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CEO career experience and firm innovativeness: Considering the moderating effect of independent directors

總經理職業經驗對企業創新之影響：考量獨立董事之調和效果

Heng-Yu Chang
School of Business, Chang Gung University; Administration Center, Chang Gung Memorial Hospital

Cheng-Yu Lee[1]
Department of Industrial Management and Information, Southern Taiwan University of Science and Technology

Ying-Jiuan Wong
Department of Business Administration, National Kaohsiung University of Science and Technology

Abstract: This study investigates the relationship between managerial attributes and firm innovativeness by examining the direct effect of CEO career variety, and the moderating effects of independent directors by building on the behavioral agency theory and motivation/cognition perspective. Using a sample of Taiwanese high-tech firms in the period 2002~2014, we found that the CEO career variety has a positive effect on firm innovativeness, and the positive moderating effect of board independence can be demonstrated only when independent directors have higher levels of shared expertise with their CEOs. These results reinforce the critical role of CEOs in driving innovation in the companies they lead and shed lights on the importance of the background commonality between CEOs and independent directors.

[1] Corresponding author: Cheng-Yu Lee, Department of Industrial Management and Information, Southern Taiwan University of Science and Technology, No.1, Nantai St., Yongkang Dist., Tainan City 710, Taiwan, R.O.C., Email: cylee@stust.edu.tw
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Keywords: CEO career variety, firm innovativeness, independent director, shared expertise.

摘要：產業環境的更迭與多變，使得提升企業創新能力成為重要的企業營運課題。相關文獻與實務案例均指出總經理對於企業創新有著重要影響，但過去研究仍未能全面指出影響原因，尤其是關於總經理職務特性的影響更為少見。爰此，本研究探討總經理職業經驗對於企業創新的影響，並兼論獨立董事對此關係的調和效果，以填補總經理對與企業創新關係的文獻上的不足。本研究以2002-2014年的臺灣上市科技公司為研究對象，結果發現總經理的職涯多樣性對於企業創新效益有正面的貢獻，而此正向關係因為獨立董事與總經理之間具有共通的職業經歷而得以強化。

關鍵詞：總經理、職涯多樣性、獨立董事、創新

1. Introduction

As more and more inquiries into exploring the importance of firm innovativeness to achieve a competitive advantage, researchers have long sought evidence on the behavioral interpretations on managerial attributes in view of risk concerns and preference propensity in pursuing firm innovativeness (e.g., Barker and Mueller, 2002; Chin *et al*., 2018; Talke *et al*., 2011). Extending from the review of managerial risk-taking studies associated with behavioral agency theory (Hoskisson *et al*., 2017), CEO demographic factors serve as a filter for the situational interpretation on multiple fronts to affect consequent innovativeness (Antia *et al*., 2010; Crossland *et al*., 2014). Individual cumulative career experiences, in particular, could cultivate a more adaptive CEO whose competency in risk-taking within a firm (Karaevli and Hall, 2006). Underpinning a contingency-based view from behavioral research on managerial risk-taking preferences, CEOs are motivated to bear risks above the aspiration level by adaptive abilities, and hence are inclined to demonstrate innovative behavior and to develop appropriate behavioral responses in an intensively competitive product market.

To an extent that CEOs' prior career experiences have a decisive and lasting impact on how they behave and develop the strategy (Crossland *et al*., 2014), this

study adopts the composite measure of CEO career experiences as the major proxy for CEO demographics, i.e., CEO career variety, in some reasons. First, some psychologists indicate that a person's experience plays a predominant role in regard to individual cognition and motivation compared to other demographic characteristics (e.g., Park *et al*., 1997). These observations suggest that CEOs' experience in career development may serve as the foundation for their managerial preferences for firm innovativeness. Second, the awareness, perception, and interpretation derived from the past experiences unravel risk propensity toward individual decisions (Diacon and Hasseldine, 2007; Zuckerman, 1994). Therefore, a CEO's career variety is highly associated with individual prior job experiences (Crossland *et al*., 2014), and also advance CEOs to suffer less from bounded rationality and limited capabilities in thoroughly analyzing information (Hambrick, 2007). The first goal of this study is thus to investigate whether firms with diversely experienced CEOs have increased firm innovativeness, with an attempt in response to the call for more research on exploring the influence of CEO career variety (Crossland *et al*., 2014) as well as the determinants of firm innovativeness (Cho *et al*., 2016).

Given that the risk orientation towards firm innovativeness derived from career variety is manageable, agency conflict may take place differently in the presence of board independence in alignment with shareholder interests (Pepper and Gore, 2015). While prior studies have documented that independent directors are highly likely to have stronger reputation incentives than any other type of directors since the direct payments to them are small (e.g., Yermack, 2004), most of the others have found that the higher level of board independence is likely to protect shareholders because of its neutral role in corporate governance (Osma, 2008). However, the efficacy of board independence remains debatable, notwithstanding the increasing percentage of independent directors in a board is viewed to protect shareholders from corporate misconduct (Su and Lee, 2013). For example, independent directors are usually contested against their neutrality due to the lack of corporate and industrial knowledge to properly perform their duties (Nicholson and Kiel, 2007), and some may also cast doubt on the manner of independent directors whose mutual collusion with the CEO in biased decision making since they are less informed but better selected due to social connections (Cavaco *et al*., 2017). Therefore, it is speculated that the

controversial findings of the effect of board independence may be due to the lack of clarity regarding whether independent directors can evaluate the CEO's decision by having background or knowledge with CEOs in common (Hamrick *et al*., 2008).

The discrepant background in prior career experiences would thus likely create asymmetric understanding in the decision-making process and judgment. Particularly, the commonly specialized expertise between the CEO and independent directors may facilitate information assurance and mutual evaluation even the latter is less involved in daily business operations (Adams and Ferreira, 2007). For this reason, shared expertise, defined by the overlap between the CEO and directors' career experience, may entangle the puzzle of the governance role of independent directors (Aguilera *et al*., 2015; Westphal and Bednar, 2005). That is, if independent directors have experience in an industry or functional background similar to that of their CEOs, they may be better able to evaluate the innovation attempts proposed by the CEOs. This study is thus to further explore whether the effect of board independence on the relationship between CEO career experience and firm innovativeness would vary when the shared career experience between CEOs and independent directors is bundled together.

This study adopts data from Taiwan for empirical evidence to examine the CEO career variety on corporate innovative behavior because Taiwan has gradually evolved from under-developed governance mechanism both internally and externally into a stronger investor protection contextual form (Yeh and Woidtke, 2005). Becoming an established economy and industrial fort that provides worldwide electronic parts, Taiwanese setting also offers insights for other emerging markets in connection with firm innovativeness and governance (Kuo and Hung, 2012). By addressing the deficiency in the existing literature on corporate governance linking to technology management, this study makes several contributions to the board literature and innovation theory. First, by applying the theoretical lens of behavioral agency theory, we look at how CEO demographics affect firm innovativeness. Moreover, the findings are likely to contribute to the accuracy of CEO selection for high-tech firms. Second, the probes of the combined effects of board independence and shared expertise between CEOs and independent directors on CEO career variety-firm innovativeness relationship help to advance scholars' knowledge of critical

contextual factors that constrain or promote the managerial influence on firm innovativeness. Third, as an important global factory in producing electronic parts and chips for worldwide use, the data from Taiwanese semiconductor and electronic-optical firms whose analysis and assurance in technological development and sustainability is valuable. The findings gained from this research context should help scholars and practitioners to understand how firms in newly industrialized countries can overcome the innovation dilemmas confronting their organizations.

