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Product market competition and corporate investment decisions

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Abstract

Purpose – The study aims to examine the association between product market competition and corporate investment decisions on, particularly, risk-taking and investment efficiency. Existing theoretical studies on whether product market competition mitigates or exacerbates agency problems are inconclusive. Prior research generally finds that competition constrains management opportunism in reporting operating performance. However, the association between product market competition and managerial investment decisions has largely been unexplored.

Design/methodology/approach – The primary measure of product market competition is the Herfindahl–Hirschman Index. The authors use regression analysis to examine the association between corporate risk-taking and over-investment of free cash flow (FCF) (as dependent variables) and product market competition (as an independent variable).

Findings – Using firm-year observations from 1990 to 2010, the authors find that competition encourages managers to invest in risky investment. They also find that competition disciplines management on its use of FCFs. Overall, their results provide support for the disciplining role of product market competition in management investment decisions. The results are robust after they control for shareholder activism and executive compensations.

Originality/value – The paper contributes to the literature by providing evidence of the disciplining role of product market competition in management investment decisions. First, the results suggest that competition encourages managers to invest in risky investment. One potential explanation for the results is that competition reduces opportunities for resource diversion for management personal benefits and, in turn, decreases management risk aversion. Another explanation is that competition forces management to take more risks for the long-term survival of the company. Second, the results indicate that competition disciplines management on its use of FCFs. Although firms in highly competitive industries make investment decisions that are less conservative, they tend to avoid suboptimal investment decisions, such as over-investment of FCF, compared to their counterparts.

Keywords Over-investment, Product market competition

Paper type Research paper

Introduction

Research in corporate governance has shown a positive impact of various mechanisms, such as board monitoring (Fama, 1980; Fama and Jensen, 1983) and the market for corporate control through a takeover or a proxy fight (Shleifer and Vishny, 1986), on mitigating the agency conflicts between managers and shareholders. However, despite the importance of these mechanisms to align managers' interests with shareholders', some companies still do not expropriate shareholders' welfare in the absence of these

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governance mechanisms (Chhaochharia *et al.*, 2012). Clearly, managers in these companies are motivated by forces other than the traditional corporate governance mechanisms. One such force, as suggested by Chhaochharia *et al.* (2012), is product market competition.

Consistent with the view that product market competition is a market force that mitigates agency problems (Hart, 1983; Schmidt, 1997; Baggs and Bettignies, 2007)[1], prior research generally finds that competition constrains management opportunism in reporting *operating* performance (Balakrishnan and Cohen, 2011; Marciukaityte and Park, 2009; Laksmana and Yang, 2012)[2]. However, the association between product market competition and managerial *investment* decisions has largely been unexplored. Because theoretical studies on whether product market competition mitigates or exacerbates agency problems are inconclusive, the association between competition and corporate investment decisions is an empirical question worth investigating.

The goal of this paper is to examine the association between product market competition and corporate investment decisions on, particularly, risk-taking and investment efficiency. Our study should provide implications for regulators setting policies for firms in certain industries and for external auditors assessing clients' overall audit risk. We begin by examining the association between product market competition and corporate risk-taking. On the one hand, prior research suggests a positive association between product market competition and corporate risk-taking. John *et al.* (2008), for example, show that better investor protection mitigates managers' taking of private benefits and reduces the forgoing of risky positive net present value (NPV) projects. When investor protection is weak, managers have more opportunities to divert firm resources for private benefit and are more likely to be risk averse because investing in risky projects could reduce the private benefits. If product market competition mitigates agency conflicts (Hart, 1983; Schmidt, 1997; Baggs and Bettignies, 2007) and suppresses opportunities for expropriation by corporate insiders, firms in highly competitive industries are more likely to invest in risky but value-enhancing projects.

On the other hand, prior research suggests a negative association between product market competition and corporate risk-taking. Competition allows firms to evaluate managers' performance relative to their competitors (Vickers, 1995; Meyer and Vickers, 1997) and intensifies managers' career concerns (Feriozzi, 2011). DeFond and Park (1999) find that the frequency of chief executive officer (CEO) turnover is higher in more competitive industries than in less competitive industries. Managers in less competitive industries where only small numbers of companies operate lack peer comparisons. When they invest in high-risk, high-return projects, they can blame bad results for exogenous shocks more easily than those in highly competitive industries, resulting in a negative association between product market competition and corporate risk-taking. In this case, product market competition will have a discouraging effect on corporate risk-taking. These competing hypotheses motivate our empirical investigation. Bargeron *et al.* (2010) examine and find that risk-taking significantly declined for US firms after the Sarbanes–Oxley Act of 2002 (SOX), suggesting that SOX discourages corporate risk-taking. Following Bargeron *et al.* (2010), we measure corporate risk-taking by a firm's capital and R&D expenditures, standard deviation of stock returns and holdings of cash and cash equivalents.

Next, we examine whether product market competition affects investment efficiency. We measure corporate investment efficiency by the extent of a firm's over-investment of

free cash flow (FCF). According to the FCF hypothesis (Jensen, 1986), managers acting in their self-interest will expand their firms beyond the optimal size. As a firm becomes larger, more opportunities exist for managers to indulge their desires for pecuniary and non-pecuniary (power and prestige) benefits. Unless properly controlled, such behaviors can lead to inefficient expenditures and investment in potentially negative NPV projects. Richardson (2006) finds that over-investment is concentrated in firms with the highest (positive) level of FCF and that certain governance structures can mitigate the over-investment. We extend this line of research by examining the moderating effect of product market competition on the association between positive FCF and over-investment. If product market competition mitigates agency problems, we expect that product market competition will weaken the strength of the association between positive FCF and over-investment. For firms with positive FCF, greater product market competition will be associated with lower level of over-investment.

Our primary measure of product market competition is the Herfindahl–Hirschman Index (HHI). The HHI is a widely used measure for market concentration, calculated as the sum of squares of market shares in the industry (defined by the four-digit Standard Industrial Classification [SIC] codes). A high value of HHI suggests low product market competition or high industry concentration. We examine the association between product market competition and corporate risk-taking and the moderating effect of product market competition on the association between over-investment and positive FCF. We control for the variables that prior research finds to be correlated with measures of corporate risk-taking behavior (Bargeron *et al.*, 2010) and over-investment of cash flow (Richardson, 2006).

Using firm-year observations from 1990 to 2010, we find that product market competition is positively associated with corporate risk-taking. Specifically, our results show that firms in more competitive industries (i.e. low HHI) is associated with greater capital and R&D expenditures and standard deviation of stock returns, suggesting that firms in high competition industries take more risks than those in low competition industries. In addition, our results indicate that for firms with positive FCF, being in more competitive industries (i.e. low HHI) is associated with lower degree of over-investment of cash flow, suggesting that product market competition serves as a governance mechanism that weakens the relationship between positive FCF and over-investment. The results are robust after controlling for corporate governance mechanism (or shareholder activism proxied by G-index) and executive compensation.

