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Does the Level of Environmental Uncertainty Matter in the Effect of Returnee CEO on Innovation? Evidence from Panel Threshold Analysis

Weili Huang *, **Guangqi Ma** and **Xuemeng Chen**

School of Economics and Management, Shaanxi University of Science and Technology, Shaanxi 710021, China; maguangqi@sust.edu.cn (G.M.); 18292002066@163.com (X.C.)

* Correspondence: 18309292107@163.com

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Abstract: This study applies a panel threshold regression model to reconcile the inconsistent findings about returnee chief executive officer (CEO) effects on enterprise innovation using the environmental uncertainty as the threshold variable and panel data from 187 publicly traded electronic firms in China for the period 2012–2016. The empirical results suggest that a significant double threshold effect does exist, showing an inverted-U correlation between returnee CEO and innovation. Specifically, a returnee CEO significantly promotes innovation at moderate levels of environmental uncertainty but significantly hinders innovation when the environmental uncertainty surpasses the larger threshold value, which contradicts much of the previous literature. This research enriches the scholarship on returnee CEOs and lays a theoretical foundation that firms can use in corporate governance. If firms pay more attention to environmental uncertainty while formulating new CEO introduction policies, substantial innovation ability can be improved at moderate levels of environmental uncertainty.

Keywords: returnee CEO; enterprise innovation; environmental uncertainty; threshold effect

1. Introduction

Returnees are skilled persons who study or work in metropole nations and subsequently return to their home country [1]. Domestic governments make great efforts to attract overseas talent due to their international capitalization advantages, such as technical and organizational knowledge, and networks absorbed [2]. China also launched a series of overseas-talent-attraction plans, such as the "Overseas High-Level Talent Introduction Program" to lure returnees [3]. Major achievements of these talent-attraction programs cannot be neglected. Statistics from the Education Service Center of the Ministry of Education show that more than three million international students chose to return to China as of 2017. These returnees played a much more crucial role in many fields [2], for instance, indigenous innovation [4]. Increasingly more companies are beginning to introduce returnees to participate in the board of directors. Some returnees even directly serve as the company's manager or chief executive officer (CEO).

With increased globalization [5], Chinese firms are in an increasingly uncertain economic environment. It is particularly important for a Chinese company to convert an idea into a business. As a decision-maker, a carrier of important technical knowledge, and a spark for indigenous innovation, a returnee CEO (hereafter, RCEO) plays a pivotal role in business innovation. Above all, it is valuable to study how an RCEO impacts the level of enterprise innovation in emerging markets from a micro level. Although there is growing research on the RCEO's effect on company innovation, there is no consensus on the relationship between RCEOs and company innovation. On the one hand, some studies argue that there is a significant association between RCEOs and company innovation [6–10].

Alternatively, one could argue that an RCEO has a non-significant effect [1,11], or even a negative effect on innovation [1,12,13]. Such complexity suggests that there is a non-uniform effect of RCEOs on enterprise innovation and the pre-requisites conditioning enterprise innovation from RCEOs.

Scholars took a contingency perspective to reconcile these inconsistent findings about the impact of returnee executive and company innovation, using variables such as environmental uncertainty (hereafter, EU) as an underlying moderator of the association between RCEOs and enterprise innovation [14–17], but these studies also show mixed findings. For example, some studies document a positive effect from the interaction between policy-makers and EU on organizational innovation [18–21]. Alternatively, others show a negative effect from the interaction between CEOs and EU on firm performance [13,22]. These ambiguous findings about the relationship between RCEOs and company innovation delineate an important research gap in the field.

This study fills this gap by utilizing a panel threshold regression model to reconcile the nonlinear relationship between RCEOs and innovation using environmental uncertainty as the threshold variable. It should be noted that the main purpose of this paper is to investigate the threshold level above which the RCEO adversely affects innovation, using a threshold regression model. Simultaneously, we also investigate the optimal threshold interval at which the RCEO can have a positive association with innovation.

To address the research question, we use panel data from 187 publicly traded electronic firms in China for the period 2012–2016. Our empirical results suggest that a significant double threshold effect does exist, showing an inverted-U correlation between returnee CEO and innovation. Furthermore, our results are consistent with the position that the impact of returnee CEOs on innovation is positive and notably significant at moderate levels of environmental uncertainty. However, the returnee CEO exerts a significant and negative effect on innovation when the environmental uncertainty surpasses the larger threshold value

This paper makes three contributions by investigating why and when an RCEO has a discordant complex effect on enterprise innovation. Firstly, to advance the scientific understanding of the complex process of the RCEO–innovation nexus, we provide a nuanced explanation of why an RCEO can have both a positive and negative effect on enterprise innovation. Secondly, departing from prior research [21], this study delineates the boundary conditions between the positive and adverse effects of RCEOs by conjecturing that the responses of enterprise innovation to an RCEO could be different when gauged at various levels of EU, in an attempt to understand when the RCEO may have a positive or negative influence on enterprise innovation. Thirdly, unlike prior studies, which rely on linear specification where an RCEO indicator is simply interacting with a conditioning variable, this study uses nonlinear panel estimation techniques to assess EU (threshold variable). Specifically, we rely on panel threshold regression (PTR) methodology, developed by Hansen (1999).