The remainder of this paper is structured as follows. The next section describes the theoretical background and develops hypotheses. Section three presents the sample and measures. Section four reports the empirical results, and the final two sections provide discussions and conclude with managerial implications and limitations.

2. Literature review and hypothesis development

The process of achieving firm innovativeness is complex and never easy, and the returns from firm innovativeness are also uncertain and somewhat remote in time. Considering the associated risks, uncertainty and cost incurred in firm innovativeness, CEOs are assumed to be hesitant in regard to increasing investments in activities that spur firm innovativeness based on the notion of agency perspective (Jensen and Meckling, 1976). Although the risk-averse agent assumption is broadly adopted by management and economics researchers, people are not always risk-averse in reality (Odean, 1998), suggesting that the agency theory may not be the only theoretical lens researchers need for studying the influence of corporate executives. As Eisenhardt (1989) suggests, using agency theory with complementary theories may be a supplementary way to capture the complex influences of CEOs on corporate behaviors. For example, the behavioral agency model in risk-taking management, proposed by Wiseman and Gomez-Mejia (1998), may provide scholars with an alternative approach to probe into the formation of managerial attitudes towards firm innovativeness. Namely, managerial tendencies can be deduced by observing the demographics of CEOs and boards (Westphal and Zajac, 1995), and the diversified characteristics among top management team have a significant influence on

strategic technology orientation under different contextual conditions (Talke *et al*., 2011). In the following, this study presents rationales and hypotheses behind the relationship between a CEO's career variety and firm innovativeness with configured board contexts.

2.1 The effect of CEO career variety on firm innovativeness

While the agency-based corporate governance models discuss the risk-taking and risk-averse behavior in aligning with shareholder interests, the behavioral agency-based perspective contends that the shareholder interests are most likely aligned if managers are motivated to perform to the best of their abilities and work motivation (Pepper and Gore, 2015). It is thus clear to observe that corporate strategy is conditioned upon CEOs' prior career trajectories and work experiences underpinning risk-taking perspective (Wiseman and Gomez-Mejia, 1998). Standing on this viewpoint, CEOs conduct in firm innovativeness would particularly reveal risk propensity because high returns in aligning with their performance are subsequent to high risks (Hoskisson *et al*., 2017). The variety of CEOs cumulative career experiences would cultivate their adaptability and competency when making strategic actions. In other words, adaptive CEOs are inclined to bear more risks because a variety of career experiences helps whose expertise in establishing structured notions and in managing task-specific knowledge (Karaevli and Hall, 2006).

By infusing behavioral agency theory with motivation and cognitive perspective, the influences of CEO career variety could subtly be further understood on firm innovativeness (Crossland *et al*., 2014). The psychological perspective of motivation contends that people having career variety exhibit higher levels of tolerance to career shifts, and have reported that people with different job experience commonly have personal dispositions favoring experimentation and risk-taking (e.g., Zuckerman, 1994). Conversely, when a person has a lower level of career variety, it implies that such individual tends to behave more rigidly and resists changes. From the cognitive perspective, career variety endows people with a broader range of viewpoints. People with varied and extensive career experiences have a more encompassing cognitive map (Fiske and Taylor, 1991). Based on such theoretical reasoning, CEOs with career variety are more likely to adopt and support various risk initiatives.

George and Zhou (2001) find that high-variety CEOs are more expected to create innovative alternatives than low-variety peers because CEOs with varied experiences are likely to have dispositional preferences for novel change and experimentation. In a similar vein, Crossland *et al*. (2014) investigate the CEOs in Fortune 500 companies and find that CEO career variety has positive effects on strategic and social novelty. Due to the capabilities and opportunities in the process of the career change in an individual's life over time, the array of past experiences frames the psychological significance of CEOs career variety, and CEOs are more willing to take initiatives and engaged in strategic actions. In Karaevli and Hall's (2006) study, the managerial adaptability developing from career variety over the span of a manager's career explains CEOs' risk-taking capability in response to the competitive environment under uncertainties. Underpinned by behavioral agency models, CEOs' strategic choices associated with uncertain outcomes, i.e., firm innovativeness, are attributed to prior career experiences as a reference point that shapes their prospect framing and their risk-taking is thus settled (Hoskisson *et al*., 2017). The process of achieving firm innovativeness is complex, and it is never easy to determine the profitability of consequent outcomes since it always entails risk and uncertainty. That is why CEOs are assumed to be hesitant to pursue firm innovativeness. However, the motivation and cognition of the CEOs who have broader levels of career variety should enable them to better recognize the value of firm innovativeness and display managerial take-taking behavior. On the contrary, the lower level of career variety may reduce CEOs' interest in pursuing firm innovativeness because their limited horizon results in risk aversion. Thus, we propose the following hypothesis:

Hypothesis 1: CEO career variety is positively related to firm innovativeness.

2.2 The configurational effect of shared expertise between CEOs and independent directors on the CEO career variety-innovation relationship

In addition to the direct effect of CEO career variety on firm innovativeness, the composition of boards of directors may moderate CEO career variety-firm innovativeness relationship because the board plays a critical mechanism for

securing shareholder interests. One of the most important shareholder interests is firms achieving sustainable business growth in a competitive environment, which can be pursued by innovations. Making sure that CEOs can develop and invest in appropriate firm innovativeness is thus one of the board of directors' obligations. Among the various components of board structures, board independence is the most widely used assessment of the quality of a board; namely, the more independent directors on a board, the greater the expected ability of a board to effectively monitor. Increased board independence is thus heavily promoted.

However, the investigations into the effects of board independence on corporate innovation or entrepreneurship are less consistent. For example, Deutsch (2007) shows that a higher level of board independence can be negatively associated with the firm's investment in R&D activities, while Kor (2006) finds a non-significant impact of independent directors on corporate innovation strategy. In addition, independent directors are too dependent on tangible and noticeable financial indicators to support innovative activities which create uncertainty and difficulty in seeking predicted financial performance (Brunninge *et al*., 2007). These pieces of evidence not only suggest that board independence does not always result as expected, but also imply that the lack of independent directors' ability to assess and comprehend the information related to corporate innovativeness would have an impact on corporate performance.

As Hambrick *et al*. (2015) suggest, judgments on CEOs' strategic actions require independent directors' considerable experiences, which could come from extensive career paths in the multi-functional industry backgrounds. In other words, directors' unobservable abilities or traits might be critical and impactful in intervening and balancing a firm's course of action on innovativeness (Cavaco *et al*., 2017). Thus, this study argues that the shared expertise between CEOs and independent directors may enhance the understanding underlying managerial decisions, and may calibrate the forbearance of risk-taking ability in alignment with each other's interests.

Although the comprehensive decision making may not be necessarily beneficial to corporate outcomes, having professional backgrounds in common between CEOs and independent directors is often regarded as reducing the information asymmetry between CEOs and independent directors, and hence facilitates validating effective and substantial investment decisions (Simons *et al*.,

1999; Westphal and Zajac, 1995). As organizational theorists argue, similar demographic characteristics of organizational members help to promote shared understanding and thus aid group members in coordinating plans and actions (e.g., Peterson *et al.*, 2000; Pfeffer, 1983). Bednar (2014) suggests that the board's ability to monitor and govern could be influenced by the extent to which independent directors share important background expertise with the CEO, such as functional background or industry experience. In a similar vein, Westphal and Bednar (2005) also verify that the similarity between board members and managers' demographic characteristics increases directors' shared concerns with management.