Our paper contributes to the literature by providing evidence of the disciplining role of product market competition in management investment decisions. First, our results suggest that competition encourages managers to invest in risky investment. One potential explanation for our results is that competition reduces opportunities for resource diversion for management personal benefits and, in turn, decreases management risk aversion. Another explanation is that competition forces management to take more risks for the long-term survival of the company. Second, our results indicate that competition disciplines management on the use of FCFs. Although firms in highly competitive industries exhibit higher level of corporate risk-taking activities, they are more inclined to avoid suboptimal investment decisions, such as over-investment of FCF, compared to their counterparts. Overall, our results provide support for the corporate governance function of product market competition in corporate investment.

Our study should be of interests to regulators and practitioners. Our results suggest that policymakers consider the disciplining role of product market competition when setting industry-specific regulatory policies. Our results also provide implications for independent auditors when assessing clients' overall audit risk. Understanding the client company and the environment in which the company operates, including the product market competition, is an important step in audit planning. Knowledge about the client's product market competition will help auditors better assess audit risk. For example, external auditors of firms in highly competitive industries are more likely to find that these firms involve in more risk-taking activities, which, in turn, could affect the level of audit risk.

The remainder of this paper is organized as follows. The next section presents the hypothesis development. The following section describes the methodology, including the product market competition and FCF measures and the regression models. The last three sections summarize the sample selection and data sources, discuss the regression results and additional analyses and provide conclusions.

Prior literature and hypothesis development

Research in product market competition provides mixed findings on whether competition in product market reduces agency cost. Some studies suggest that increased product market competition exacerbates managerial slack and agency problems (Horn *et al.*, 1994; Schfarstein, 1988), whereas others suggest that such competition is a market force that aligns managers' interests with shareholders' (Hart, 1983; Schmidt, 1997; Baggs and Bettignies, 2007). Prior studies examining product market competition and corporate financial reporting generally find a positive impact of competition on financial reporting quality, supporting the view that competition reduces agency costs. For example, Dhaliwal *et al.* (2012) document that intense product market competition leads to more timely recognition of economic losses in accounting income; Laksmana and Yang (2012) show that both accrual-based and real activity-based earnings manipulations are more prevalent among firms in less competitive industries than those in highly competitive industries; Balakrishnan and Cohen (2011) find that the level of product market competition acts as a disciplining force constraining managers from misreporting; and Cheng *et al.* (2013) find a consistent and significant positive relation between product market competition and various earnings attributes.

We extend prior literature in product market competition by examining the association between competition and corporate investment decisions, including risk-taking and investment efficiency. Prior research suggests a positive association between product market competition and corporate risk-taking. Chhaochharia *et al.* (2012) find that firms in more competitive industries are more efficient and less likely to be associated with financial fraud than those in less competitive industries, suggesting that product market competition protect investors against expropriation by corporate insiders.

Using a cross-country panel and a US-only sample, John *et al.* (2008) show that the quality of investor protection is positively related to corporate risk-taking. When investor protection is weak, insiders have greater amount of corporate resources to divert for private benefits. As such, management of firms with poor investor protection is more likely to avoid investment in risky projects because these projects could reduce its private benefits. In contrast, management of firms with better investor protection is

more likely to make risky value-enhancing investment choices because the investor protection mechanism suppresses the opportunity for insiders to expropriate corporate resources. Taken together, this strand of research suggests that product market competition, as an investor protection mechanism, provide managers with incentives to take on risky projects.

Although the prediction of a positive association between product market competition and corporate investment risk choices is appealing, a negative association is also plausible. Hirshleifer and Thakor (1992) show that when a manager's future wages depend on perceptions about his/her ability, this compensation scheme will induce the manager to seek safety, avoiding investment with risky projects. The incentive for managers to build reputations can cause excessive conservatism in investment policy. Product market competition makes the outcomes of managerial decisions observable and reduces the information asymmetry between managers and shareholders. Thus, to build and protect their reputations, managers in highly competitive industries may be more likely to seek safe projects than those in less competitive industries.

Similarly, competition allows firms to evaluate managers' performance relative to their competitors (Vickers, 1995; Meyer and Vickers, 1997) and intensifies managers' career concerns (Feriozzi, 2011). Thus, product market competition may have a discouraging effect on corporate risk-taking. In contrast, because managers in less competitive industries where small numbers of companies operate in similar environment can blame bad results for exogenous shocks, they may be more likely to invest in high-risk, high-return projects than those in highly competitive industries (DeFond and Park, 1999). The discussion above suggests a negative association between product market competition and corporate risk-taking. Given the two competing arguments on the association between product market competition and corporate risk-taking, we present the following hypothesis, stated in the alternative form:

H1. Product market competition is associated with corporate risk-taking.

According to the FCF hypothesis (Jensen, 1986), managers have incentives to expand their firms beyond the optimal size. As the firms become larger, managers will have more resources under their control. The conflict between managers and shareholders is especially severe when firms have FCF, defined as cash flow in excess of what is required to fund all projects that have positive NPV. Richardson (2006) shows that managers have to be monitored to prevent them from investing FCF at below the cost of capital or wasting it on organizational inefficiencies. He finds that firms with the highest (positive) level of FCF are likely to over-invest and that certain governance structures can mitigate the over-investment. Jensen (1986) argues that external capital markets in general, and debt markets in particular, provide monitoring mechanisms to discipline managerial use of funds and prevent over-investment.

Product market competition is another powerful mechanism, ensuring that management does not waste resources. If managers waste large amounts of resources in a competitive market environment, their firms will be unable to compete and may become insolvent. In other words, more intense competition subjects a firm to a higher risk of liquidation (Hou and Robinson, 2006). Because of career concerns, managers in more competitive industries are less likely to waste corporate resources and make

suboptimal investment decisions. Baggs and Bettignies (2007) show that competition increases the importance firms place on quality improvement, cost reduction, contractual incentives and employee effort, consistent with the argument that product market competition serves to align the interests of managers and shareholders.