The article is structured as follows: Section 2 reviews the related literature and develops the hypotheses. Section 3 introduces the panel threshold model and describes the sample data. Section 4 provides the results. Section 5 discusses the findings and explores their implications. Finally, Section 6 concludes and gives directions for future research

2. Theoretical Analysis and Research Hypothesis

2.1. RCEO and Enterprise Innovation

The concept of imprinting attracted interest from a broad range of areas—from organizational ecology to individual careers. The widespread use of the imprinting concept makes it possible to develop a general definition of imprinting theory, which highlights the lasting impact of previous history on individuals. Specifically, the definition of imprinting theory includes three key elements [23]: brief sensitive periods of transition during which the individuals or organizations exhibit high susceptibility to the external environment [23]; (2) a process whereby the individuals or organizations develop characteristics from experiences during sensitive periods; and (3) the persistence of imprints despite time passing and subsequent environmental changes [24]. In terms of this study, the CEO's experience in developed countries is an "imprinting" process. Namely, CEOs come to reflect elements of their environment during overseas work and study periods. The CEO's cognition and capability imprints persistently impact their decision-making and management behaviors of enterprise innovation even though they returned to China. According to imprinting theory, the impact of RCEOs on enterprise innovation is the combined effects of their advantages and disadvantages.

On the one hand, this assessment is consistent with the imprinting theory argument that prior history has an enduring impact on the individual. Hence, returnees are seen as an important mechanism for bridging knowledge gaps and for upgrading the technological capabilities of electronic firms in emerging economies when compared to their local counterparts. Firstly, returnee CEOs represent an important channel for international knowledge spillovers from developed countries [1], and their foreign knowledge contributes to domestic firm innovation, which may help firms actively explore innovation opportunities [25]. In addition, pursuing technological innovation is an activity with innately risky and uncertain characteristics. CEOs with international experience have enough valuable and rare abilities to deal with complex environments, uncertainty, and high risk [9,13]. Moreover, the RCEO's unique social capital advantage is conducive to reducing transaction costs and the time needed to build the company's capabilities when exploring innovation [26].

On the other hand, RCEOs also have potential disadvantages and may actually limit innovation performance [12]. Firstly, according to imprinting theory, having stayed abroad for a long period of time, RCEOs are imprinted with developed institutional environments, such as developed capital markets [27], higher informational efficiency levels [28], and strong intellectual property protection [23]. The imprinted experiences exert a persistent influence on CEOs and make it hard for them to re-adapt to the underdeveloped institutional environment [12]. The RCEO's initially learned responses or knowledge sets are disadvantageous in Chinese distinct regulatory and normative institutional environments, which may constrain the RCEO's appropriation of identifying innovation opportunities and management skills. RCEOs lack local knowledge and home-based social networks, even though they have advanced knowledge and experience accumulated in relatively developed countries [29]. Secondly, after many years, RCEOs may face great challenges in building local connections and maintaining old contacts (Butcher, 2002; Qin, 2007), which represent crucial channels for accessing scare information and resources [30] when operating in weak situations. Thirdly, RCEOs need to take time to understand domestic markets, society, and how to conduct business during the new sensitive period when they operate in China [31].

2.2. Threshold Effect of Environmental Uncertainty

Such complexity suggests the existence of the RCEO's non-uniform effect on enterprise innovation and the pre-requisites conditioning enterprise innovation. Scholars took a contingency perspective to reconcile these inconsistent findings about the impact of returnee executive and company innovation, using variables such as environmental uncertainty as an underlying moderator of the association between RCEOs and company innovation.

EU refers to the rapidly changing markets [32] and is usually associated with high risk, high ambiguity [33], and a lack of information, which makes it difficult for RCEOs to assess means–ends relationships, analyze and understand strategy [34], allocate resources for innovation [35], and confidently assign probabilities to their outcomes [15]. According to upper echelons theory, the more unstable, risky, or crisis-laden the decision-making situation is, the more likely it is that RCEOs will bear the stress. Hence, RCEOs are more motivated to make sense of environmental cues, interpret relevant information, and change crises into opportunity [19]. According to imprinting theory, CEOs with advanced management skills are better prepared to deal with turbulent environments by executing innovation strategies to achieve superior innovation performance [15].

However, a high degree of environmental dynamism might reduce the likelihood of the RCEO's strategic orientation to engage in enterprise innovation [13]. According to the resource-based perspective, in situations with high instability of environmental change, achieving innovation performance takes longer. As such, the RCEO may select a short-term plan that is an effective use of the firm's limited resources to obtain the benefit as soon as possible [36]. Consequently, when EU is above a certain level, the RCEO cannot fully increase innovation performance due to constrained information. When EU reaches a certain level (i.e., a threshold), the effects of the RCEO on enterprise innovation will become significant and positive due to the effective use of prior experience, limited resource, and information.

In view of the inconclusive findings provided by previous studies, the aim of this paper is to revisit threshold effects in the RCEO–innovation nexus. We use the panel threshold regression approach and reassess whether the RCEO's effects depend on the level of EU.

