15,377 million. In terms of leverage, the total debt ratio averages 23.9% for the whole sample. The EBITR is EBIT divided by total assets. The average EBITR is 11.7%. We captured growth opportunities by using the ratio of capital expenses to total assets. This ratio averages 23.3% for the sample.

Table 1. Descriptive statistics.

	Mean	Median	Std. Dev	25th	75th
Innovation					
Text-Based Innovation Index	0.097	0.067	0.999	−0.702	0.747
Patent	0.054	0.000	0.367	0.000	0.000
Hostile Takeover Index					
Takeover Index	0.231	0.230	0.104	0.146	0.320
Firm Characteristics					
Total Assets (Million USD)	15,377.28	5161.10	42,855.94	2409.50	13,084.50
Total Debt/Total Assets	0.239	0.229	0.163	0.125	0.331
EBIT/Total Assets	0.117	0.109	0.093	0.067	0.161
Capital Expenses/Total Assets	0.059	0.048	0.045	0.028	0.077
R&D Expense/Total Assets	0.030	0.007	0.048	0.000	0.041
Advertising Expense/Total Assets	0.018	0.000	0.039	0.000	0.020
SG&A Expense/Total Assets	0.233	0.193	0.191	0.087	0.331
Cash Holding/Total Assets	0.112	0.058	0.139	0.020	0.147

Note: This table presents descriptive statistics. The final sample consists of 5059 observations from 583 unique firms from years 1990 to 2010. The hostile takeover index is constructed by Cain et al. (2017) based on the following exogenous factors (1) legal determinants (state laws related to takeovers) (2) macroeconomic factor (capital liquidity) (3) a firm-specific factor that is not subject to firm choice (firm age). A higher value of the index indicates more susceptibility to a hostile takeover. The text-based innovation index is constructed by Bellstam et al. (2021). This table presents variables including text-based innovation index, patent, takeover index, total assets, R&D expense/total assets, total debt/total assets, EBIT/total assets, capital expense/total assets, advertising expense/total assets, SG&A/total assets and cash holding/total assets.

5. Empirical Results

5.1. Analysis of Regression Results

Table 2 shows the baseline regression results where the text-based innovation index is the dependent variable. The takeover index is included as an independent variable along with the control variables. In Model 1, the text-based innovation index carries a negative and significant coefficient at a 1% confidence level, suggesting that a stronger hostile takeover market reduces corporate innovation significantly. In Model 2, we include the control variables and execute the ordinary least square regression. Again, the takeover index carries a negative and significant coefficient at a 1% confidence level. Finally, to show that our results are robust to the estimation method, we also run a random-effects regression in Model 3 and obtain a consistent result.

We estimate the economic significance of the effect of takeover vulnerability as follows. The interquartile range of the takeover index is 0.174. The coefficient of the takeover index in Model 2 is 0.581. So, as takeover susceptibility rises from the 25th to the 75th percentiles, the text-based innovation index falls by 0.174 multiplied by 0.581, which is 0.101. Because the median text-based innovation index is 0.067, a decrease by 0.101 represents a 150% decline in text-based innovation, after controlling for firm-specific characteristics.

The result is in line with most prior studies that find a negative significant relationship between hostile takeover market and firm innovation (Hart and Moore 1990; Aghion and Tirole 1994; Atanassov 2013). Our empirical results provide support for the managerial myopia hypothesis, which states that the rise in hostile takeover threats discourages managers from putting effort in innovation because takeovers result in less job security for managers. Consequently, managers focus on short-term projects at the expense of long-term projects. Managerial effort to innovate is reduced, as managers neglect long-term innovative projects due to fear that they may not be able to reap the benefit of these long-term projects (Hart and Moore 1990; Aghion and Tirole 1994).

Table 2. The effect of the hostile takeover on text-based innovation index as a proxy for corporate innovation.