Moreover, product market competition induces efficient managerial behavior because when competition exists, shareholders can observe performance in other firms and use this information as a benchmark to evaluate managers. For example, examining the association between management turnover and market structure in the newspaper industry, Fee and Hadlock (2000) find that management turnover rates in competitive markets are higher than those in monopolistic markets and that turnover rates increase as firms underperform their competitors. The availability of peers for performance evaluation reduces the asymmetric information problem and the costs of incentive alignment between shareholders and managers. Chhaochharia *et al.* (2012) find that firms in less competitive industries have to resort to more formal governance mechanisms such as having less anti-takeover provisions, greater pay for performance sensitivity and greater managerial equity ownership. To the extent that product market competition alleviates agency problems, it may reduce investment inefficiency, such as over-investment of FCF. As over-investment is concentrated in firms with positive FCF (Richardson, 2006), our second hypothesis focuses on the negative moderating effect of product market competition on the association between positive FCF and over-investment. Our second hypothesis, stated in the alternative form, is as follows:

H2. Product market competition is negatively associated with over-investment of positive FCF.

Research design

Product market competition measures

Our proxy for product market competition is HHI, a widely used measure of market concentration. HHI is inversely related to product market competition. The index is calculated as the sum of squares of market shares in a four-digit SIC industry. Using the sales data from COMPUSTAT, we measure a firm's market share as the ratio of the firm's sales to the sum of sales of all firms in the industry. HHI ranges from 0 to 1, moving from a large number of very small firms (i.e. high competition industry) to a monopolistic producer (i.e. low competition industry).

The use of industry concentration measures constructed with COMPUSTAT data is not without criticism. First, COMPUSTAT covers only public firms (Hay and Morris, 1991). The exclusion of private firms from the sample could provide an inaccurate measure of concentration in an industry. However, as larger firms are usually publicly owned and these firms significantly determine the value of HHI, the bias due to the exclusion of private, and usually small, firms may be minimal. Second, Ali *et al.* (2009) suggest that industries with very high HHI computed using COMPUSTAT data may be declining, as they consist of only a few large firms. Ali *et al.* (2009) use concentration measures calculated by the US Census Bureau in the *Census of Manufactures* publications, which cover all public and private firms. However, the US Census only covers the manufacturing sector (i.e. firms with two-digit SIC codes between 20 and 39) and is only available every five years[3]. Thus, for generalizability of findings, our main analysis is based on HHI constructed with COMPUSTAT annual data that include a wide spectrum of industries. In our main analysis, we exclude industries with less than

five firms to avoid the potential bias due to industry decline. Furthermore, as a robustness check, we remove industries with less than 10, 15 and 20 firms. Our results, discussed in the subsequent section, do not seem to be driven by declining industries.

FCF and over-investment measures

For our analysis of investment efficiency, we follow the framework in Richardson (2006) to construct the FCF and over-investment measures. This framework allows the simultaneous estimation of FCF and over-investment. It uses accounting information to measure the constructs of FCF and over-investment, thereby allowing a more powerful test on a large sample as opposed to the use of small samples in prior studies[4].

First, total investment expenditure (I_{Total}) is calculated as the sum of capital expenditure (CAPEX), acquisitions (ACQUISITION) and research and development expenditures (R&D) less proceeds from the sale of property, plant and equipment (SALE_PPE):

$$I_{TOTAL} = CAPEX + ACQUISITION + R\&D - SALE\_PPE \quad (1)$$

I_{TOTAL} can then be decomposed into two main components:

(1) required investment expenditure to maintain assets in place, $I_{MAINTENANCE}$, proxied by amortization and depreciation; and

(2) investment expenditure on new projects, I_{NEW}.

I_{NEW} is further split into expected investment expenditure in new positive NPV projects, I^{*}_{NEW}, and abnormal investment, I^{s}_{NEW}. This breakdown is shown below:

$$I_{TOTAL} = I_{MAINTENANCE} + I_{NEW}, \quad (2a)$$

$$\text{where } I_{NEW,t} = I^{*}_{NEW,t} + I^{s}_{NEW,t} \quad (2b)$$

All investment expenditure variables are scaled by average total assets. The investment expectation model in equation (2b) is estimated using the following regression specification:

$$I_{NEW,t} = \beta_0 + \beta_1 V/P_{t-1} + \beta_2 LEVERAGE_{t-1} + \beta_3 CASH_{t-1} + \beta_4 SIZE_{t-1} + \beta_5 STOCK\_RETURN_{t-1} + \beta_6 I_{NEW,t-1} + \Sigma YR + \Sigma IND + \varepsilon, \quad (3)$$

where V/P is a measure of growth opportunities. It is calculated as the ratio of the value of the firm (V_{AIP}) to the market of equity. V_{AIP} is estimated as $V_{AIP} = (1 - \alpha r)BV + \alpha(1 + r)X - \alpha rd$, where $\alpha = (\omega/(1 + r - \omega))$, r = 12 per cent and $\omega = 0.62$. ω is the abnormal earnings persistence parameter from the Ohlson (1995) framework, BV is the book value of common equity, d is annual dividends and X is operating income after depreciation. LEVERAGE is the sum of the book value of short-term and long-term debt deflated by the sum of the book value of total debt and the book value of equity. CASH is the balance of cash and short-term investments deflated by total assets. SIZE is the log of total assets. STOCK_RETURN is the stock returns for the year, measured as the change in market value of the firm over the year. YR and IND are indicator variables to control for year and industry fixed effects, respectively.

The predicted value from the investment expectation model in equation (3) is I^{*}_{NEW}, and the residual value from the expectation model is I^{s}_{NEW}. I^{s}_{NEW} is our estimate for over-investment (OVERINVEST). It can be either positive or negative. Positive (negative) values correspond to over- (under-) investment.

FCF is cash flow beyond what is necessary to maintain assets in place and to finance expected new investments. To compute FCF, expected new investment I^{*}_{NEW} is subtracted from cash flow generated from assets in place (CF_{AIP}):

$$FCF = CF_{AIP} - I^{*}_{NEW,t} \tag{4}$$

I^{*}_{NEW} is defined earlier. The estimated cash flow generated from assets in place, CF_{AIP}, is computed as follows:

$$CF_{AIP} = CFO - I_{MAINTENANCE} + R\,\&\,D \tag{5}$$

CF_{AIP} is estimated directly from the statement of cash flows by adding R&D expenditure back to operating cash flows. The accounting standards require companies to expense R&D expenditure in the period it is incurred. As a result, R&D is included as a deduction to operating cash flows (CFO). R&D expenditure, however, is a discretionary spending and needs to be added back to CFO. Similarly, maintenance expenditure ($I_{MAINTENANCE}$) is deducted, as it is not a discretionary use of funds.