3. Study Design

In this section, to demonstrate that the panel threshold regression technique is a more appropriate testing approach, the linear regression model is firstly employed. Studies of the sensitivity of enterprise innovation (*Innovat*) to an RCEO (*Ceosea*) under environmental uncertainty (*Eu*) typically employ the following regression:

$$Innovat_{\mathrm{it}} = \mu_i + \beta_1 Ceosea_{it-1} + \beta_2 Eu_{it-1} + \beta_3 Ceosea_{it-1} * Eu_{it-1} + \alpha \sum CV_{it-1} + \varepsilon_{it}, \quad (1)$$

where subscript i represents the ith firm and t denotes the tth period; *Innovat* is the number of patents; *Ceosea* is a dummy variable that is equal to one if the CEO is a returnee from overseas and zero otherwise; *Eu* is coefficient of variation of sales, standing proxy for variability in the organization's external environment; and *CV* represents a series of control variables.

The coefficient (β_3) on $Ceosea_{it-1} * Eu_{it-1}$, indicates the sensitivity of enterprise innovation to an RCEO under EU. A significant β_3 implies that enterprise innovation is sensitive to the RCEO under EU, whereas a statistically insignificant β_3 implies it is not sensitive. However, since our study is based on the hypothesis that the RCEO will impact enterprise innovation in a nonlinear way, on the basis of Equation [23], we further adopt a nonlinear analysis tool to study the RCEO's impact on enterprise innovation by specifically using the Hansen panel threshold regression analysis (PTR) with EU as the threshold variable [37].

3.1. Panel Threshold Regressions

To avoid error from the artificial EU division interval, we use the Hansen PTR to internally divide the EU ($q_{it} = Eu_{it}$) interval according to data characteristics. Then, the influence mechanism of the RCEO ($z_{it} = Ceosea_{it}$) on enterprise innovation ($y_{it} = Innovat_{it}$) for different intervals is examined by firstly considering a single-threshold regression model as a special case of the panel threshold model, which takes the following form:

$$y_{\mathrm{it}} = \mu_{\mathrm{i}} + \beta_1 z_{it} I(q_{it} \le \gamma) + \beta_2 z_{it} I(q_{it} > \gamma) + \varepsilon_{it}, \quad (2)$$

where subscripts i = 1, . . . , N index the firm and the subscript t = 1, . . . , T represents time; q_{it} indexes the threshold variable, standing proxy for EU; γ is the threshold value; the indicator function $I(\cdot)$ is equal to 0 when $q_{it} \le \gamma$ and 1 in the other case; y_{it} is $Innovat_{\mathrm{it}}$; z_{it} represents an m-vector of explanatory variables; the slope coefficient β_1 represents the parameter vector of the regression in a low-uncertainty regime; and β_2 represents the corresponding parameter vector in a high-uncertainty regime. μ_{i} is the firm-specific fixed effect and the random variable, and ε_{it} is the regression error term.

As in Hansen [37], at the first step, removing the individual specific effects by "mean differencing" yields the model in Equation. At the second step, the threshold parameter, $\hat{\gamma}$, is estimated by minimizing the concentrated sum of square errors (the residual vector is $\hat{\varepsilon}^* = \hat{\varepsilon}^*(\hat{\gamma})$). Once $\hat{\gamma}$ is identified, the slope coefficient estimates, $\hat{\beta}$, can be obtained [37].

$$y^*_{it} = \beta z^*_{it}(\gamma) + \varepsilon^*_{it}, \tag{3}$$

where * represents variables deviated from the group mean.

Two tests are then performed: a test of the significance of the threshold effect and a test of whether the threshold estimation value is equal to the true value. Firstly, an F-stat test under the null hypothesis of no threshold effect ($H_0 : \beta_1 = \beta_2$) is used to determine if there exists a threshold effect, and a "bootstrap" method is used to simulate the asymptotic distribution of the likelihood ratio statistic $\mathrm{F}(\gamma)$ [37], such that

$$\mathrm{F}(\gamma) = \frac{SSE_0 - SSE_1(\hat{\gamma})}{\hat{\delta}^2}, \tag{4}$$

where SSE_0 and SSE_1 are the residual sum of squares under H_0 and H_1, respectively; $\hat{\sigma}^2$ is the residual variance under H_1.

The null hypothesis of no threshold effect is rejected if the asymptotic *p*-value for $\mathrm{F}(\gamma)$ under H_0 constructed from the bootstrap is smaller than the desired critical value (e.g., 5%).

Secondly, when there is a threshold effect, the next interesting question is whether or not the threshold parameter $\hat{\gamma}$ is consistent with the true value of γ. Since γ is not identified under H_0, the asymptotic distribution is not standard, and the best way to form confidence intervals for γ is to form "no-rejection region" using a "bootstrap" method to simulate the likelihood ratio statistic for tests on γ. The null hypothesis is rejected when the likelihood ratio statistic value is too large and the *p*-value is less than the desired critical value (e.g., 5%) [38].