From the monitoring perspective, shared background assists board members to more effectively comprehend the details and substance of proposed strategy (Tung, 2011); the shared experience and background between independent directors and CEOs should help to enhance mutual cognizance and dialogue on issues of common concern. Independent directors who share similar expertise or experience with their CEOs in a firm are more likely to comprehend the detailed complexity of pursuing firm innovativeness. As independent directors can well understand the efforts that CEOs make towards firm innovativeness, the corresponding executive decisions and actions should be supported; that is, the unfavorable effect of independent directors' engagement on innovation could be eased and the benefits of independent directors for corporate innovation could be enhanced. We, therefore, have reason to believe that independent directors possessing shared expertise with CEOs contributes to realizing the value of board independence to firm innovativeness.

Hypothesis 2: In the presence of higher levels of shared expertise between independent directors and the CEO, a higher level of board independence will strengthen the effect of CEO career variety on firm innovativeness.

3. Methods

3.1 Sample

After 2002, Taiwan's government has embarked upon a series of corporate governance reforms to enhance the quality of governance (Yeh and Chou, 2016).

These reforms not only require publicly listed firms to adopt independent directors to board, but also enable the transparency of top management team and board of directors, such as name, tenure, kinship, education background, working experience and shareholdings. These reform efforts make the variables that this study wants to be measure become feasible. Regarding the industrial sector selection, semiconductor and electronic-optical industries not only contribute significantly to Taiwan's industrial development, but also emphasize on innovation. A sample of Taiwanese publicly listed firms in the semiconductor and electronic-optical sectors thus were selected to test the proposed hypotheses.

The company data were drawn from the Taiwan Economic Journal (TEJ) database, while the data on firm innovativeness were collected from two sources: the TEJ and Taiwanese Intellectual Property Office (TIPO); they reveal different aspects of firm innovativeness. In 2002, the Taiwan Stock Exchange Corporation (TSEC) introduced the concept of independent directors and started to require publicly listed firms to appoint independent directors and disclose boards of directors and top executives' information in their annual reports, including name, tenure, kinship, education background, working experience and shareholdings; thereby, the data on boards of directors become available. As Lin and Chang (2015) suggest, compared with a shorter observation period, longer observation which contains vital information to capture a wide variety of business cycles and economic conditions is better able to generate more generalizable results. To avoid any reverse causality, a time lag between the independent variables (2002-2012) and the dependent variables (2002-2014) was adopted (Lin, 2014). For the above reasons, this study collected the data from 2002 to the end of 2014.

Our data comprised an unbalanced panel due to the inclusion of some firms which were newly listed in our sample observation period and the exclusion of some firms without complete data. Sample observations with incomplete information are mostly due to the lack of patent and R&D information, which will be further discussed in the research limitation section. Finally, a sample of 2397 firm-year observations on 261 firms was used to test our hypotheses.

3.2 Measurements

Dependent variable. According to the literature, measuring "*firm innovativeness*" is challenging, given the different definitions, and does not result

in a consistent approach. As Damanpour (1991) suggests, a firm's innovativeness represents multiple, rather than single, innovations, such as R&D, patents, new product and process developments, organizational restructuring, and so on. Each of the above-mentioned innovative activities can benefit firm performance. However, not all innovative activities can be estimated quantitatively (Cohen *et al*., 2000). This situation made it difficult to have a single archival source to measure firm innovativeness. As Coad and Rao (2008) suggest, no firm can survive without at least some degree of various innovation dimensions; thus, we can still capture a firm's innovativeness by referring to indicators that are available. This may be why prior studies mostly used single archival data such as patent (e.g., Chen *et al*., 2011) or R&D intensity (e.g., Miller, 2011) to evaluate firm innovativeness.

However, using single archival data to measure firm innovativeness may be problematic because innovative activities in different industries could also vary greatly. For example, the use of patents may raise some concerns because not all firms choose to patent their innovations either because of the patentability criteria or because some may resort to secrecy or other means to protect product details (Grilliches, 1990). However, as Cohen *et al*. (2000) suggest, in tandem with other appropriate data, patent data can still provide sufficient information to capture a firm's innovation activities. Coad and Rao (2008) thus argue that the fusing of patent and R&D data can counter the disadvantages of patent data because a firm's investment in R&D can be viewed as input into firm innovativeness. In addition, by reviewing prior studies, Coad and Rao (2008) found that different-sized firms have opposite preferences towards granting patents and investing in R&D, so the integration of patent and R&D data can be a more comprehensive indicator for evaluating firm innovativeness.

In accordance with Coad and Rao (2008), this study measures firm innovativeness by combining the information extracted from patent and R&D data. As Grilliches (1990) suggests, the statistical distributions of patent and R&D data are not identical; the value of R&D intensity is smoother and steadier, whereas the value of a patent count is more random. Coad and Rao (2008) suggest that principal component analysis (PCA), a data reduction technique that aims to explain most of the variance in the data while reducing the number of variables to a few uncorrelated components, is a suitable method to combine the

data obtained from the patent count and R&D intensity. The R&D intensity was measured by total R&D expenses divided by total sales, while the patent count was measured as the number of patents filed by the company in a given year. Before conducting PCA, the values of R&D intensity and patents were first standardized by industry (i.e., semiconductor and electronic-optical), and classified by the Taiwan Stock Exchange Corporation (TSEC) to mitigate the potential industrial effects. The scores derived from PCA were used to measure firm innovativeness. Furthermore, because the effects of independent variables on firm innovativeness may not occur in a timely fashion or may require considerable time to complete the development process, such as a typical patent trial taking approximately 2~3 years, the time-lag effect should be incorporated. This study uses a three-year timeframe (t~t+2) to estimate the subsequent firm innovativeness; that is, the value of firm innovativeness for each year was calculated and summed up to evaluate overall firm innovativeness.

Independent variable. To measure "*CEO career variety (CCV),"* this study collected each CEO's career experience from the firm's annual report. To obtain a complete picture of CEO career variety, this study measured it by combining two indicators: the varieties of a CEO's functional and industry experience. Regarding the diversity of a CEO's functional experience, following Barker and Muller (2002), we coded each CEO's functional experience into six categories: finance/accounting, legal, productions/operations, administration, marketing/ sales, and engineering/R&D. These six functional experience categories are not mutually exclusive; that is, a CEO could not only have functional experience in multiple areas but also have multiple experiences with the same type of functional experience. We thus created six variables for these six functional experience categories. For example, we coded 2 if the CEO has two such work experiences in an area, and 0 otherwise. The Herfindahl index was then used to evaluate the variety of a CEO's functional experience. CEO career $\text{variety}_{(functional)} = 1\text{-HHI} = 1 - \sum S_i^2$, where S_i is the proportion of the i_{th} functional category. The higher value represents the CEO having a more diversified functional experience. Regarding the variety of a CEO's industry experience, Tuggle *et al.*'s (2010) classification: (1) insider, (2) outsider intra-industry and (3) outsider inter-industry, was used to determine whether the CEO had diversified industry experience. The way CEO career $\text{variety}_{(functional)}$ was established and

measured is based on the way we constructed CEO career variety$_{(functional)}$. Considering the time limit of working life, the varieties of a CEO's functional and industry experience may not be easy to ascertain at the same time. The standardized scores of both indicators were then summed to obtain the measure of CEO career variety to better reflect the real conditions. A higher value of this variable denotes a higher level of CEO career variety.