Models

We test the first hypothesis using the following model:

$$\begin{aligned} RISK\_TAKING_t = {} & \beta_0 + \beta_1 HHI_t + \beta_2 SOX_t + \beta_3 INDEX\_RETURN_t + \beta_4 GDP\_GROWTH_t \\ & + \beta_5 EBIT_{t-1} + \beta_6 MB_{t-1} + \beta_7 DEBT_{t-1} + \beta_8 G - Index_t + \beta_9 BONUS_t \\ & + \beta_{10} EXOPTION_t + \beta_{11} UNEXOPTION_t + \beta_{12} OWNED_t + \varepsilon \end{aligned} \tag{6}$$

Following Bargeron *et al.* (2010), we measure corporate risk-taking behavior (RISK_TAKING) by a firm's capital expenditure (CAPEX) and R&D expenditure (RDEX), the sum of CAPEX and RDEX (INVEST), the standard deviation of stock returns (SD_Return) and holdings of cash and cash equivalents (CASH). Although higher level of CAPEX, RDEX, INVEST and SD_Return suggests higher degree of corporate risk-taking, higher value of CASH suggests a preference for low risk, non-operating investment. All of the dependent variables, except for SD_Return, are scaled by average assets.

Our variable of interest is HHI, the proxy of product market competition. If the coefficient estimate of HHI is statistically significant and negative (positive), one can conclude that product market competition is positively (negatively) associated with risk-taking activities. The control variables we include in equation (6) are consistent with those used in prior studies (Cohen *et al.*, 2007; Bargeron *et al.*, 2010). SOX is a dummy variable that equals to 1 for the years 2002 onward, and 0 otherwise. Cohen *et al.* (2007) document that risky investments declined significantly after SOX of 2002, even after controlling for the effects of the economic environment and compensation structure. Similarly, Bargeron *et al.* (2010) find that several measures of risk-taking declined significantly for US versus non-US firms after SOX. They conjecture that the reduction in risk-taking resulted from the increasing liability imposed on directors and

executives for violation of security laws and the requirement of testing and disclosing the adequacy of internal controls. Thus, we expect SOX to be negatively associated with the risk-taking variables.

INDEX_RETURN is the return on the S&P 500 index, and GDP_GROWTH is the per cent change in the real gross domestic product from the previous year. We include both INDEX_RETURN and GDP_GROWTH, as corporate investment should be directly related to the health of the overall economy. EBIT is the earnings before interest and taxes divided by average assets. MB is market-to-book ratio, calculated as the year-end market value of the assets divided by the year-end book value of the assets. We include EBIT and MB to control for profits and growth opportunity, respectively. We expect CAPEX, RDEX and INVEST to be associated with EBIT and MB, as firms with greater profitability and more growth opportunities are likely to make more investment in R&D and long-term assets. DEBT is the average debt divided by the average market value of assets. We expect SD_Return to be directly related to DEBT, as firms with more debt have higher equity risk.

The G-index is constructed from data compiled by the Investor Responsibility Research Center, as described in Gompers *et al.* (2003). A firm's score is based on the number of shareholder rights-decreasing provisions a firm has. The index ranges from a feasible low of 0 to a high of 24; a high score is associated with weak shareholder rights. John *et al.* (2008) show that better investor protection reduces the forgoing of positive NPV risky projects. Thus, we include G-index to control for shareholder activism. BONUS is the annual bonus compensation as a proportion of total compensation received by the CEO. EXOPTION is exercisable options defined as the number of unexercised options that the CEO held at year-end that were vested, scaled by total outstanding shares of the firm. UNEXOPTION is unexercisable options defined as the number of unexercised options (excluding option grants in the current period) that the CEO held at the year-end that have not vested, scaled by the total outstanding shares of the firm. OWNED is the number of restricted stocks that have not vested and the aggregate number of shares held by the CEO at the year-end (excluding stock options), scaled by total outstanding shares of the firm. Equity incentives motivate managers to undertake more risky but positive NPV and, hence, value-increasing projects (Rajgopal and Shevlin, 2002). Thus, we include BONUS, EXOPTION, UNEXOPTION and OWNED to control for executive equity incentives.

We test the second hypothesis using the following model:

$$\begin{aligned} \text{OVERINVEST}_t = {} & \beta_0 + \beta_1 \text{Neg\_FCF}_t + \beta_2 \text{Neg\_FCF}_t * \text{HHI}_t + \beta_3 \text{Pos\_FCF}_t \\ & + \beta_4 \text{Pos\_FCF}_t * \text{HHI}_t + \beta_5 \text{HHI}_t + \beta_6 \text{G} - \text{Index}_t + \beta_7 \text{BONUS}_t \\ & + \beta_8 \text{EXOPTION}_t + \beta_9 \text{UNEXOPTION}_t + \beta_{10} \text{OWNED}_t + \varepsilon \end{aligned} \tag{7}$$

OVERINVEST (I^s_{NEW}) is the residual from the regression model in equation (3). It is an estimate of over-investment. Neg_FCF (Pos_FCF) is equal to FCF for values of FCF less (greater) than zero, and zero otherwise. FCF is free cash flow, computed and defined in equation (4). Having both Neg_FCF and Pos_FCF in the regression allows the relation between over-investment and FCF to be asymmetric.

Richardson (2006) finds that over-investment is concentrated in firms with positive FCF. Based on our second hypothesis, we expect a negative moderating effect of product market competition on the association between positive FCF and over-investment. We expect that product market competition, as a governance mechanism to discipline managers, will decrease the strength of the association between positive FCF and over-investment. As a higher (lower) value of HHI suggests a less (more) competitive product market, the expected sign of the interactive variable, Pos_FCF*HHI, is positive, consistent with the negative moderating effect of product market competition. Holding the value of Pos_FCF constant, we expect that firms in more competitive industries (i.e. lower value of HHI) are associated with lower over-investment than those in less competitive industries (i.e. higher value of HHI).

The rest of the variables are previously defined in equation (6). Table I provides detailed variable definitions. We outline the data and present descriptive statistics in the next section.

Data and sample selection

Our initial sample consists of firms in non-regulated industries available in the COMPUSTAT/Research Insight database from 1990 to 2010. We deleted observations from four-digit SIC industries with less than five firms because observations with a very high value of HHI are likely from declining industries (Ali *et al.*, 2009, p. 3,865)[5]. We performed two regression analyses: corporate risk-taking and investment efficiency. For the risk-taking regressions, the final sample contains 187,460 firm-years with complete data in 398 four-digit SIC industries. For the investment efficiency regressions, the final sample size is 40,632 firm-years with complete data in 338 four-digit SIC industries. For both set of analyses, our sample size significantly drops when we included G-index and the executive compensation variables in the regression models. We present the regression results estimated without (Tables IV and VIII) and with G-index and the compensation variables (Tables V and IX).