Then, if all tests are passed, the above steps can be repeated to test two or multiple threshold effects. In our study, we start by considering the double-threshold regression model, which is expressed as follows:

$$\begin{aligned} Innovat_{it} = {} & \mu_i + \beta_1 Ceosea_{it} I(Eu_{it} \le \gamma_1) + \beta_2 Ceosea_{it} I(\gamma_1 < Eu_{it} \le \gamma_2) \\ & + \beta_3 Ceosea_{it} I(\gamma_2 < Eu_{it}) + \alpha \sum CV_{it} + \varepsilon_{it} \end{aligned}. \tag{5}$$

In Equation (5), only the slope coefficient on $Ceosea_{it}$ switches between regimes depending on the value of an observable threshold variable Eu_{it}, while the slope coefficients on the other control variables are constrained to remain invariant [39]. In this way, we isolate the variable of interest and concentrate the analysis on the contingency effects in the relationship between the RCEO and enterprise innovation. The innovation-enhancing or -debasing effects of the RCEO will vary with the threshold condition.

3.2. *Variable Measurement*

3.2.1. Dependent Variable

The indicator commonly used to characterize the enterprise innovation level is patent application quantity [40]. The number of patent applications is a relatively good proxy for innovation capability because it reflects a better proxy for innovative output [41].

3.2.2. Independent Variable

As in Yuan and Wen [25], in our study, RCEO is constructed as a dummy variable, which is equal to 1 if the CEO is a returnee from overseas in year t, and 0 otherwise.

3.2.3. Threshold Variable

The key elements in a firm's external environment are customers, competitors, government regulations, and the labor market [42]. A firm's market characteristic can be parsimoniously characterized by the coefficient of variation of sales (CVS) [32,43]. The CVS is calculated over a five-year period (e.g. 2012–2016). Specifically, the coefficient of variation for sales is calculated as

$$CVS(Z_{it}) = \frac{\sqrt{\sum_{t=1}^{n} \frac{(z_{it}-\bar{z})^2}{n}}}{\bar{z}}, \quad (6)$$

where Z_{it} is the market uncertainty for firm *i* in year *t*, which is the residual of the model (7); $\bar{z}$ represents the five-year mean; in this case, n means five years.

$$Sale_{it} = \alpha_0 + \alpha_1 Year + \varepsilon_{it}, \quad (7)$$

where $Sale_{it}$ is the sale revenue of firm *i* in year *t*; *Year* is an ordinal categorical variable, and, in our analysis, *Year* is equal to 1 if *t* is 2016, *Year* is equal to 2 if *t* is 2015, ... , and *Year* is equal to 5 if *t* is 2012.

To mitigate industry effects, the CVS from previous steps is normalized by dividing it by the uncertainty measure for that firm's two-digit SITC code over 2012–2016, yielding the "final" firm-specific proxy for EU.

3.2.4. Control Variables

Following prior studies, such as Chen, Sharma, Zhan, and Liu [13], Haider et al. [44], Kieschnick and Moussawi [45], and Francis et al. [46], we control a variety of board and firm characteristics that may affect innovation capability in our regressions. For firm characteristics, we include firm age (*Age*), firm ownership (*Nature*), research and development staff (*Rdstaff*), asset–liability ratio (*Alr*), liquidity ratio *(Al)*, and shareholding ratio of the largest shareholder (*Concen*). For board characteristics, we include board size (*Mtbgm*), board average age (*Tmtage*), and returnee executive size (*Sumforeitm*), In addition, as the CEO's demographic characteristics reflect their cognitive mode and value [47], which may influence their decision behaviors, we include CEO ownership (*CEOshare*), CEO gender (*CEOgender*), and CEO duality (*CEOduab*). The details of variable construction are shown in Appendix A.

3.3. Sample

The empirical analysis uses all firms from electronic industry that were listed on the Shanghai and Shenzhen Stock Exchange (A) spanning the period 2012 to 2016 as our initial sample. Companies in the electronic industry are typical for this empirical analysis due to their inherent strong attraction to the returnee. We use annual accounting and board characteristics data from the Wind database and China Security Market and Accounting Research (CSMAR) database. Consistent with prior research, for a firm/year to be included in the sample, it must satisfy the following requirements: (i) non-missing comparability measures, (ii) non-missing firm and board characteristics, and (iii) a balanced panel data for the threshold regression model (Hansen 2000). The final balanced panel dataset covers 187 listed firms and 935 observations during 2012–2016, the detailed information can be shown in Supplementary Materials. We further winsorize all continuous variables at the top and bottom one percentile to eliminate the undue influence of outliers. STATA version 14.0 was used for calculation and analyses.

4. Empirical Research

We used the panel threshold model to analyze the possible asymmetric nonlinear relationship between the RCEO and innovation using EU as the threshold variable. Enterprise innovation ability was the explained variable, RCEO was the core explaining variable, and EU was the threshold variable. Simultaneously, we used a one-year time lag for our independent variable to reduce endogeneity problems.

4.1. Unit Root Tests

Before proceeding to the threshold regression, the time series properties of all variables were checked through the Harris and Tzavalis panel unit root procedures [48]. For this test, the null hypothesis is that there is a unit root [49]. The results in Table 1 reveal that nonstationarity cannot be rejected just in the cases of *Patent*, *Ceosea*, *Ceogender*, *Ceoshare*, *and Sumforeitm.* However, the five cases become stationary in their first logarithmic differences at any conventional level.