Moderating variables. "*Board independence (BI)*" was measured according to the proportion of independent directors on the board of directors in the given year (Osma, 2008). Regarding the measurement of "*Shared expertise (SE)*", we followed Bednar's (2014) approach in which independent directors' functional or industry backgrounds should be defined first and then calculate the degree of overlap of the CEO and independent directors on the functional and industry backgrounds. The information on independent directors' functional and industry backgrounds can also be found in the annual reports of sample firms. By employing the same classification methods used for evaluating CEO career variety; that is, Barker and Muller's (2002) classification of functional experience and Tuggle *et al*.'s (2010) classification of industrial experience, the numbers of independent directors that shared the same functional background and industry experience with the CEO then were separately counted. The amounts of shared functional and industry experience are definitely influenced by the total number of independent board directors. These two indicators were each divided by the total number of independent directors to control the influence of size effect; they were then aggregated to produce a composite indicator. The higher score signifies the higher level of CEO-independent directors' shared expertise.

Control variables. Some characteristics of a firm have been known to provide explanations for firm innovativeness, such as firm age, firm size, debt-to-equity ratio, current ratio, prior performance, free cash flow, investment opportunities, and patent stock. Regarding the effect of firm age (the number of years from the founding date), several researchers have indicated that firm age is related to innovation behaviors (e.g., Coad *et al.*, 2016). Likewise, large and small firms may excel in innovative activities for different reasons. Thus, it is necessary to control for the potential effect of firm size. In accordance with prior studies (e.g., Lee and Chang, 2014), firm size was measured by the natural

logarithm of total assets (Chang *et al*., 2017). The level of slack resources may impact a firm's innovation activities (Huang and Chen, 2010). Debt-to-equity and current ratios were used as proxies of absorbed and unabsorbed slack. Since prior performance may affect a firm's investment decisions (Diacon and Hasseldine, 2007), this study also controls for this effect. ROA_{t-1} was used as a proxy for prior performance to control for its potential influence on firm innovativeness. Free cash flow has been considered vital to develop innovation and stimulate organizational growth (Galan and Sanchez, 2006). The net cash flow from operating activities minus capital expenditures and then divided by total assets was used to measure free cash flow (Jurkus *et al*., 2011). The availability or lack of investment opportunities is also an important consideration in assessing the wealth effect of corporate investment decisions (Chen *et al*., 2000). The most common proxies for investment opportunities rely on stock price data, such as market-to-book ratio (e.g., Di Giuli, 2013). The market-to-book ratio was measured as the market value of equity divided by the book value of equity in year t. Previous studies suggest that firms' accumulation of patents impacts sequential innovation activities (e.g., Hunt, 2004). However, since organizational memory in a firm is imperfect, as Argote (1999) argues, and knowledge depreciates sharply, losing significant value within approximately five years, this study focuses only on recent patents. To account for skewness in the data, this study used an *ln*(patent count+1) transformation.

In addition to the above, we also controlled for some board, CEO and top management team (TMT)-level variables shown to influence a firm's level of risk-taking (Nakano and Nguyen,2012), such as CEO ownership, CEO gender, CEO education level, CEO tenure, board ownership, board size and TMT size. CEO (board) ownership was measured by the percentage of common equity held by the CEO (total directors) at the end of the prior fiscal year. CEO gender was measured by a dummy variable, coded 1 if the CEO was a male and 0 if female. According to Barker and Mueller (2002), CEO education level was measured on a four-point scale reflecting the highest level of education attained (1=no college degree, 2=undergraduate degree, 3=master's degree, or 4=Ph.D. degree). CEO tenure was measured as the number of years a CEO had been in the CEO position. TMT size was measured by the total numbers of top executives reported in firms' annual reports.

4. Results

Table 1 represents means, standard deviations, and the correlation matrix for our variables. The average firm age of Taiwanese publicly listed semiconductor and electronic-optical firms is around 15 years, indicating that these two industries are still in the growth and development stage. Before taking the natural logarithm of firm size, the average total assets of sample firms is around 14.5 billion NTD dollars. The descriptive statistics related to the CEO shows that CEOs in our sample are mainly male and have a bachelor's degree. The mean of tenure indicates that CEOs have been in their position for an average of 9 years.

According to the correlation coefficients shown in Table 1, the correlation between "firm innovativeness and patent stock" and "firm size and patent stock" is especially high. The high correlation between firm innovativeness and patent can be explained by Lee and Huang's (2014) study in which they found that patent stock can benefit a firm's exploratory innovation efforts. The high correlation between firm size and patent count should be unsurprising because larger firms may have more resources to obtain and defend patents (Wang and Li, 2008). To ensure that multicollinearity was not a problem in this study, we ran an OLS regression that contained all the explanatory variables, without considering the effects of firm- and year-fixed effects. The results of the VIF test show that the mean of VIFs is 1.426, well below the rule-of-thumb cut-off of 10 (Myers, 1990). The largest VIF value is 2.365. The issue of multicollinearity did not arise in the data used in this study.

The data structure of this study is a cross-sectional time-series design that uses information from 261 firms over the period 2002-2014. As prior literature suggests (e.g., Samila and Sorenson, 2010), each firm may have its distinct characteristics which may be correlated with the explanatory variables; these potential effects should be controlled if unobserved time-invariant characteristics exist, suggesting that a fixed-effects model can capture biases resulting from omitted time-invariant characteristics. Baltagi (2001) also emphasizes that the choice between the fixed and random effects models should be solely based on theoretical considerations. The nature of the data included in this study, with observations from individual firms, would suggest that the fixed effects model is

Table 1
Descriptive statistics and correlation matrix

		Mean	S.D.	Min.	Max.	1	2	3	4	5	6
1	Firm age	14.190	8.871	0.000	51.000						
2	Firm size	14.933	1.618	6.347	20.668	0.317*					
3	Debt-to-equity ratio	33.360	17.627	0.180	132.460	-0.021	0.153*				
4	Current ratio	41.524	132.282	0.000	4142.08	0.031	0.123*	0.377*			
5	Prior performance	10.280	14.248	-69.320	67.180	-0.082*	0.187*	-0.193*	-0.119*		
6	Free cash flow	0.004	0.248	-2.504	4.293	-0.046*	-0.049*	-0.131*	-0.043*	0.126*	
7	Investment opportunities	1.683	1.748	0.000	25.808	-0.044*	0.132*	-0.059*	0.166*	0.354*	0.021
8	Patent stock	1.399	1.758	0.000	7.937	0.152*	0.616*	-0.054*	0.038	0.053*	0.029
9	CEO ownership	0.844	1.385	0.000	12.780	-0.002	-0.096*	-0.013	-0.013	0.084*	0.042*
10	CEO gender	0.961	0.202	0.000	1.000	0.048*	0.063*	-0.026	-0.098*	0.062*	0.055*
11	CEO education level	2.678	0.855	0.000	4.000	-0.175*	0.152*	-0.030	0.052*	0.012	0.038
12	CEO tenure	8.955	14.152	-5.000	101.000	0.120*	-0.032	0.013	-0.011	-0.026	-0.040
13	Board size	6.760	1.584	2.000	15.000	-0.032	0.322*	0.042	0.019	0.082*	0.007
14	Board ownership	19.759	14.102	0.280	99.420	-0.209*	-0.073*	0.068*	0.007	0.133*	-0.029
15	TMT size	7.991	3.346	2.000	35.000	0.131*	0.342*	0.100*	0.043*	0.018	-0.029
16	CEO career variety	-0.216	1.909	-2.960	2.960	-0.083*	0.044*	0.211*	0.075*	-0.102*	-0.073*
17	Board independence	0.227	0.154	0.000	0.600	-0.200*	-0.137*	-0.067*	-0.033	0.063*	0.030
18	Shared expertise	0.734	0.442	0.000	1.000	-0.037	0.020	0.138*	0.054*	-0.019	-0.026
19	Firm innovativeness	0.000	2.737	-1.818	37.061	-0.035	0.210*	-0.188*	-0.044*	-0.111*	0.044*