Results

Tables II and III present the descriptive statistics and correlation matrix for the risk-taking sample, respectively. On average, our sample firms invest approximately 11 per cent of total assets annually, including 5.95 per cent in capital expenditure and 4.84 per cent in R&D. The average amount of cash and short-term investment at the end of year is 16.57 per cent of the total assets. As seen in Table III, CASH is highly correlated with RDEX and INVEST in both Spearman and Pearson correlations, indicating that firms with a larger amount of cash also have more RDEX and INVEST. MB is highly correlated with EBIT, indicating that firms with better financial performances also have higher market-to-book ratios.

Table IV reports the results of estimating equation (6) without G-index and the executive compensation variables (i.e. BONUS, EXOPTION, UNEXOPTION and OWNED). Each panel contains the results for regressing each of the five risk-taking variables on HHI and the control variables. The coefficient estimates of our variable of interest, HHI, are negative and statistically significant at the 1 per cent level in all regressions. The results indicate that firms in more competitive industries (i.e. lower HHI) tend to take more risks as measured by CAPEX, RDEX[6], INVEST and SD_Return than those in less competitive industries (i.e. higher HHI). Management of

Variable	Definition
Dependent variables	
CAPEX	The capital expenditures for the year divided by the average assets for the year
RDEX	The R&D expenditures for the year divided by the average assets for the year; this variable is set to zero if the R&D expenditure is missing
INVEST	The sum of CAPEX and R&D
CASH	The cash and short-term investment at the end of year divided by average assets
SD_RETURN	Standard deviation for the returns for the year
I^{ϵ} NEW	An over-investment measure; It is the residual from estimating the following model: $I_{NEW,\,t} = \beta_0 + \beta_1\,V/P_{t-1} + \beta_2 LEVERAGE_{t-1} + \beta_3 CASH_{t-1} + \beta_4 SIZE_{t-1} + \beta_5 STOCK\_RETURN_{t-1} + \beta_6\,I_{NEW,\,t-1} + \Sigma YR + \Sigma IND + \epsilon$, where V/P is a measure of growth opportunities. It is calculated as the ratio of the value of the firm (V_{AIP}) to the market of equity. $V_{AIP} = (1 - \alpha r)BV + \alpha(1 + r)X - \alpha rd$, where $\alpha = (\omega/(1 + r - \omega))$ and r = 12% and $\omega = 0.62$. BV is the book value of common equity, d is annual dividends, and X is operating income after depreciation. LEVERAGE is the sum of the book value of short term and long term debt deflated by the sum of the book value of total debt and equity. CASH is the balance of cash and short term investments deflated by total assets. SIZE is the log of total assets. STOCK_RETURN is the stock returns for the year, measured as the change in market value of the firm over the year. YR and IND are indicator variables to control for year and industry fixed effects
Independent variables	
HHI	The HHI is calculated as the sum of squares of market shares in the industry = $\Sigma\,[s/S]^2$, where s is the firm's sales, and S is the sum of sales for all firms in the industry (defined by the two-digit SIC code)
CR4	Four-firm concentration ratio, calculated as the total market share of the four firms with the largest market share for each industry (classified by the four-digit SIC codes)
SOX	A dummy variable that equals to 1 for the years 2002 onward, and 0 otherwise
INDEX_RETURN	The return on the S&P 500 index for the year
GDP_GROWTH	The percent change in the real gross domestic product from the previous year
EBIT	The earnings before interest and taxes divided by average assets
MB	The year-end market value of the assets divided by the year-end book value of the assets
DEBT	The average debt divided by the average market value of assets
FCF	FCF is cash flow beyond what is necessary to maintain assets in place and to finance expected new investments
Neg_FCF	Neg_FCF is equal to FCF for values of FCF less than zero, and zero otherwise
Pos_FCF	Pos_FCF is equal to FCF for values of FCF greater than zero, and zero otherwise
G-index	The G-index is constructed from data compiled by the Investor Responsibility Research Center, as described in Gompers *et al.* (2003). A firm's score is based on the number of shareholder rights-decreasing provisions a firm has. The index ranges from a feasible low of 0 to a high of 24; a high score is associated with weak shareholder rights
BONUS	The annual bonus compensation as a proportion of total compensation received by the CEO

Table I.
Variable definitions

(*continued*)

Variable	Definition
EXOPTION	Exercisable options defined as the number of unexercised options that the executives held at the year-end that were vested scaled by total outstanding shares of the firm
UNEXOPTION	Unexercisable options defined as the number of unexercised options (excluding option grants in the current period) that the executives held at the year-end that have not vested, scaled by total outstanding shares of the firm
OWNED	The number of restricted stocks that have not vested and the aggregate number of shares held by the executives at the year-end (excluding stock options), scaled by total outstanding shares of the firm

Table I.

Variable	Mean	SD	10%	25%	Median	75%	90%
CAPEX	0.0595	0.0891	0.0000	0.0048	0.0305	0.0728	0.1458
RDEX	0.0484	0.1213	0.0000	0.0000	0.0000	0.0286	0.1550
INVEST	0.1102	0.1597	0.0000	0.0094	0.0565	0.1378	0.2804
STD_RET	0.0993	0.1028	0.0197	0.0197	0.0675	0.1464	0.2310
CASH	0.1657	0.2435	0.0000	0.0064	0.0530	0.2179	0.5283
HHI	0.2006	0.1576	0.0518	0.0843	0.1550	0.2689	0.4060
SOX	0.3886	0.4874	0.0000	0.0000	0.0000	1.0000	1.0000
Index Return	9.0568	18.7182	−13.0427	−1.5393	12.7828	26.3066	31.0084
GDP Growth	4.9039	2.0718	3.3000	4.2000	5.7000	6.3000	6.4000
EBIT	−0.8840	1.4632	−3.3300	−3.3300	−0.0073	0.0896	0.1591
MB	−4.5140	13.2643	−24.1400	−24.1400	1.1450	2.5516	5.2478
DEBT	0.2207	0.3344	0.0000	0.0000	0.0930	0.3398	0.5617

Note: See Table I for variable definitions

Table II.
Descriptive statistics for the risk-taking sample

firms in more competitive industries, however, are likely to hold more cash than those in less competitive industries.

Table V reports the results of estimating equation (6). The results, in general, are consistent with those shown in Table IV, even after controlling for the corporate governance (G-index) and executive compensation variables. The coefficient estimates of HHI are negative and statistically significant, except for that of the SD_Return, suggesting that product market competition encourages corporate risk-taking through investment in current and new projects[7]. Our conclusions remain unchanged when including (two-digit SIC) industry, firm and year fixed effects. Overall, *H1* is supported.