Table 1. Panel unit root test.

Variable	Statistic	z	*p*-Value
Patent	0.686	5.205	1.000
Δ *Patent*	−0.234	−15.001	0.000
Ceosea	0.630	3.636	0.999
Δ *Ceosea*	−0.500	−21.293	0.000
EU	0.000	−14.030	0.000
Ceogender	0.500	0.000	0.500
Δ *Ceogender*	−0.500	−21.283	0.000
Ceoshare	0.592	2.571	0.995
Δ *Ceoshare*	−0.488	−21.001	0.000
Ceoduab	0.259	−6.742	0.000
Sumforeitm	0.457	−1.198	0.116
Δ *Sumforeitm*	−0.267	−15.779	0.000
Mtbgm	0.281	−6.141	0.000
Tmtage	0.344	−4.384	0.000
Rdstaff	0.066	−12.192	0.000
Concen	0.435	−1.816	0.035
Age	0.000	−14.030	0.000
Nature	0.403	−2.721	0.003
Alr	0.186	−8.826	0.000
Al	0.360	−3.918	0.000

Notes: HT is the Harris and Tzavalis test for a unit root in the model. (***) signifies rejection of the unit root hypothesis at the 1% level. See Table A1 (Appendix A) for variable definitions.

4.2. Threshold Effect Test

The threshold effect was tested first. Recall that there are two tests, F and LR, where the former examines the significance of the threshold effect and the latter examines whether the threshold estimation value is equal to the true value. The two tests results are presented in Table 2.

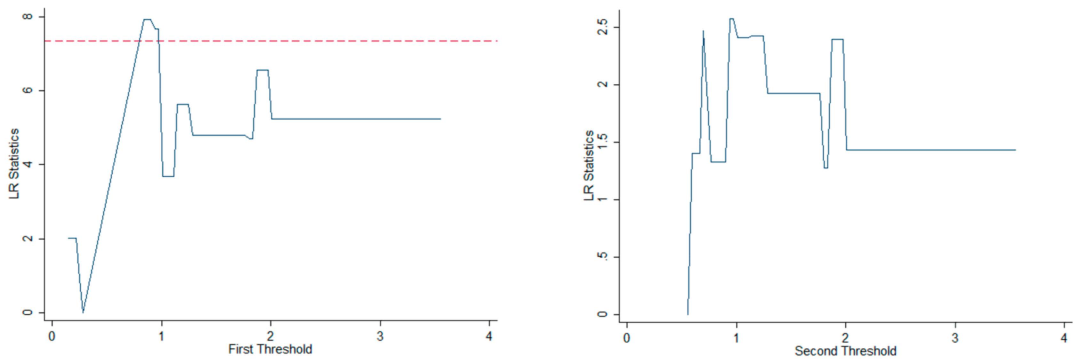
Table 2. Tests for threshold effects and threshold estimates.

Model	F-Value	*p*-Value	Critical Value			Threshold Value	Confidence Interval
			1%	5%	10%		
Single Threshold	0.817	0.072	7.488	4.342	2.902	0.283	0.145–3.561
Double Threshold	3.445	0.059	5.992	3.675	2.666	0.697	0.559–3.561
Triple Threshold	0.286	0.600	6.381	3.356	2.520		

Note: F-statistics and *p*-values are from repeating the bootstrap procedures 1000 times.

The *p*-values of the single, double, and triple threshold models were 0.072, 0.059, and 0.600, respectively. The threshold effect was significant for the single- and double-threshold model, at a significance level of 0.10 for both. The results reveal two threshold estimation values of EU, 0.283 and 0.697. Hence, a detailed analysis of the double-threshold model is provided. For the double-threshold model, there are three regimes, referred to as low-, moderate-, and high-uncertainty levels, and their EUs fall within the ranges 0–0.283 and 0.283–0.697, and exceed 0.697, respectively.

Once the thresholds were obtained, their confidence intervals were then examined to check whether the threshold of the EU estimate was equal to the real value. As discussed earlier, this can be achieved by computing the likelihood ratio test. (a,b plot the confidence intervals for the first and second thresholds, respectively. The EU is the threshold estimation value when the LR value is 0. As presented in (a,b, the corresponding threshold parameters of the EU were 0.283 and 0.697, respectively (see the value in the axis of Figure 1a,b). The confidence interval of the threshold estimation value was the interval of EU, which was less than LR = 7.3523 when the confidence interval was 95%. Hence, the 95% confidence intervals of the threshold estimation values 0.283 and 0.697 were 0.145–3.561 and 0.559–3.561, respectively. As the two threshold estimation values were contained in the corresponding confidence interval, the threshold of the EU estimate was equal to the real value [50].



(**a**) (**b**)

Figure 1. Confidence interval for the threshold. (**a**) First threshold in the two-threshold model; (**b**) second threshold in the two-threshold model.