	(1)	(2)	(3)
	OLS	OLS	Random-Effects
	Text-Based Innovation Index	Text-Based Innovation Index	Text-Based Innovation Index
Takeover Index	−2.080 ***	−0.581 ***	−0.525 **
	(0.131)	(0.215)	(0.236)
Ln (Total Assets)		0.146 ***	0.102 ***
		(0.021)	(0.024)
Total Debt/Total Assets		−0.567 ***	−0.644 ***
		(0.127)	(0.136)
EBIT/Total Assets		0.740 ***	1.145 ***
		(0.250)	(0.218)
Capital Expense/Total Assets		1.278 **	1.122 **
		(0.540)	(0.492)
R&D/Total Assets		3.679 ***	2.813 ***
		(0.751)	(0.728)
Advertising Expense/Total Assets		0.580	0.140
		(0.739)	(0.714)
SG&A Expense/Total Assets		0.094	−0.208
		(0.190)	(0.187)
Cash Holding/Total Assets		1.138 ***	0.755 ***
		(0.192)	(0.181)
Constant	0.578 ***	−1.365 ***	−1.042 ***
	(0.033)	(0.355)	(0.354)
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	5114	5059	5059
R-squared	0.047	0.404	0.553

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$

Note: This table presents ordinary least square and random-effects regressions that link the text-based innovation index and takeover index. The takeover index is constructed by Cain et al. (2017) based on the following exogenous factors (1) legal determinants (state laws related to takeovers) (2) macroeconomic factor (capital liquidity) (3) a firm-specific factor that is not subject to firm choice (firm age). The text-based index is constructed by Bellstam et al. (2021). The signs **, and *** indicate statistical significance at the 5% and 1% level, respectively.

5.2. Robustness Tests

5.2.1. Analysis of Regression Results of Alternative Innovation Measure

As a robustness check, we replace the text-based innovation index with the patent variable. Exploiting insight from Trajtenberg et al. (2001), we construct the variable "patent" by dividing each firm's number of patents by the average number of patents of the same technological cohort for the same year. Table 3 shows the regression results. In Model 1, we use the patent as the dependent variable. The independent variable of interest is the text-based innovation index. The coefficient of the text-based innovation index is positive and significant, suggesting that firms with high text-based innovation index have adopted a higher number of patents. In Models 2, 3, and 4, the patent is regressed on the takeover index. The coefficients are negative and significant coefficient at a 1% confidence level, implying that a reduction in hostile takeover market is associated with an increase in firm innovation. Thus, the negative association between hostile takeover market and firm innovation seems to be robust.

Table 3. The effect of the hostile takeover on the patent as a proxy for corporate innovation.

	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	Random-Effects
	Patent	Patent	Patent	Patent
Text-based innovation index	0.010 **			
	(0.005)			
Takeover Index		−0.103 **	−0.184 ***	−0.184 ***
		(0.049)	(0.068)	(0.068)
Ln (Total Assets)			−0.012 *	−0.012 *
			(0.007)	(0.007)
Total Debt/Total Assets			0.014	0.014
			(0.048)	(0.048)
EBIT/Total Assets			0.090	0.090
			(0.084)	(0.084)
Capital Expense/Total Assets			−0.345 ***	−0.345 ***
			(0.127)	(0.127)
R&D/Total Assets			0.267	0.267
			(0.242)	(0.242)
Advertising Expense/Total Assets			0.003	0.003
			(0.228)	(0.228)
SG&A Expense/Total Assets			−0.001	−0.001
			(0.055)	(0.055)
Cash Holding/Total Assets			−0.028	−0.028
			(0.085)	(0.085)
Constant	0.054 ***	0.078 ***	0.020	0.020
	(0.005)	(0.013)	(0.107)	(0.107)
Year Fixed Effects			YES	YES
Industry Fixed Effects			YES	YES
Observations	5114	5114	5059	5059
R-squared	0.001	0.001	0.065	0.166

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: This table presents ordinary least square and random-effects regressions that link the patent and the takeover index. The takeover index is constructed by Cain et al. (2017) based on the following exogenous factors (1) legal determinants (state laws related to takeovers) (2) macroeconomic factor (capital liquidity) (3) a firm-specific factor that is not subject to firm choice (firm age). The text-based index is constructed by Bellstam et al. (2021). The signs *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