		7	8	9	10	11	12	13	14	15	16	17	18
8	Patent stock	0.091*											
9	CEO ownership	0.112*	-0.093*										
10	CEO gender	0.069*	0.072*	0.002									
11	CEO education level	0.106*	0.216*	-0.007	0.303*								
12	CEO tenure	-0.081*	-0.021	0.002	-0.556*	-0.455*							
13	Board size	-0.023	0.210*	-0.114*	0.019	0.114*	-0.020						
14	Board ownership	0.053*	-0.163*	-0.001	-0.020	-0.015	-0.079*	0.137*					
15	TMT size	-0.009	0.316*	0.035	0.038	0.108*	0.022	0.191*	-0.088*				
16	CEO career variety	-0.118*	-0.084*	-0.090*	-0.100*	-0.040*	0.097*	0.133*	-0.065*	0.004			
17	Board independence	0.111*	-0.081*	0.120*	0.039	0.025	-0.047*	-0.028	-0.001	-0.116*	-0.059*		
18	Shared expertise	-0.083*	-0.004	-0.059*	-0.074*	-0.070*	0.059*	-0.086*	-0.004	0.022	0.443*	-0.349*	
19	Firm innovativeness	0.044*	0.537*	-0.045*	0.046*	0.196*	0.003	0.088*	-0.108*	0.158*	-0.084*	-0.008	-0.025

*$p<0.05$

the most appropriate model. That is the analysis approach using in this study likely provide a more complete exploration of the relationship between explanatory variables and firm innovativeness. However, as some researchers point out (e.g., Lin and Chang, 2015; Keil *et al*., 2008), the random-effects model can be used to verify the robustness of the findings generated from the fixed-effects model. Both fixed- and random-effects models will be conducted to examine the influences of exploratory variables on firm innovativeness. Furthermore, as Chang *et al*. (2010) and Wong *et al*. (2017) suggest, the skewness and kurtosis of the explanatory variables should be checked by the Kolmogorov-Smirnov test before performing panel data analysis. The results reveal that the majority of variables were not normally distributed. We, therefore, followed the approach suggested by Blom (1958) to transform the data into normal scores. However, by comparing the results derived from the non-transformed and transformed data, the directions and statistical significance of the main variables of interest remain similar so that the results presented are based on non-transformed data.

In addition to the above, prior research indicates that endogeneity could be a concern when searching for the relationship between corporate arrangements and consequent outcomes (e.g., Kim and Lu, 2011). Several evaluations were made to assess and eliminate this problem. First, according to Chang and Chung's (2017) comprehensive review of the endogeneity problem and its remedies, panel data with fixed effects is one of the methodologies that can address endogeneity. Second, based on the suggestion of previous studies (e.g., Lin, 2014), a one-year lag between independent variables and dependent variable can be used to avoid the potential endogeneity problem. Third, we checked and found that the value of the main independent variable (i.e., CEO career variety) does not fluctuate hugely over time, suggesting that CEO career variety could not be influenced over firm innovativeness. Fourth, we ran a simple OLS regression of firm innovativeness on CEO career variety and found that the correlation between residual with independent variable was not significant ($p > 0.05$). These precautions and tests suggest that endogeneity is not a problem in this study.

The results of the fixed-effect panel data regressions are listed in Table 2. First, we entered the control variables in Model 1a and subsequently estimated

the effect of CEO career variety on firm innovativeness in Model 2a. In Model 3a, we tested the moderating effect of board independence on the relationship between CEO career variety and firm innovativeness. In Model 4a, we further examined whether the moderating effect of board independence on the relationship between CEO career variety and firm innovativeness can be reinforced when the CEO and independent directors have higher levels of shared expertise.

According to the results shown in Table 2, as expected, CEO career variety has a significant positive effect on firm innovativeness (*coef.* = 0.188, $p<0.001$). Hypothesis 1 was thus supported by the evidence. In Model 3a, the moderating effect of board independence on the relationship between CEO career variety and firm innovativeness was tested. The results revealed that the moderating effect of board independence was not significant (*coef.* = -0.071, $p>0.05$). In regard to the three-way interaction effect of CEO career variety, board independence and shared expertise between the CEO and independent directors, according to the parameter estimation in Model 4a, the coefficient of CCV×BI×SE was significantly positive (*coef.* = 3.859, $p<0.001$). To further clarify the three-way interaction effect, we used the regression coefficients derived from Model 3a in Table 2 to calculate firm innovativeness for different levels of CEO career variety, board independence, and shared expertise between CEO and independent directors. Specifically, based on the suggestion made by Aiken and West (1991), we used the means of the control variables and cut values of one standard deviation above and below the mean for each of the three variables of interest (i.e., CEO career variety, board independence, and shared expertise) to obtain eight separate plotting points. The points were connected to form lines. As illustrated in Figure 1a, it is clear that firm innovativeness is highest when the levels of both board independence and shared expertise between CEO and independent directors are high, suggesting that shared expertise between CEO and independent directors positively moderates the extent to which higher levels of board independence enhance the relationship between CEO career variety and firm innovativeness. In addition to Figure 1a, we also divided “shared expertise” into two groups (i.e., high and low SE) to examine how board independence affects the relationship between CEO career variety and firm innovation at high

Table 2
Regression results of the fixed effects model

	Model 1a		Model 2a		Model 3a		Model 4a	
	Coef.	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*
Constant	0.736	(0.757)	-0.108	(0.772)	-0.092	(0.776)	-0.017	(0.789)
Firm age	0.009	(0.013)	0.015	(0.013)	0.015	(0.013)	0.021	(0.013)
Firm size	-0.157**	(0.053)	-0.102	(0.054)	-0.103	(0.054)	-0.092	(0.054)
Debt-to-equity ratio	-0.011***	(0.003)	-0.012***	(0.003)	-0.012***	(0.003)	-0.013***	(0.003)
Current ratio	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Prior performance	-0.027***	(0.003)	-0.028***	(0.003)	-0.028***	(0.003)	-0.029***	(0.003)
Free cash flow	0.076	(0.128)	0.097	(0.127)	0.096	(0.127)	0.110	(0.127)
Investment opportunity	-0.010	(0.020)	0.002	(0.020)	0.001	(0.020)	0.005	(0.020)
Patent stock	0.168***	(0.046)	0.161***	(0.046)	0.163***	(0.046)	0.163***	(0.046)
CEO ownership	-0.003	0.026	0.015	(0.026)	0.015	(0.026)	0.017	(0.026)
CEO gender	0.169	(0.277)	0.219	(0.276)	0.223	(0.276)	0.236	(0.274)
CEO education level	0.190*	(0.076)	0.175*	(0.076)	0.176*	(0.076)	0.192*	(0.076)
CEO tenure	0.023**	(0.009)	0.024**	(0.009)	0.024**	(0.009)	0.024**	(0.009)
Board size	0.093**	(0.033)	0.085**	(0.033)	0.082*	(0.033)	0.085*	(0.034)
Board ownership	0.005	(0.004)	0.009*	(0.004)	0.009*	(0.004)	0.008*	(0.004)
TMT size	0.038**	(0.014)	0.033*	(0.014)	0.033*	(0.014)	0.032*	(0.014)
CEO career variety (CCV)			0.188***	(0.038)	0.188***	(0.038)	0.273***	(0.046)
Board independence (BI)					0.080	(0.311)	-1.158**	(0.446)
Shared expertise (SE)							0.353	(0.200)
CCV × BI					-0.072	(0.151)	-1.103***	(0.259)
CCV × SE							-0.459***	(0.120)
BI × SE							4.933***	(1.380)
CCV × BI × SE							3.859***	(0.823)
R^2	0.102		0.112		0.113		0.126	
F	16.09***		16.78***		14.92***		13.79***	