4.3. Main Results

Table 3 reports the estimated results from the linear regression model and the panel threshold regression model. To better illustrate the nonlinear size of EU, we firstly estimated the fixed-effect model, a linear regression modeland found that RCEO was positive and significantly ($\beta = 149.5$, $p < 0.01$) associated with enterprise innovation, as shown in Model 1 of Table 3. However, EU negatively moderated the effect of the RCEO on enterprise innovation.

We turn now to the results of the estimation of the panel threshold model. Model 2 in Table 3 represents the regression slope estimates for the three regimes, which were distinguished by different regression slopes. In regime 1, where the EU was below 0.283, the estimate of the RCEO coefficient was positive, but insignificant ($\beta = 1.219$, $p > 0.1$). In regime 2, where the EU was between 0.283 and 0.697, the estimated coefficient was significantly positive ($\beta = 72.070$) at the level of 1%. In regime 3, where the EU was above 0.697, the estimate of RCEO coefficient was positive ($\beta = 8.664$), but insignificant.

As the larger threshold value was smaller than the mean $(0.697 < 1.428)$, we further divided the last regime into two regimes $(0.697 < EU < 1.428;\ EU > 1.428)$. By doing so, we could investigate why the coefficient on RCEO was insignificant when EU exceeded the larger threshold value.

Table 3. FE and threshold regression estimate of Equation (5).

Variables	Model 1 (Without Threshold Effects)	Variables	Model 2 (With Threshold Effects)
Ceosea	149.5 ***	*Low regime*	1.219
	(50.76)	*(EU ≪ 0.283)*	(0.135)
EU	−25.33	*Moderate regime*	72.070 ***
	(21.75)	(0.283 < *EU* < 0.697)	(3.999)
Ceosea × *EU*	−60.61 *	*High regime*	8.664
	(33.62)	*(EU ≫ 0.697)*	(1.031)

Table 3. *Cont.*

Variables	Model 1 (Without Threshold Effects)	Variables	Model 2 (With Threshold Effects)
L1. Ceogender	108.4	*L1. Ceogender*	−4.676
	(85.25)		(−0.167)
L1. Ceoshare	−0.000	*L1. Ceoshare*	0.000 ***
	(0.000)		(2.895)
L1. Ceoduab	31.20	*L1. Ceoduab*	2.633
	(31.53)		(1.452)
L1. Sumforeitm	16.64 **	*L1. Sumforeitm*	13.319 **
	(8.105)		(2.263)
L1. Mtbgm	2.843	*L1. Mtbgm*	−0.299
	(8.058)		(−0.158)
L1. Tmtage	−0.512	*L1. Tmtage*	−1.632
	(4.745)		(−1.538)
L1. Rdstaff	0.374	*L1. Rdstaff*	−0.204
	(0.770)		(−1.011)
L1. Concen	−0.469	*L1. Concen*	−0.3475
	(1.149)		(−1.189)
L1. Age	16.56 ***	*L1. Age*	12.156 ***
	(4.109)		(11.712)
L1. Nature	−16.39	*L1. Nature*	21.950
	(53.37)		(1.463)
L1. Alr	1.954 **	*L1. Alr*	0.174
	(0.936)		(0.897)
L1. Al	1.185 *	*L1. Al*	−0.116
	(0.609)		(−0.875)
Observations	935	*Observations*	935

Note: ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively. Standard errors are in parentheses.

4.4. Further Research

Table 4 presents the estimation results when the last regime was divided into two regimes. Consistent with our expectations, in Model 1, we found the estimated new coefficient on RCEO was still insignificant when the EU was between 0.697 and 1.428. However, in Model 2, the coefficient on RCEO was significant and negative ($\beta = -13.321,\ p < 0.1$) when EU exceeded 1.428. In sum, the results presented in suggested that any relationship at higher levels was either insignificant or notably negative. This means that the RCEO–innovation nexus in the case of China experiences threshold effects and asymmetries, challenging the widespread belief in the field of EU that the ongoing build-up of external environmental instability clearly threatens the effect of RCEO knowledge spillovers. Hence, on average, the net effect of RCEOs relative to their local counterparts on enterprise innovation was negative in high environmental dynamism—their disadvantages outweighed the advantages.

Over all, the results presented in, together with the significant and positive coefficient on RCEO in the second regime, lend credence to our hypothesis that the RCEO has a positive relationship with enterprise innovation in the moderate-uncertainty leverage regime but a negative relationship in the higher-uncertainty leverage regime. The findings are also in line with the emerging empirical evidence of the RCEO's non-monotonic relationship with enterprise innovation.

Table 4. Divided regimes regression estimation results.