5.2.2. Exploring Endogeneity

As Aghion et al. (2005) pointed out, the degree of takeover vulnerability changes as a result of successful innovation, which changes the competitive pressure to innovate. This may give rise to endogeneity problems. In addition, unobserved heterogeneity such as firm and manager attributes are possible sources of endogeneity (Coles and Li 2020). To alleviate endogeneity concerns, we execute two instrumental variables (IV) analyses. The purpose of running an instrumental variables test is to ensure that our result is not the consequence of possible measurement error, unobservable characteristics omitted in the model, or reverse causality. The two instrumental variables are (i) the earliest year takeover index and (ii) the industry-median takeover index.

The first instrumental variable used is the earliest year hostile takeover index. We identify the earliest year in which each firm appears in the sample. Then, we employ the takeover index in the earliest year as the instrument. The idea is that the takeover index in the earliest year could not have resulted from risk-taking innovation projects in any of the subsequent years, thereby mitigating reverse causality. This instrument is highly exogenous and unlikely to be related to firm innovation because it comes from another time period (the earliest year instead of year i for each firm). Therefore, if we find that the takeover market in the earliest year can explain firm innovation in the subsequent years,

then the direction of causality is much more likely to run from the takeover market to firm innovation than vice versa. The results of the two-stage least square (2SLS) regression analysis are shown in Table 4. Model 1 is the first-stage regression, where the dependent variable is the takeover index. The coefficient of the takeover index in the earliest year is positive and significant, indicating that the takeover index in the earliest year significantly explains the subsequent takeover market, consistent with our expectations. Model 2 is the second-stage regression, where the dependent variable is the text-based innovation index. The coefficient of takeover index instrumented from the first stage is negative and significant at a 1% confidence level, suggesting that a more active takeover market leads to a decline in firm innovation. In Models 3 and 4, we replace the text-based innovation index with the patent variable. Again, the coefficients of the takeover index instrumented from the first stage are negative and significant, mirroring the results obtained earlier. The instrumental variables analysis, which is substantially less vulnerable to endogeneity, confirms that our results are more likely to show causality, rather than merely an association.

To further ensure that our results are robust, we execute the second instrumental variable. We utilize the industry-median takeover index. Although firm-level innovation might influence the takeover threat of an individual firm, it is unlikely to be related to industry-level takeover threats. Managers in each given firm can influence their own firm's policies on innovation and impact on firm exposure to takeover threat but they probably have little, if any, influence on other firms' takeover threat in the industry. This is why the industry-median takeover index should serve as a valid instrumental variable. A similar technique based on industry structure is employed by various studies such as John and Knyazeva (2006). Table 5 shows the results of the two-stage regressions. Model 1 shows the first-stage regression. As expected, the coefficient of the industry-median takeover index is positive and significant at a 1% confidence level, indicating that the industry-median takeover market significantly explains the firm-level takeover market. In Model 2, we replace the takeover index with the predicted takeover index from the first-stage regression. The coefficient of the predicted takeover index is negative and significant at a 1% confidence level corroborating our previous results. The interesting point to take note of is that the coefficient of the instrumented takeover index from the second stage is -3.051 which is much larger than -0.581, the coefficient of the takeover index from OLS regression in Table 2 Model 2. This suggests that there might be bias in the OLS estimate of the takeover index coefficient. In Models 3 and 4, we replace the text-based innovation index with the patent variable. Again, the coefficients of the takeover index instrumented from the first stage are negative and significant, consistent with our previous results. Because the results remain consistent even after accounting for endogeneity, it appears that our results are robust and our conclusion is not confounded by endogeneity.

Finally, it could be argued that our results support the managerial myopia hypothesis. A possible explanation is that in the presence of an incomplete contract, the hostile bidder who obtains control of a company might remove the manager and might not uphold the implicit contract, resulting in shareholders reneging on implicit contracts and expropriating rent from managers. As a result, managers may anticipate that takeover increases the probability of ex post expropriation, which leads to managers making a suboptimal investment decision. Therefore, managers put less effort in innovation as they are not certain they will be on the job long enough to reap the benefits of these long-term innovative projects (Hart and Moore 1990; Aghion and Tirole 1994).