The coefficients of most of the control variables in Table V are statistically significant. Two notable results follow. First, consistent with Bargeron *et al.* (2010), the coefficient estimates of SOX are negative and statistically significant in Panels A through D, indicating that corporate risk-taking decreased after the passage of SOX[8]. The degree of cash holdings (CASH) increased compared to that of the pre-SOX period, suggesting a shift to lower risk investment. Second, we find that better investor protection (i.e. lower value of G-index) is associated with greater degree of risk-taking. This result, along with that of the product market competition (HHI), suggests that governance mechanisms are effective in encouraging corporate risk-taking and investment.

Table III.
Correlation matrix for the risk-taking sample

Variable	CAPEX	RDEX	INVEST	CASH	SD_Return	HHI	SOX	Index_Return	GDP_Growth	EBIT	MB	DEBT
CAPEX		0.1005	0.7796	0.2857	0.2223	−0.1019	−0.0794	0.0293	0.0812	0.4019	0.3513	0.2645
		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
RDEX	−0.0316		0.5796	0.4747	0.2820	0.0639	0.0277	−0.0159	0.0226	0.0622	0.2881	−0.0387
	< 0.0001		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
INVEST	0.5873	0.7715		0.4996	0.3006	−0.0964	−0.0076	0.0036	0.0610	0.2623	0.4163	0.1427
	< 0.0001	< 0.0001		< 0.0001	< 0.0001	< 0.0001	0.0010	0.1192	< 0.0001	< 0.0001	< 0.0001	< 0.0001
CASH	0.0238	0.4217	0.3394		0.3442	0.0113	0.1335	−0.0279	−0.0136	0.2171	0.3985	−0.0151
	< 0.0001	0.0017	< 0.0001		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
SD_Return	0.0237	0.1647	0.1334	0.1882		0.0287	−0.0782	−0.0018	−0.0191	0.3180	0.4767	0.1788
	< 0.0001	< 0.0001	< 0.0001	< 0.0001		< 0.0001	< 0.0001	0.4350	< 0.0001	< 0.0001	< 0.0001	< 0.0001
HHI	−0.0984	−0.0301	−0.0822	−0.0145	0.0059		−0.0170	−0.0050	0.0105	0.0061	0.0121	−0.0322
	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0113		< 0.0001	0.0305	< 0.0001	0.0083	< 0.0001	< 0.0001
SOX	−0.0467	0.0397	0.0110	0.0938	−0.0830	−0.0049		−0.2446	−0.2699	0.0468	0.0672	0.0376
	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	0.0349		< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Index_Return	0.0195	−0.0135	−0.0005	−0.0031	−0.0292	−0.0083	−0.2697		0.0874	−0.0459	−0.0406	−0.0609
	< 0.0001	< 0.0001	0.8237	0.1745	< 0.0001	0.0003	< 0.0001		< 0.0001	< 0.0001	< 0.0001	< 0.0001
GDP_Growth	0.0704	0.0052	0.0429	−0.0051	−0.0459	−0.0032	−0.3942	0.1575		−0.0722	0.0259	−0.0688
	< 0.0001	0.0240	< 0.0001	0.0268	< 0.0001	0.1661	< 0.0001	< 0.0001		< 0.0001	< 0.0001	< 0.0001
EBIT	0.1221	−0.0182	0.0445	0.0747	0.3079	−0.0140	0.1143	−0.0796	−0.1102		0.4685	0.4903
	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		< 0.0001	< 0.0001
MB	0.1416	0.1239	0.1745	0.1605	0.3690	0.0165	0.1006	−0.0558	−0.0445	0.5768		0.1966
	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001		< 0.0001
DEBT	0.0438	−0.0066	0.0271	−0.1193	−0.0028	−0.0095	0.0528	−0.0377	−0.0363	0.2601	0.0940	
	< 0.0001	0.0040	< 0.0001	< 0.0001	0.2288	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	

Note: See Table I for variable definitions. The upper (lower) diagonal of the matrix reports Spearman (Pearson) correlations

Table IV. Ordinary least squares (OLS) regressions of risk-taking on HHI

Variable	Panel A CAPEX Coefficient (*t*-statistics)	Panel B RDEX Coefficient (*t*-statistics)	Panel C INVEST Coefficient (*t*-statistics)	Panel D SD_Return Coefficient (*t*-statistics)	Panel E CASH Coefficient (*t*-statistics)
Intercept	0.0363*** (23.60)	0.0429** (20.92)	0.0780*** (27.51)	0.1443*** (82.58)	0.2575*** (60.25)
HHI	−0.0099*** (−7.57)	−0.0542*** (−31.06)	−0.0656*** (−27.20)	−0.0137*** (−9.22)	−0.0557*** (−15.32)
SOX	−0.0095*** (−21.91)	0.0086*** (14.92)	0.0014* (1.71)	−0.0344*** (−69.80)	0.0457*** (37.92)
INDEX_RETURN	0.00005*** (4.50)	−0.00003** (−2.04)	0.00002 (1.11)	−0.00019*** (−16.48)	0.00034*** (11.76)
GDP_GROWTH	0.0022*** (21.59)	−0.0003*** (−2.04)	0.0020*** (10.75)	−0.0040*** (−34.95)	0.0028*** (9.78)
EBIT	0.0044*** (27.10)	−0.0088*** (−40.26)	−0.0063*** (−21.08)	0.0123*** (66.34)	0.0091*** (20.06)
MB	0.0008*** (45.33)	0.0014*** (61.30)	0.0023*** (72.78)	0.0021*** (108.53)	0.0022*** (45.49)
DEBT	0.0030*** (5.15)	0.0144*** (18.45)	0.0229*** (21.23)	−0.0166*** (−24.96)	−0.0835*** (−51.24)
N	187,460	187,460	187,460	187,460	187,460
F-statistics	566.38	703.89	411.01	667.44	474.23
Adjusted R^2 (%)	18.45	21.95	14.09	21.05	15.92

Notes: See Table I for variable definitions; ***, ** and *represent significant level at 1, 5 and 10% (two-tailed), respectively

Table V.
OLS regressions of risk-taking on HHI controlling for corporate governance and compensation variables