Variables	**Model**1$(0.697<\boldsymbol{EU}<1.428)$	**Model**2$(\boldsymbol{EU}>1.428)$
Ceosea	4.563	−13.321 *
	(15.92)	(7.848)
L1. Ceogender	−63.93 *	3.049
	(36.97)	(15.86)

Table 4. *Cont.*

Variables	Model1(0.697<*EU*<1.428)	Model2(*EU*>1.428)
L1. Ceoshare	−1.71E−8	7.66E−10
	(1.84E−7)	(7.06E−8)
L1. Ceoduab	15.53	−2.897
	(11.57)	(10.84)
L1. Sumforeitm	3.529	3.261
	(5.338)	(2.049)
L1. Mtbgm	−7.534 *	−1.809
	(3.933)	(1.749)
L1. Tmtage	2.129	1.452
	(2.541)	(1.027)
L1. Rdstaff	0.159	0.327 **
	(0.332)	(0.162)
L1. Concen	−0.022	−0.186
	(0.637)	(0.211)
L1. Age	9.410 ***	0.412
	(2.296)	(0.525)
L1. Nature	0.746	20.18 **
	(18.43)	(9.562)
L1. Alr	−0.610	−0.305
	(0.405)	(0.239)
L1. Al	−0.505 *	−0.537 ***
	(0.291)	(0.159)
Observations	170	410

Notes: significance at 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively. Standard errors are in parentheses.

5. Robustness

An alternative measure of enterprise innovation was used to increase the robustness of the results. We measured firm innovation with net profit margin on sales [51], as it can reflect the quality of innovation.

According to Table 5, the results of the F-test and *p*-value show that the null hypothesis of threshold effect test of EU was rejected at the 1% statistical level only in the double-threshold model, showing that the RCEO–innovation model is a double-threshold model. The threshold values were 1.284 and 2.008. In addition, the 95% confidence intervals of the threshold estimation values 1.284 and 2.008 were 1.284–2.008 and 2.008–3.561, respectively.

Table 5. Tests for threshold effects and threshold estimates.

Model	F-Value	*p*-Value	Critical Value			Threshold Value	Confidence Interval
			1%	5%	10%		
Single Threshold	1.987	0.147	2.414	3.745	7.237	1.284	1.284–2.008
Double Threshold	7.580	0.009	2.395	3.729	7.481	2.008	2.008–3.561
Triple Threshold	0.378	0.521	3.128	4.263	8.255		

Note: F-statistics and *p*-values are from repeating the bootstrap procedures 1000 times.

Table 6 reports the effect of RCEO on innovation (net profit margin on sales) in the threshold model. If EU is less than 1.284 (regime 1), a 1% increase in RCEO may significantly contribute to a 0.938% increase in innovation. If EU is above 1.284 and below 2.008 in Regime 2, a 1% increase in RCEO may significantly lead to an 11.253% increase in innovation at the 1% statistical level. If EU exceeds 2.008 in Regime 3, a 1% increase in RCEO can bring about a 3.341% decrease in innovation at the 1% statistical level. The results of this robustness test using an alternative measure of enterprise innovation were similar and suggested the same conclusion.

Table 6. The effect of returnee chief executive officer (RCEO) on innovation in the threshold model.

Variables	Threshold Effects
Low regime	0.938 *
(EU ≪ 1.284)	(0.544)
Moderate regime	11.253 ***
(1.284 < EU < 2.008)	(2.152)
High regime	−3.341 **
(EU ≫ 2.008)	(1.492)
L1. Ceogender	2.123
	(1.836)
L1. Ceoshare	0.000 ***
	(0.000)
L1. Ceoduab	0.550
	(0.776)
L1. Sumforeitm	0.106 **
	(0.183)
L1. Mtbgm	0.065
	(0.047)
L1. Tmtage	0.005
	(0.117)
L1. Rdstaff	0.029
	(0.019)
L1. Concen	0.084 ***
	(0.032)
L1. Age	−0.582 ***
	(0.119)
L1. Nature	−0.084
	(1.246)
L1. Alr	0.005
	(0.025)
L1. Al	0.081 ***
	(0.014)
Observations	935

Notes: significance at 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively. Standard errors are in parentheses.

6. Discussion

There are valuable, theoretical, and practical policy implications that emerge from the empirical results [52], from which scholars and managers can considerably benefit.

6.1. Theoretical Contributions

This study aimed to explain the conflicting findings about the impact of an RCEO on enterprise innovation by examining the complex mechanism of the RCEO on firm innovation and investigating why and when an RCEO might benefit or hamper firm innovation. This study shows the mechanism via which an RCEO has a positive and a negative effect on firm innovation. An RCEO has a positive effect on enterprise innovation when firms operate in the environment with moderate uncertainty but a negative effect on enterprise innovation when firms operate in the environment with high uncertainty.

By investigating the complex mechanisms and contingencies of RCEOs on firm innovation, this study makes three incremental contributions to the RCEO literature. Firstly, this study extends the knowledge on the dual roles of RCEOs from a nonlinear perspective, thus providing a complete understanding of the positive and negative effects of firm innovation. Over the past few decades, the study of RCEOs attracted significant attention from different research fields [53–60]. However, the majority of research focuses on the linear relationship between RCEOs and innovation while neglecting the nonlinear effect of RCEOs on innovation, leaving an incomplete picture of the RCEO's role.

Secondly, by categorizing environmental uncertainty into three regimes and comparing their different implications, this study helps reconcile conflicting findings about the threshold effect of environmental uncertainty on the link between RCEOs and firm innovation. Our findings show that the RCEO has a positive effect on innovation when firms operate in an environment with moderate uncertainty, while also has a negative effect on innovation when firms operate in the environment with high uncertainty, thus explaining why previous studies generated inconsistent findings on the moderating role of environmental uncertainty.