Table 4. Instrumental-variable analysis using takeover index in the earliest year in the sample.

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	Random-Effects	OLS	Random-Effects
	First Stage	Second Stage	Second Stage	Second Stage	Second Stage
	Takeover Index	Text-Based Innovation Index	Text-Based Innovation Index	Patent	Patent
Takeover Index (Earliest Year)	0.864 ***				
	(0.034)				
Takeover Index (Instrumented)		−0.769 ***	−0.926 ***	−0.284 ***	−0.241 ***
		(0.277)	(0.295)	(0.095)	(0.084)
Ln (Total Assets)	0.006 ***	0.150 ***	0.109 ***	−0.011	−0.013
	(0.002)	(0.022)	(0.025)	(0.010)	(0.008)
Total Debt/Total Assets	−0.006	−0.567 ***	−0.643 ***	−0.003	0.016
	(0.010)	(0.127)	(0.136)	(0.060)	(0.058)
EBIT/Total Assets	0.004	0.741 ***	1.151 ***	0.102	0.076
	(0.017)	(0.251)	(0.218)	(0.110)	(0.109)
Capital Expenditures/Total Assets	−0.107 ***	1.233 **	1.045 **	−0.365 **	−0.402 **
	(0.035)	(0.541)	(0.493)	(0.176)	(0.191)
R&D/Total Assets	0.021	3.620 ***	2.780 ***	0.505 *	0.614 *
	(0.050)	(0.749)	(0.725)	(0.292)	(0.333)
Advertising Expense/Total Assets	0.065	0.586	0.211	−0.040	−0.032
	(0.055)	(0.731)	(0.703)	(0.251)	(0.226)
SG&A Expense/Total Assets	−0.005	0.104	−0.207	0.018	0.001
	(0.017)	(0.194)	(0.186)	(0.066)	(0.062)
Cash Holding/Total Assets	−0.024 *	1.117 ***	0.722 ***	−0.083	−0.082
	(0.014)	(0.194)	(0.183)	(0.082)	(0.080)
Constant	−0.026	−1.351 ***	−1.009 ***	−0.001	0.004
	(0.024)	(0.357)	(0.351)	(0.134)	(0.135)
Year Fixed Effects	YES	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES	YES
Observations	5059	5059	5059	2828	2828
R-Squared	0.774	0.404	0.553	0.072	0.155

Robust standard errors in parentheses
*** $p < 0.01$,
** $p < 0.05$, * $p < 0.1$

Note: This table presents first-stage IV regression. We employ the takeover index as an independent variable of interest while positioning the takeover index in the earliest year as a dependent variable. This table also presents the second-stage IV regression where we employ the term "Takeover index (Instrumented)" which is predicted in the first-stage IV analysis as an independent variable of interest while positioning text-based innovation index and patent as dependent variables. The takeover index is constructed by Cain et al. (2017). The text-based index is constructed by Bellstam et al. (2021). The signs *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Table 5. Instrumental-variable analysis using industry-median takeover index.