*$p<0.05$; **$p<0.01$; ***$p<0.001$
Values in parentheses are standard errors of the coefficients.
Note. CCV: CEO career variety; BI: Board independence; SE: Shard expertise

and low shared expertise. Specifically, we divided the observations into two groups by the medium of shared expertise, and used two separate regressions based on high and low independent directors to test the interaction effect of CCV×BI for both high and low shared expertise groups. The results are reported n Figure 1b. In the group of high SE, compared to low BI, high BI is better able to enhance the effect of CCV on firm innovativeness. Based on the regression and *post-hoc* results above, Hypothesis 2 was well supported by the evidence.

In addition to testing the hypotheses, we also found some significant interaction effects in the regression results. In Models 4a~4d, CCV×BI and CCV×SE both were significantly negatively correlated to firm innovativeness. These results may reflect that without considering the other boundary conditions, the moderating effect of either board independence or shared expertise could hinder a firm's innovation. For example, as Hoskisson *et al*. (2002) state, independent directors may negatively affect innovation investments because independent directors have difficulty in gathering information, and tend to use financial metrics to measure innovation effectiveness. Regarding the significantly negative interaction effect of CCV×SE, without considering the percentages of board members who are independent, shared expertise may imply strong ties among executives and directors (Tung, 2011), which may lead to collusion that will be detrimental to the corporate outcomes (Towry, 2003). Based on the above findings, including the significantly positive effect of BI×SE, the merit of board independence or shared expertise for firm innovativeness can only be generated when they are aligned with each other.

Several tests were also conducted to confirm the robustness of the results. First, as Table 3 shows, the random-effects approach yielded similar findings. Second, two additional tests were performed to compare the explanatory abilities of the CEO's diversified functional and industry experience. As shown in Table 4, the results demonstrate that a CEO's diversified functional and industry experience is positively related to firm innovativeness; however, this was not statistically significant. This discovery indirectly supports Barker and Muller's (2002) claim that different backgrounds may have different effects on innovation. The non-significant direct effects of a CEO's functional and industry background diversity further support our claim that the accumulation of CEO experience is

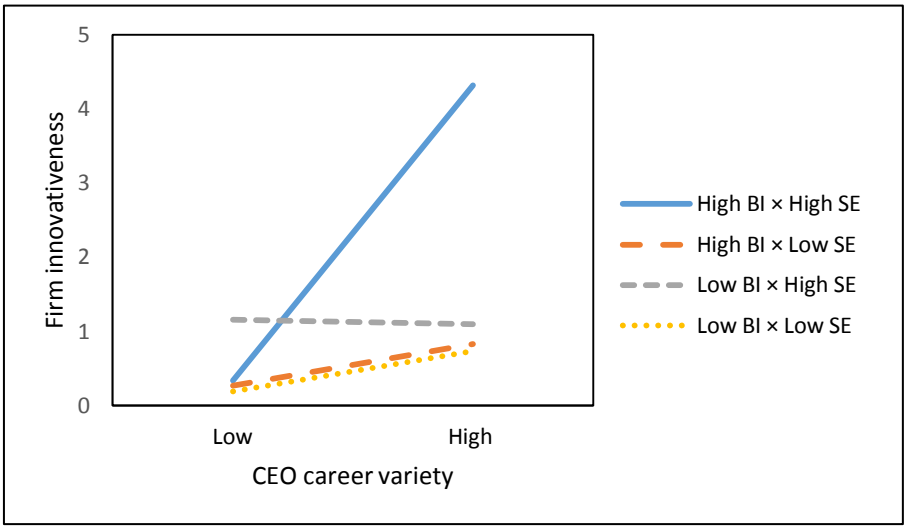
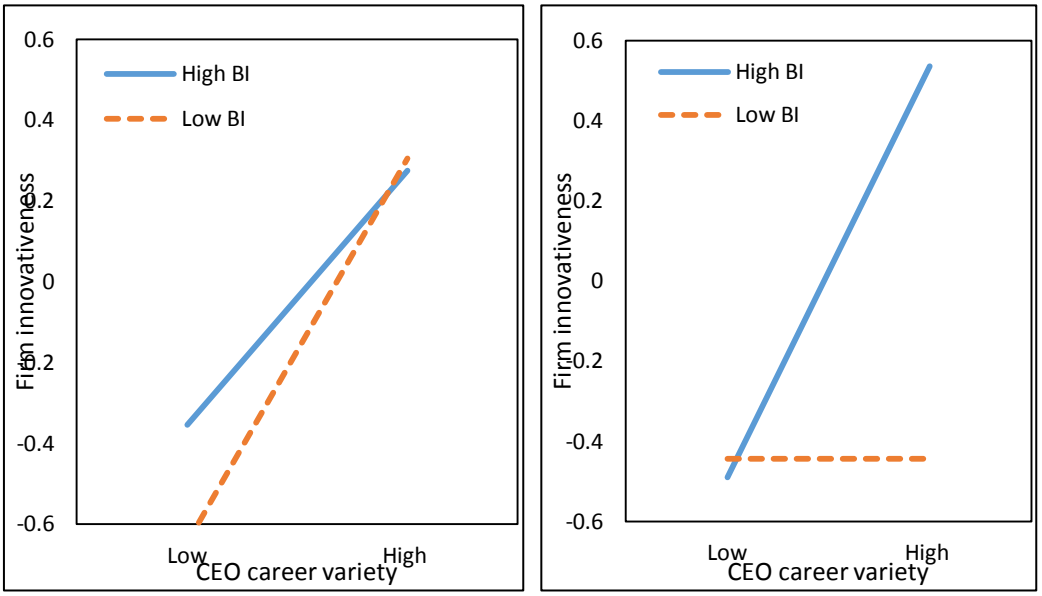


Figure 1a
The interaction effects among CEO career variety (CCV), board independence (BI) and shared expertise (SE)



(a) Low SE (b) High SE

Figure 1b
The interaction effects among CEO career variety (CCV), board independence (BI) and shared expertise (SE)