Thirdly, we measured firm innovation with patent application quantity as it can reflect the quantity of innovation. We also measured firm innovation with net profit margin on sales as it can reflect the quality of innovation. Our findings are robust to using net profit margin on sales yields as alternative measures of patent application quantity.

Finally, our findings further deepened the imprinting theory by exploring the interaction between a CEO's overseas experience and the current environment in which they operate.

6.2. Managerial Implications

Our study has some important implications for firms and policy-makers in emerging countries. Firstly, our findings show that firms place too much stress on a CEO's overseas experience but neglect their external environment, which might expose the firm to potentially lower innovation performance. Therefore, when designing the programs, CEO recruitment and training programs should consider the beneficial and detrimental roles of the returnee, especially in turbulent environments.

Secondly, our findings reveal that RCEOs should also be like contingent CEOs, and their behavior should align with the firm's environmental uncertainties. In other words, we recommend that RCEOs should adjust their behavior to better adapt to the prevailing environment faced by their firms. In addition, training programs could be provided to help RCEOs change their behavior, with continuous direction toward the changing trends in technology and customer market.

Thirdly, there should be a series of policies to mitigate the potentially harmful effect of RCEOs. Our study suggests that governments should build some appropriate social network platforms to help returnees develop business communities and political capital in their local countries, as well as obtain local market knowledge. Doing so can allow RCEOs to overcome their disadvantages in organization innovation activities.

7. Conclusions

Prior literature that examines the effect of returnee CEOs on enterprise innovation in turbulent environments mainly uses linear models and achieves complex results. Conversely, this paper uses a nonlinear model to study the relationship between RCEOs and innovation using environmental uncertainty as the threshold variable.

We use a panel threshold model to examine the threshold effect of the RCEO on enterprise innovation based on firm leverage panel data from 187 publicly traded electronic firms in China for the period 2012–2016. There are three primary conclusions: (i) on balance, the RCEO has a significant and positive effect on firm innovation. This finding supports our argument that the RCEO has advantages in terms of advanced knowledge and management experience from developed countries, and disadvantages in terms of a lack of business community and political capital in their local countries, and limited local market knowledge. What is more, their advantages outweigh the disadvantages; (ii) the double threshold effect of the RCEO on enterprise innovation is significant, and the consistencies of the threshold estimation value and the threshold real value are tested using the LR function diagram; (iii) the empirical results show an inverted-U correlation between returnee CEO and innovation. Specifically, the returnee CEO significantly promotes innovation at moderate levels of environmental uncertainty, whereas any relationship at higher levels is either insignificant or notably negative.

The above findings can explain why and when an RCEO has the discordant complex effect on enterprise innovation. Moreover, our findings offer important implications for firms and policy-makers operating in emerging economies.

Limitations and Future Research Directions

This study involved certain limitations that require consideration. Firstly, the variables used in this study do not exhaust all variables in a fully developed supply-side model. To address this concern, it could be beneficial for researchers to include additional variables such as financial constraint and the geographies of marketization in future studies.

Secondly, we selected environmental uncertainty as one threshold variable to explain the complex mechanism of the RCEO on firm innovation, but there may be other contingency variables that could moderate this relationship, and they deserve further investigation in the future.

Thirdly, our empirical results were derived from a sample of electronic firms in China, thus raising concern about the universality for other emerging economies. Hence, future research is necessary to test the validity of the hypothesis in other countries.

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Appendix A

Table A1. Variable definitions. R&D—research and development.

Variable Name	Variable Symbol	Variable Value Method and Main Specifications	Mean	SD
Enterprise innovation	*Innovat*	Patent application quantity	118.253	440.157
Returnee CEO	*Ceosea*	*Ceosea* is “1” if a firm’s CEO is a returnee and “0” otherwise	13.4%	
Environmental uncertainty	*EU*	The coefficient of variation of sales over a five-year period	1.428	1.466
Firm ownership	*Nature*	A dummy variable, 1 = private enterprise, 0 = others	72.7%	
CEO ownership	*CEOshare*	Shares CEO owns	2.26E7	6.37E7
CEO gender	*CEOgender*	1 = male, 0 = other	96.5%	
CEO duality	*CEO duab*	A dummy variable that is equal to one if the CEO is also the chairman and zero otherwise	89.20%	
Returnee executive size	*Sumforeitm*	The number of overseas executives in the enterprise	1.056	1.443
Board size	*Mtbgm*	Total number of directors	18.141	4.299
Average age of the board	*Tmtage*	The directors’ average age	46.869	2.886
R&D staff	*Rdstaff*	The number ratio of the R&D employees to the total staff	26.596	16.428
Ownership concentration	*Concen*	Shareholding ratio of the largest shareholder	32.990%	13.712
Enterprise age	*Age*	The time between the initial creation of a company and the present time (in years)	14.872	5.343
Asset-liability ratio	*Alr*	The book value of total debt over assets	33.634	18.816
Liquidity ratio	*AL*	Current assets/total assets	35.649	24.664

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