	(1) OLS	(2) OLS	(3) Random-Effects	(4) OLS	(5) Random-Effects
	First Stage	Second Stage	Second Stage	Second Stage	Second Stage
	Takeover Index	Text-Based Innovation Index	Text-Based Innovation Index	Patent	Patent
Industry-Median Takeover Index	0.584 ***				
	(0.057)				
Takeover Index (Instrumented)		−3.051 ***	−2.450 ***	−0.560 **	−0.560 **
		(0.683)	(0.663)	(0.227)	(0.227)
Ln (Total Assets)	0.020 ***	0.196 ***	0.141 ***	−0.005	−0.005
	(0.004)	(0.025)	(0.027)	(0.008)	(0.008)
Total debt/Total Assets	−0.006	−0.571 ***	−0.645 ***	0.013	0.013
	(0.020)	(0.127)	(0.135)	(0.048)	(0.048)
EBIT/Total Assets	0.006	0.754 ***	1.161 ***	0.092	0.092
	(0.035)	(0.252)	(0.220)	(0.084)	(0.084)
Capital Expense/Total Assets	−0.203 **	0.686	0.607	−0.435 ***	−0.435 ***
	(0.079)	(0.554)	(0.514)	(0.139)	(0.139)
R&D/Total Assets	−0.324 ***	2.906 ***	2.159 ***	0.149	0.149
	(0.085)	(0.805)	(0.773)	(0.248)	(0.248)
Advertising Expense/Total Assets	0.022	0.653	0.266	0.014	0.014
	(0.115)	(0.742)	(0.726)	(0.231)	(0.231)
SG&A Expense/Total Assets	0.048 *	0.220	−0.113	0.018	0.018
	(0.026)	(0.195)	(0.193)	(0.056)	(0.056)
Cash Holding/Total Assets	−0.093 ***	0.856 ***	0.502 ***	−0.071	−0.071
	(0.022)	(0.208)	(0.192)	(0.090)	(0.090)
Constant	−0.031	−1.180 ***	−0.880 **	0.048	0.048
	(0.049)	(0.350)	(0.345)	(0.107)	(0.107)
Year Fixed Effects	YES	YES	YES	YES	YES
Industry Fixed Effects	YES	YES	YES	YES	YES
Observations	5059	5059	5059	5059	5059
R-Squared	0.357	0.405	0.555	0.064	0.145

Robust standard errors in parentheses
*** $p < 0.01$,
** $p < 0.05$, * $p < 0.1$

Note: This table presents first-stage IV regression where we employ industry-median takeover index as an independent variable of interest while positioning takeover index as a dependent variable. This table also presents the second-stage IV regression where we employ the term "Takeover index (Instrumented)" which is predicted in the first-stage IV analysis as an independent variable of interest while positioning text-based innovation index and patent as dependent variables. The takeover index is constructed by Cain et al. (2017). The text-based index is constructed by Bellstam et al. (2021). The signs *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

6. Conclusions

Prior research has recognized that corporate innovation requires managerial effort and attention to engage with a long and complicated process (Younge and Tong 2018). Although the manager may be well aware of the benefit of the innovation, managers may neglect to engage in innovative projects due to the huge amount of effort required. Therefore, factors that induce managerial innovative effort and corporate innovation are of great importance to ensure optimal benefit to firms and shareholders.

This study investigates how hostile takeover threats influence managerial innovation effort. In this study, we used the takeover index constructed by Cain et al. (2017) and the text-based innovation index constructed by Bellstam et al. (2021). The data on firm characteristics were gathered from COMPUSTAT. In total, we have 5059 observations from 583 unique firms from 1990 to 2010. We performed several additional robustness tests, including alternative innovation measure and two alternative instrumental variable analyses were executed, and all showed that our results are robust. Our empirical results show that the hostile takeover threats have negative statistically significant effects on managerial effort to innovate. Our results are in favor of the managerial myopia hypothesis, where the pressure created by takeover threats provides an incentive for managers to focus on current earnings at the expense of long-term projects that are more valuable and innovative (Shleifer and Summers 1988). Our results complement those in the literature such as Chemmanur and Tian (2018) and Atanassov (2013).

Our study makes three contributions to the current literature. First, unlike other studies that focus on conflicting views between takeover threats and the outcome of observable innovation (Jensen and Meckling 1976; Jensen and Murphy 1990; Manso 2011), we link takeover threats to managerial effort to innovate proxied by text-based innovation index which includes both observable and unobservable innovation outcomes. Second, we exploit a novel measure of hostile takeover threat index. This overcomes the limitation of endogeneity that arises from measuring takeover defenses at the firm level (Core et al. 2006). Finally, our novel measure of takeover index is considered as superior measure of hostile takeover threats as it only takes account of hostile takeover activities.