Variable	Panel A CAPEX Coefficient (*t*-statistics)	Panel B RDEX Coefficient (*t*-statistics)	Panel C INVEST Coefficient (*t*-statistics)	Panel D SD_Return Coefficient (*t*-statistics)	Panel E CASH Coefficient (*t*-statistics)
Intercept	0.0783*** (54.01)	0.0496*** (31.94)	0.1270*** (60.81)	0.1766*** (111.32)	0.2154*** (52.93)
HHI	−0.0517*** (−20.31)	−0.0139*** (−5.11)	−0.0658*** (−17.94)	0.0005 (0.17)	−0.0527*** (−7.38)
SOX	−0.0221*** (−23.25)	−0.0032*** (−3.09)	−0.0245*** (−17.91)	−0.0142*** (−13.66)	0.0475*** (17.78)
INDEX_RETURN	0.00003 (1.54)	0.0001** (2.49)	0.0001*** (2.83)	−0.0004*** (−19.26)	0.0004*** (6.41)
GDP_GROWTH	0.0022*** (11.62)	0.0009*** (4.39)	0.0031*** (11.39)	−0.0080*** (−38.78)	0.0015*** (2.75)
EBIT	0.0066*** (11.27)	−0.0005 (−0.87)	0.0051*** (6.04)	0.0022*** (3.48)	0.0165*** (10.01)
MB	0.0005*** (7.37)	0.0011*** (16.37)	0.0017*** (17.70)	0.0012*** (16.34)	0.0032*** (17.43)
DEBT	−0.0014 (−0.73)	−0.0616*** (−30.84)	−0.0618*** (−22.97)	−0.0192*** (−9.38)	−0.3145*** (−60.05)
G-index	−0.0005*** (−5.91)	−0.0008*** (−8.16)	−0.0013*** (−10.37)	−0.0026*** (−27.64)	−0.0052*** (−21.56)
BONUS	−0.0001*** (−4.78)	−0.0003*** (−13.31)	−0.0004*** (−13.19)	−0.0003*** (−10.42)	−0.0007*** (−11.62)
EXOPTION	−0.0019*** (−5.73)	0.0040*** (11.32)	0.0020*** (4.19)	0.0017*** (4.86)	0.0070*** (7.68)
UNEXOPTION	−0.0014*** (−3.81)	0.0066*** (16.82)	0.0053*** (10.11)	0.0095*** (23.80)	0.0170*** (16.68)
OWNED	0.0007*** (7.15)	−0.0013*** (−12.61)	−0.0005*** (−3.82)	−0.00004 (−0.40)	−0.0004 (−1.29)
N	27,270	27,270	27,270	27,270	27,270
F-statistics	199.50	201.20	243.82	375.67	483.58
Adjusted R^2 (%)	8.03	8.10	9.65	14.15	17.52

Notes: See Table I for variable definitions; ***and **represent significant level at 1 and 5% (two-tailed), respectively

Tables VI and VII provide the descriptive statistics and correlation matrix for the over-investment of FCF sample, respectively. OVERINVEST or I^{s}_{NEW} is our measure of over-investment estimated from equation (3). Both OVERINVEST and FCF have negative medians, indicating that more than 50 per cent of the firm-year observations under-invest and have a negative amount of FCF. As seen in Panel B of Tables VI and VII, both Neg_FCF and Pos_FCF are positively correlated with OVERINVEST (significant at the 0.01 level or better)[9]. Next, we turn to multivariate analysis to examine the moderating effect of HHI on the association between Pos_FCF and OVERINVEST.

Panel A of Table VIII serves as a base model examining the association between over-investment and FCF. The coefficient estimate of Neg_FCF is 0.2056, and the coefficient estimate of Pos_FCF is 0.8226, significantly different from zero at the 1 per cent level. Consistent with Richardson's (2006) key results, our results show that over-investment is concentrated in firms with positive FCF. Panel B of Table VIII reports the results of examining whether product market competition moderates the association between over-investment and FCF. The coefficient estimate of our variable of interest, Pos_FCF*HHI, is positive and statistically significant at the 1 per cent level. Holding the value of Pos_FCF constant, firms with a lower value of HHI (i.e. more competitive market) will have a lower value of OVERINVEST than firms with a higher value of HHI (i.e. less competitive market). Therefore, we conclude that, when firms have positive FCF, product market competition is negatively associated with over-investment. Our result supports *H2*[10].

Variable	Mean	SD	10%	25%	Median	75%	90%
OVERINVEST	−0.0290	0.2410	−0.2619	−0.1441	−0.0330	0.0733	0.1837
FCF	−0.1142	0.2697	−0.4963	−0.2534	−0.0657	0.0688	0.1761
Neg_FCF	−0.1634	0.2193	−0.4963	−0.2534	−0.0657	0.0000	0.0000
Pos_FCF	0.0492	0.0927	0.0000	0.0000	0.0000	0.0688	0.1761
HHI	0.2142	0.1549	0.0635	0.1057	0.1718	0.2813	0.4094

Table VI. Descriptive statistics for the over-investment sample

Variable	OVERINVEST	FCF	Neg_FCF	Pos_FCF	HHI
OVERINVEST		0.5724	0.5441	0.5565	−0.0429
		< 0.0001	*< 0.0001*	*< 0.0001*	*< 0.0001*
FCF	0.3879		0.9725	0.8718	0.0243
	< 0.0001		*< 0.0001*	*< 0.0001*	*< 0.0001*
Neg_FCF	0.3121	0.9489		0.8324	0.0330
	< 0.0001	*< 0.0001*		*< 0.0001*	*< 0.0001*
Pos_FCF	0.3903	0.6651	0.3954		−0.0061
	< 0.0001	*< 0.0001*	*< 0.0001*		*0.2157*
HHI	−0.0337	0.0156	0.0293	−0.0238	
	< 0.0001	*0.0017*	*< 0.0001*	*< 0.0001*	

Notes: See Table I for variable definitions; the upper (lower) diagonal of the matrix reports Spearman (Pearson) correlations

Table VII. Correlation matrix for the over-investment sample

Variable	Panel A Coefficient (*t*-statistics)	Panel B Coefficient (*t*-statistics)
Intercept	−0.0359 *(−21.57)***	−0.0206 *(−7.18)***
Neg_FCF	0.2056 *(38.29)***	0.2000 *(22.23)***
Neg_FCF*HHI		0.0343 *(0.98)*
Pos_FCF	0.8226 *(64.75)***	0.7031 *(33.20)***
Pos_FCF*HHI		**0.5805 *(6.89)*****
HHI		−0.0701 *(−6.46)***
N	40,632	40,632
F-statistics	4,515.30	1,833.82
Adjusted R^2 (%)	18.18	18.40

Table VIII.
OLS regression of over-investment on FCF and HHI

Notes: See Table I for variable definitions; ***represent significant level at 1% (two-tailed), respectively

We further examine the robustness of our result presented in Panel B of Table VIII. Specifically, Panel A of Table IX replicates the regression result in Panel B of Table VIII, but controls for the quality of corporate governance (or the level of shareholder activism), proxied by G-index. The coefficient estimate of Pos_FCF*HHI remains positively and significant. The coefficient estimate of G-index is positive and significant, suggesting that weak shareholder rights are associated with over-investment. Similarly, when we replicate the regression result in Panel B of Table VIII and include control variables for executive compensation, including BONUS, EXOPTION, UNEXOPTION and OWNED, the coefficient estimate of Pos_FCF*HHI remains positively and significant. The coefficient estimates of EXOPTION and OWNED are negative and significant, whereas the coefficient estimate of BONUS is positive and significant,