Table 3
Regression results of the random effects model

	Model 1b		Model 2b		Model 3b		Model 4b	
	Coef.	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*
Constant	-0.088	(0.692)	-0.502	(0.701)	-0.503	(0.702)	-0.360	(0.712)
Firm age	-0.016	(0.010)	-0.011	(0.010)	-0.011	(0.010)	-0.007	(0.010)
Firm size	-0.103*	(0.047)	-0.077	(0.048)	-0.077	(0.048)	-0.067	(0.048)
Debt-to-equity ratio	-0.013***	(0.002)	-0.014***	(0.002)	-0.014***	(0.002)	-0.012***	(0.002)
Current ratio	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Prior performance	-0.029***	(0.003)	-0.030***	(0.003)	-0.030***	(0.003)	-0.030***	(0.003)
Free cash flow	0.077	(0.127)	0.090	(0.126)	0.089	(0.126)	0.102	(0.125)
Investment opportunities	0.001	(0.020)	0.010	(0.020)	0.010	(0.020)	0.013	(0.020)
Patent stock	0.357***	(0.043)	0.351***	(0.043)	0.352***	(0.043)	0.349***	(0.043)
CEO ownership	0.003	(0.025)	0.017	(0.026)	0.017	(0.026)	0.019	(0.025)
CEO gender	0.222	(0.260)	0.272	(0.259)	0.274	(0.259)	0.273	(0.258)
CEO education level	0.269***	(0.070)	0.263***	(0.070)	0.264***	(0.070)	0.277***	(0.070)
CEO tenure	0.016**	(0.005)	0.016**	(0.005)	0.016**	(0.005)	0.016**	(0.005)
Board size	0.090**	(0.031)	0.083**	(0.031)	0.082**	(0.032)	0.086**	(0.032)
Board ownership	0.004	(0.004)	0.006	(0.004)	0.006	(0.004)	0.006	(0.004)
TMT size	0.039**	(0.014)	0.036*	(0.014)	0.036**	(0.014)	0.035*	(0.014)
CEO career variety (CCV)			0.124***	(0.034)	0.124***	(0.034)	0.220***	(0.043)
Board independence (BI)					0.006	(0.294)	-1.260**	(0.436)
Shared expertise (SE)							0.394*	(0.195)
CCV × BI					-0.044	(0.147)	-1.103***	(0.254)
CCV × SE							-0.490***	(0.118)
BI × SE							4.992***	(1.365)
CCV × BI × SE							4.017***	(0.814)
Log likelihood	-4350.064		-4343.467		-4343.420		-4326.183	
LR Chi-square	297.86***		311.06***		311.15***		345.62***	

$^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$

Values in parentheses are standard errors of the coefficients.
Note. CCV: CEO career variety; BI: Board independence; SE: Shard expertise

Table 4
Regression results of the fixed effects model (varied CEO functional and industry experience)

	CEO career variety$_{(functional)}$		CEO career variety$_{(industry)}$	
	Coef.	*S.E.*	*Coef.*	*S.E.*
Constant	0.728	(0.757)	0.748	(0.758)
Firm age	0.008	(0.013)	0.008	(0.013)
Firm size	-0.158**	(0.053)	-0.159**	(0.053)
Debt-to-equity ratio	-0.011***	(0.003)	-0.011***	(0.003)
Current ratio	-0.000	(0.000)	-0.000	(0.000)
Prior performance	-0.028***	(0.003)	-0.028***	(0.003)
Free cash flow	0.080	(0.128)	0.076	(0.128)
Investment opportunities	-0.010	(0.020)	-0.011	(0.020)
Patent stock	0.171***	(0.046)	0.168***	(0.046)
CEO ownership	-0.004	(0.026)	-0.004	(0.026)
CEO gender	0.188	(0.278)	0.167	(0.277)
CEO education level	0.185*	(0.076)	0.189*	(0.076)
CEO tenure	0.023**	(0.009)	0.022**	(0.009)
Board size	0.092**	(0.033)	0.092**	(0.033)
Board ownership	0.005	(0.004)	0.005	(0.004)
TMT size	0.039**	(0.014)	0.039**	(0.014)
CEO career variety	0.451	(0.389)	0.129	(0.261)
R^2	0.103		0.102	
F	15.17***		15.10***	

**p<0.05; **p<0.01; ***p<0.001*

Values in parentheses are standard errors of the coefficients.

multifaceted and complex. Such findings support our argument that the combined measurement of CEO career variety can offer a higher explanatory ability regarding firm innovativeness variation. Third, because there is no consistent method to measure firm innovativeness, both R&D intensity (e.g., Chiao *et al*., 2006) and patent counts (e.g., Chen *et al*., 2011) have been used alone to proxy firm innovativeness. In Table 5, R&D intensity in year *t* was treated as the dependent variable. The results were similar to our previous

findings. In addition to R&D in the year *t*, we also used three-year (*t*~*t*+*2*) averaged R&D intensity as the response variable and obtained similar results. Table 6 shows the results of using patent counts as the dependent variable. Although the R^2 of the models were lower and the significance levels of variables of interest were reduced, Hypotheses 1 and 2 were still supported. Given these tests, the measurements and results presented in this study should be sufficiently robust and reliable.

5. Discussions

This study contributes to corporate governance literature by building on the behavioral agency perspective. The value of surveillance and responsible role in independent directors hinges on the incentives to bear risks and align the interests with managers. Rather than directly taking the increasing ratio of independent directors on boards into consideration, understanding the appointed independent directors' background and competency in parallel with CEOs' is of critical nexus to verify the applicability of behavioral agency theory in corporate governance research on firm innovativeness. This study also supplements the effect of CEO career variety on firm innovativeness could be explained further by the shared expertise between outside monitors and inside executives Departing from existing research stressing the importance of board independence on corporate innovation (e.g., Osma, 2008), the finding helps us to clarify the disputed role of independent directors and identify what types of independent directors can bolster CEOs to pursue firm innovativeness. Consistent with the previous study (Gray and Nowland, 2013), board composition germane to its competences and experience is vital to affect CEOs' decision on firm innovativeness, particularly the shared expertise and background between independent directors and CEOs in composing the board background.

Several managerial implications also stem from our results. First, given the positive effect of CEO career variety on firm innovativeness, the importance of CEOs with career variety should be taken into account when hiring a CEO. The horizon of potential internal successors can be expanded by job rotation, owners are suggested to understand the merits of different career experiences.–Second, echoing Gray and Nowland's (2013) study, the effectiveness of overseas

Table 5
Regression results of the fixed effects model (R&D intensity$_t$)

	Model 1c		Model 2c		Model 3c		Model 4c	
	Coef.	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*
Constant	30.540***	(6.041)	26.672***	(6.184)	26.181***	(6.206)	27.884***	(6.326)
Firm age	0.058	(0.101)	0.087	(0.101)	0.085	(0.102)	0.105	(0.106)
Firm size	-1.751***	(0.420)	-1.498***	(0.429)	-1.464***	(0.431)	-1.399**	(0.431)
Debt-to-equity ratio	-0.097***	(0.020)	-0.104***	(0.020)	-0.102***	(0.021)	-0.108***	(0.020)
Current ratio	0.002	(0.002)	0.002	(0.002)	0.002	(0.002)	0.001	(0.002)
Prior performance	-0.248***	(0.022)	-0.253***	(0.022)	-0.253***	(0.022)	-0.256***	(0.022)
Free cash flow	-4.506***	(1.020)	-4.408***	(1.019)	-4.390***	(1.019)	-4.285***	(1.015)
Investment opportunities	-0.077	(0.160)	-0.022	(0.161)	-0.015	(0.162)	-0.002	(0.162)
Patent stock	-0.570	(0.367)	-0.605	(0.367)	-0.546	(0.368)	-0.538	(0.367)
CEO ownership	-0.060	(0.206)	0.024	(0.208)	0.036	(0.208)	0.055	(0.208)
CEO gender	1.237	(2.211)	1.468	(2.209)	1.585	(2.209)	1.635	(2.200)
CEO education level	0.943	(0.607)	0.872	(0.606)	0.942	(0.607)	0.998	(0.607)
CEO tenure	0.168*	(0.069)	0.175*	(0.069)	0.178**	(0.069)	0.174*	(0.069)
Board size	0.200	(0.261)	0.166	(0.261)	0.168	(0.267)	0.155	(0.269)
Board ownership	0.080**	(0.030)	0.098**	(0.031)	0.097**	(0.031)	0.094**	(0.031)
TMT size	0.157	(0.114)	0.131	(0.114)	0.129	(0.114)	0.124	(0.114)
CEO career variety (CCV)			0.860**	(0.304)	0.854**	(0.304)	1.486***	(0.366)
Board independence (BI)					-2.015	(2.486)	-12.438***	(3.564)
Shared expertise (SE)							3.045	(1.602)
CCV × BI					-2.260	(1.212)	-9.831***	(2.062)
CCV × SE							-2.995**	(0.961)
BI × SE							40.350***	(10.993)
CCV × BI × SE							29.928***	(6.530)
R^2	0.110		0.114		0.115		0.125	
F	17.53***		16.99***		15.32***		13.72***	