Such findings can be beneficial to various stakeholders. First, efforts by policy makers to enforce proper anti-takeover measures are desirable to create a good external environment for firm innovation. Second, managers and shareholders need to realize that, when managers are properly protected from takeover threats, shareholders' benefit is enhanced as managers put more effort into innovation projects. Thus, firms should implement proper anti-takeover measures such as Poison Pill and Golden Parachute to insulate managers from takeover threats. Lastly, managers and shareholders of a firm that relies heavily on R&D should carefully consider the location of their firm to ensure that the firm is operating in a supportive environment that encourage innovation.

Given the results of our study, further work should be encouraged to shed light on how other less extreme corporate governance mechanisms such as board composition influence managerial innovation efforts. Furthermore, our results suggest that future studies can focus on how hostile takeover threats affect other unobservable factors that could be viewed as ingredients for generating innovation such as talent acquisition and employee skills.

Finally, there are at least two important limitations in this paper (i) although our findings suggest that takeover threats discourage managerial effort to innovate which leads to both observable and unobservable innovation outcomes, we are unable to specifically test whether managerial effort to invest leads to unobservable innovation outcome due to data limitation (ii), data on text-based innovation index are only available up to 2010. However, despite this limitation, to date, there is no other widely available measure that can better capture managerial effort in innovation.

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Notes

[1] Previous studies on takeover and innovation often rely on the patent count and R&D expenditures as proxies for firm innovation (Baranchuk et al. 2014; Mazouz and Zhao 2019).

[2] The notion that takeover defenses deter takeovers has surprisingly little empirical support. The available evidence indicates that there is no meaningful relation between takeover frequencies and the G-index (Core et al. 2006; Bates et al. 2008; Sokolyk 2011). G-index represents counts of the number of takeover defenses a firm has and is often used as a summary measure of the firm's protection from unsolicited takeover bids.

[3] In addition, Cain et al. (2017) examined 65 years of takeover laws and found no association between state antitakeover laws and variation in takeover markets.

[4] Another example is shareholders might gain from firing workers whom they insured against uncertain ability and who turned out to be inept.

[5] William Act is 1968 amendment to SEC Act of 1934 to regulate tender offers: requires SEC filings, disclosure, and waiting periods. Applies equally to all firms in all states. Business Combination, also known as "freeze-out" statutes, prohibits bidders from engaging in a business combination with a target for a pre-set period upon the bidder's acquisition of 20% or more of the target's equity unless the purchase is pre-approved by the target's board or a specified percentage of disinterested target stockholders (Cain et al. 2017).

[6] Staggered board is when board is classified into three equal groups. Only one group is elected each year. Thus, bidder cannot obtain control of the target immediately after obtaining a majority of shares. Fair price is to waive super-majority provisions if bidder pays all stockholders the same price. This is to prevent two-tier takeover offers. Poison pill is rights to preferred stock issued to shareholders. Rights can be exercised after a tender offer or the accumulation of a large block of shares by an outside party. In flip-over plans exercised rights can be used to purchase stock in the bidder on favorable terms. In flip-in plans exercised rights are repurchased by the issuing firm at a substantial premium. The bidding firm or large shareholder is excluded from the repurchase. This makes hostile tender offer prohibitively expensive.

[7] The study includes Williams Act in 1968, business combination laws, fair price provisions, control share acquisition statutes, control share cash-out statutes, poison pill cases and statutes, expanded constituency laws, disgorgement provisions, anti-greenmail laws, golden parachute restrictions, tin/silver parachute blessings, assumption of labor contract laws, and the Revlon, Unocal, and Blasius standards of review (Cain et al. 2017).

[8] Patent count and R&D expenditure are unable to accurately capture firm innovation (Bellstam et al. 2021). Although patent count can measure innovation output concerning intellectual properties, one of the serious problems has been an inability to measure other aspects of innovation output that are not patentable such as improved products, improved production processes, and new marketing methods (Moser 2012; Hall et al. 2014). While R&D expenditure measures observable innovation input, it is not able to capture the quality of innovation output (Aghion et al. 2013).

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