Variable	Panel A Coefficient (*t*-statistics)	Panel B Coefficient (*t*-statistics)	Panel C Coefficient (*t*-statistics)
Intercept	−0.0227 *(−7.83)***	0.0067 *(1.64)*	0.0068 *(1.61)*
Neg_FCF	0.1964 *(21.77)***	0.4152 *(17.43)***	0.4153 *(17.41)***
Neg_FCF*HHI	0.0325 *(0.93)*	−0.2927 *(−3.57)***	−0.2925 *(−3.56)***
Pos_FCF	0.6942 *(32.67)***	0.5950 *(26.28)***	0.5952 *(26.24)***
Pos_FCF*HHI	**0.5669 *(6.73)*****	**0.1766 *(1.97)****	**0.1766 *(1.97)****
HHI	−0.0704 *(−6.49)***	−0.0161 *(−1.15)*	−0.0161 *(−1.14)*
G-index	0.0018 *(5.01)***		0.0000 *(−0.13)*
BONUS		0.0002 *(2.32)**	0.0002 *(2.32)**
EXOPTION		−0.0019 *(−1.73)**	−0.0019 *(−1.73)**
UNEXOPTION		0.0000 *(0.01)*	0.0000 *(−0.01)*
OWNED		−0.0007 *(−2.85)***	−0.0007 *(−2.85)***
N	40,632	8,759	8,759
F-statistics	1,533.26	483.77	435.34
Adjusted R^2 (%)	18.45	33.16	33.15

Table IX.
OLS regression of over-investment on FCF and HHI controlling for corporate governance and compensation variables

Notes: See Table I for variable definitions; ***, **and *represent significant level at 1, 5 and 10% (two-tailed), respectively

indicating that exercisable options and management stock ownership are negatively associated with over-investment and that bonus is positively associated with over-investment. Consistent with prior studies (Rajgopal and Shevlin, 2002), we find that equity incentives reduce agency costs. Panel C of Table IX presents the results of estimating equation (7). Our main finding that product market competition moderates the association between over-investment and positive FCF is robust after controlling for corporate governance mechanism and executive compensation.

We conduct several robustness checks. First, we estimate the regressions using an alternative measure of product market competition, four-firm industry concentration ratio (CR4). Our results are qualitatively unchanged. Second, instead of removing observations due to missing R&D data, we set observations with missing R&D expenditure equal to zero and re-run the estimation models and the main regressions. Our results remain unchanged, suggesting that the results are unlikely driven by sample bias. Third, to test whether the results are driven by particular industries, we classify firms into high and low technology groups and examine the distribution of HHI for the two groups. We find that the two groups have similar distributions of HHI, suggesting that low HHI (i.e. high competition) is not concentrated in high-tech industries. We also re-estimate the main regressions with a dummy variable for high-tech industries. The results remain unchanged with the presence of the high-tech dummy. Finally, to address the potential cross-sectional dependencies in our panel data, we follow the approach in Fama and MacBeth (1973) and estimate yearly regressions to replicate the results in Tables V and IX. The means of the yearly coefficient estimates and the *t*-values based on the standard errors of the time-series of the yearly estimate support the results in our main analysis.

Conclusions

We examine the association between product market competition and management investment decisions on, particularly, corporate risk-taking and investment efficiency. We present two competing hypotheses on the association between competition and risk-taking. On the one hand, greater competition provides greater shareholder protection by limiting the diversion of corporate resources by corporate insiders. As a result, when shareholder protection is high, management is more likely to invest in risky projects. On the other hand, competition discourages risk-taking because competition makes the outcomes of managerial decisions more observable, facilitating the evaluation of firm performance relative to competitors. With regard to the association between competition and investment efficiency, we hypothesize that competition has a negative moderating effect on the association between positive FCF and over-investment. We expect that competition alleviates agency problems by disciplining managers to reduce over-investment in positive FCF.

Our results reveal that firms in more competitive industries take more risks as measured by capital expenditure, R&D expenditure and standard deviation of stock returns than those in less competitive industries. The former, however, is more likely to have greater holdings of cash (i.e. low risk investment) than the latter. We further find that competition moderates the association between over-investment and positive FCF, suggesting that firms in highly competitive industries are less likely to waste resources in organizational inefficiencies. Taken together, our results provide insights that

product market competition serves as a governance tool for corporate investment decisions.

Notes

1. The opposing view suggests that increased product market competition exacerbates managerial slack and agency conflicts (e.g., Horn *et al.*, 1994; Schfarstein, 1988).
2. For example, focusing on the role of product market competition in affecting earnings restatements, Balakrishnan and Cohen (2011) find that the frequencies of earnings restatement in a particular industry are constrained by competition.
3. The most recent census data were for 1997 (published in 2001) and 2002 (published in 2006).
4. See Richardson (2006) for more discussion.
5. The conclusions remain unchanged when industries with less than 10, 15 and 20 firms are removed from the sample.
6. As a significant number of firm-years have missing R&D data and RDEX is set to zero, we re-run the RDEX regression for only the subsample with positive R&D expense. Our conclusion remains unchanged when firm-years with missing R&D data are excluded.
7. Results are similar when an alternative proxy for product market competition, four-firm concentration ratio (CR4), is used in the regression models. CR4 is defined as the total market share of the four largest firms in a four-digit SIC industry.
8. However, in Table IV, SOX is significantly and positively associated with RDEX and INVEST. This result is inconsistent to the result presented in Table V. The inconsistency is due to the use of different samples in Tables IV and V. The majority of observations in the regressions in Table IV is from non-ExecuComp firms. These firms are, on average, smaller and less profitable than ExecuComp firms (i.e. sample firms in Table V).
9. Neg_FCF is equal to FCF for values of FCF less than zero, and zero otherwise. Neg_FCF and OVERINVEST are positively correlated in Panel B, Table VII, indicating that increases in the value of Neg_FCF are associated with increases in the extent of OVERINVESTMENT. Therefore, a lower value of Neg_FCF (i.e. larger negative value) is associated with lower over-investment than a higher value of Neg_FCF (i.e. smaller negative value).
10. To check the multicollinearity for Table VII where both Neg_FCF and Pos_FCF are included in the same regressions, we test the variance inflation factors (VIF) and find that all VIFs in Panels A and B are less than 4, suggesting that there is no severe multicollinearity problem in the models.

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