**p<0.05; **p<0.01; ***p<0.001*
Values in parentheses are standard errors of the coefficients.
Note. CCV: CEO career variety; BI: Board independence; SE: Shard expertise

Table 6
Regression results of the fixed effects model (Patent Count$_{t\sim t+2}$)

	Model 1d		Model 2d		Model 3d		Model 4d	
	Coef.	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*	*Coef.*	*S.E.*
Constant	-76.152*	(29.461)	-93.061**	(30.140)	-93.235**	(30.262)	-76.178*	(30.388)
Firm age	-0.645	(0.492)	-0.515	(0.494)	-0.550	(0.497)	-0.240	(0.508)
Firm size	3.540	(2.047)	4.643*	(2.088)	4.656*	(2.100)	5.327*	(2.070)
Debt-to-equity ratio	0.204*	(0.099)	0.174	(0.100)	0.177	(0.100)	0.102	(0.098)
Current ratio	0.004	(0.010)	0.004	(0.010)	0.004	(0.010)	0.004	(0.009)
Prior performance	-0.179	(0.108)	-0.197	(0.108)	-0.195	(0.108)	-0.231*	(0.106)
Free cash flow	0.618	(4.975)	1.068	(4.971)	1.019	(4.975)	2.095	(4.876)
Investment opportunities	-0.977	(0.779)	-0.734	(0.784)	-0.755	(0.789)	-0.764	(0.776)
Patent stock	12.073***	(1.790)	11.918***	(1.789)	12.094***	(1.795)	11.728***	(1.761)
CEO ownership	1.313	(1.006)	1.685	(1.015)	1.704	(1.016)	1.687	(0.998)
CEO gender	8.810	(10.782)	9.834	(10.774)	10.242	(10.781)	11.581	(10.567)
CEO education level	5.571	(2.958)	5.253	(2.957)	5.382	(2.961)	5.339	(2.912)
CEO tenure	0.033	(0.336)	0.067	(0.336)	0.074	(0.336)	0.041	(0.330)
Board size	2.893*	(1.273)	2.736*	(1.273)	2.608*	(1.302)	2.153	(1.292)
Board ownership	0.040	(0.148)	0.121	(0.151)	0.126	(0.152)	0.091	(0.150)
TMT size	-0.357	(0.556)	-0.473	(0.557)	-0.463	(0.558)	-0.432	(0.547)
CEO career variety (CCV)			3.794*	(1.468)	3.778*	(1.468)	9.638***	(1.721)
Board independence (BI)					-0.649	(12.117)	-91.438***	(16.918)
Shared expertise (SE)							36.105***	(7.611)
CCV × BI					-7.165	(5.861)	-79.181***	(9.601)
CCV × SE							-33.119***	(4.540)
BI × SE							409.932***	(51.881)
CCV × BI × SE							260.670***	(30.897)
R^2	0.038		0.041		0.042		0.083	
F	5.67***		5.74***		5.19***		8.65***	

**p<0.05; **p<0.01; ***p<0.001*
Values in parentheses are standard errors of the coefficients.
Note. CCV: CEO career variety; BI: Board independence; SE: Shard expertise

assignments and cross-functional projects and task-forces. Corporate independent directors cannot be captured by merely measuring the ratio of independent directors to the total members of the board. Instead, corporate owners should be aware of the background and competency of the appointed independent directors rather than to simply achieve a particular level of board independence. That is, the shared expertise between independent directors and CEOs may not only help to improve monitoring functions but also enable independent directors to modify or enhance the strategy to achieve superior firm innovativeness. The selection of individual independent directors has the potential to act as a significant influence in this regard.

Still, our findings contain several limitations. First, firm innovativeness in this study is a composite measure that only takes into account the level of R&D intensity and the number of patents, although Coad and Rao (2008) posit that these two indicators can validly reflect a firm's innovativeness. However, a few of our sample observations don't disclose the information of R&D and patents and so needed to be eliminated from the study sample. Some firms may capitalize R&D inputs after achieving technological feasibility based on international accounting standards, meaning that those firms without R&D expenses which have been eliminated from our study sample are highly likely to be at the stage of completing detailed designs to be readily released to the market. Also, some firms did not intend to patent their innovations because they may keep secret their novel technological knowledge. Second, corporate behaviors could be affected by various CEO characteristics. Although this study has controlled for several CEO characteristics and extended the literature to explore the impact of CEO career variety on firm innovativeness, the CEO variables which were not included in this study may also affect firm innovativeness. Data availability led to the exclusion of some CEO variables from the regressions. For example, CEO age is an important antecedent of corporate behaviors (e.g., Kraiczy *et al*., 2014), but was not included in the analytical model due to Taiwan's laws restricting the disclosure of personal information of CEOs (e.g., "Company Act" and "Personal Information Protection Act"). Likewise, the information on duration regarding each job is not required to be disclosed in annual reports, so we could not further incorporate its possible impact into the calculation of CEO career variety. Subsequent research can use case studies to

explore all the factors that may influence CEO decision making. Third, in Taiwan, since the Taiwan Patent Office does not require patent applicants to provide full patents related to their inventions (i.e., backward citations), future research may replicate this research in countries with more abundant patent information, such as the United States, by using other patent information (e.g., forward citations) to measure a firm's innovativeness. In addition to the shared expertise, other common or differentiating characteristics between CEOs and independent directors, such as age, gender, nationality, and various social variables, may be associated with executive decision-making and consequent outcomes. Although much remains to be done, we hope our findings can serve as a trigger for future research investigating the effects of CEOs on corporate innovation.

6. Conclusions

Although a growing number of studies have investigated the influences of CEO characteristics on a firm's innovation activities, the inconsistent results imply that the underlying decision-making processes have not yet been comprehensively explored, so that further research is needed in this area. As some researchers of organizational behavior or human resource management suggest, individuals' attitude towards an issue or object are influenced by their previous work experience (e.g., Dokko *et al*., 2009; Dokko and Gaba, 2012), but researchers in corporate governance and innovation management field have seldom investigated whether the decision-making preferences of CEOs are influenced by their career experiences. Differed from the study of Crossland *et al*. (2014), this study explores how the CEO career variety has an impact on firm innovativeness rather than that on strategic dynamism, offering a more concentrated investigation upon managerial behavior in innovation. Synthesizing behavioral agency theory with motivation and cognition perspective, the empirical findings demonstrate that CEO career variety has a substantially positive impact on the innovative efforts of firms. Due to the importance of innovativeness for firms' survival in the dynamics of the industry, our study also investigates whether corporate governance mechanisms moderate the effects of CEO career variety on firm innovativeness. By further considering the shared

expertise between independent directors and CEOs, the benefits of board independence can be realized in terms of promoting firm innovativeness. This finding is also relevant for corporate owners and policy makers to regard the interplay effects between the CEO and independent directors so that they can better govern the companies.

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