Journal of Open Innovation: Technology, Market, and Complexity

MDPI

Article

Antecedents of Technological Diversification: A Resource Dependence Logic

Xuanjin Chen

School of Economics and Management, Tsinghua University, Beijing 100084, China; chenxj.15@sem.tsinghua.edu.cn

Received: 29 August 2019; Accepted: 27 September 2019; Published: 7 October 2019

Abstract: This paper extends resource dependence logic by investigating the antecedents of technological diversification and further identifies its boundary condition. We argue that this resource dependence logic is bound by state ownership through coalitions with firms, a less discussed component of interdependence. The empirical results, based on a panel data analysis of Chinese listed firms, suggest that environmental dynamism positively relates to technological diversification, while environmental munificence negatively relates to technological diversification. These relationships changed when state ownership is considered. The theoretical implications for resource dependence theory and diversification research are discussed.

Keywords: technological diversification; resource dependent theory; environmental dynamism; environmental munificence; state ownership

1. Introduction

Diversification is a central topic in resource dependence theory (RDT). However, since the seminal work of Pfeffer and Salancik [1], most work has been concentrated on joint ventures [2], and mergers and acquisition [3] as ways to manage interdependencies and lessen uncertainties between firms and environment (for a recent review see Hillman, et al. [4]). Among the few exceptions, diversification is mostly treated as an independent variable rather than a phenomenon that needs to be explained [5]. In my view, this emphasis is biased. If diversification has a positive role in affecting firm outcomes, then its antecedents deserve more concerns. Although Pfeffer and Salancik [1] theorise that interdependencies can be managed through exchange and ownership, existing research largely draws its theoretical frameworks from the exchange, neglecting ownership as the boundary of interdependencies [6].

To address the research gap, this paper extends RDT by considering the antecedents of technological diversification from a relational view [7] and investigating ownership's role as a boundary condition of interdependence. Firms, according to RDT, diversify in order to absorb constraints and reduce interdependencies from (the actors in) the environment [8,9]. The way that firms interact with their environment thus exerts a compelling influence on the diversification patterns of firms. The study distinguishes two different but interrelated environmental dimensions: environmental munificence and environmental dynamism [10] to see how they affect the interdependencies and further determine diversification behaviour. Although the mechanisms by which firms identify and manipulate resources in the environment to diversify are identified in the RDT literature [1,4,11], there is limited empirical evidence of the antecedents of firm diversification strategy. Further, we argue that firm-environment interdependence can also be altered by state ownership through coalition [12], leaving ownership as an important boundary condition of interdependencies. Although much work has been done to deepen the understanding of RDT, scholars also call for more attention to be paid to the boundary conditions of RDT, which help to refine the precision of its predictions [4,6].

This paper aims to make two contributions. First, this study fills the diversification research by investigating the antecedents through the lens of RDT. Although an important concept to demonstrate the ideas of RDT, diversification has not drawn as much attention as joint ventures, and mergers and acquisition. In technological diversification research, most studies regard it as an approach to improve firm performance, and little attention has been paid to the antecedents of diversification, and even fewer on the basis of RDT. We extend the diversification research by incorporating the antecedents of diversification through the lens of constraint absorption and reducing interdependence from the external environment. Since the main purpose of firms in the view of RDT is to reduce uncertainties and manage interdependence rather than improve performance [13], a firm's attempts to change their power in the environment and manage interdependence should be given consideration. We thus provide a unique lens through which to study diversification behaviour.

Second, this paper enriches RDT by emphasising a triadic relationship, incorporating state ownership beyond the traditional dyadic relationship between firm and environment. As noted earlier, RDT research focuses on interdependence through the exchange, largely neglecting ownership which can also shape the relationship. In this paper, I argue that state ownership is a powerful actor that forges the state-firm relationship and further alters firm-environment dependence and power relations through a coalition in which triadic networks collapse into dyadic (state firm)-environment relationships (see Emerson [12]). In this way, the understanding of interchange and interdependence through ownership are extended.

2. Theory and Hypothesis

From the view of RDT, the strategy of a firm is not intended to manipulate resources and maximise output, rather, it is to absorb external constraints and acquire resources [5]. In other words, due to the resources scarcity, the priority of companies is not to use resources but gain access to resources in ways that least compromise autonomy. The interaction and interdependence of firms and environmental actors are thus vital to a firm's survival. In RDT, power is a useful concept with which to describe the interdependence. Power refers to the control of resources that firm value and that are not available elsewhere [14]. In an interdependence relationship, firms are constrained by powerful actors with whom resources are exchanged [15,16].

Adaption (or cost-reduction strategy) and avoidance (or balancing operations) are two approaches to managing this interdependence and power asymmetry [1]. Adaptation involves changes in the firm strategy in deference to the environment [17]. While adaption can manage interdependence, it can be also problematic. This strategy gives up scope for action and also increases the probability of future demands because other actors judge the success of earlier attempts at influence as an indicator of future success [18]. In short, organisational compliance increases other kinds of dependence and thus loses autonomy [4,19,20]. Avoidance strategy, on the other hand, eases the tensions of interdependence by escaping current relationships [6]. Diversification is a kind of avoidance strategy which enables firms to engage in another relationship setting [1]. In this way, firms diversify in order to absorb constraints and mitigate power asymmetry [21,22].

2.1. Diversification through the Lens of RDT

At first, interdependence was considered a monolithic construct to illustrate both the exchange and power relations between different actors, however, building on Emerson [12] dyadic approach to the power and dependence notions, interdependence can be unpacked into two dimensions: power imbalance (or power advantage) and mutual dependence (or joint dependence) [2,16]. These two dimensions are analogous to Emerson's dependence asymmetry and cohesion concept [12]. Power imbalance refers to the difference between dependencies, and mutual dependence relates to the sum of the total dependencies between two actors. Imagine two actors, A and B, are exchanging resources, and therefore depend on each other, and that A has more power than B in the relationship, thus giving A a power advantage in the relationship. A can use this advantage to negotiate with B for

a better contract for trading and even can force B to accept unfavourable conditions that A offers [23]. To balance this asymmetry, Firm B can either 1) search for alternative resource sources to reduce B's dependence on A, or 2) to mitigate the relative importance of the resource that B needs in order to reduce the power of A. Diversification is a way to achieve both goals [24]. On the one hand, firms using diversification strategy can obtain resources from alternative sources, apart from A, in the unbalanced power relationship, on the other hand, diversifiers can mitigate the relative importance of the resource A provides that results in the power imbalance.

While the understanding of antecedents of diversification is rather limited, the efforts arising from RDT are even less. We argue that efforts to utilize RDT to investigate the antecedents of diversification will deepen the understanding of RDT as well as diversification, by considering firm-environment interdependence through the logic of resource dependence.

2.2. Ownership as a Boundary Condition

Interdependence is not a single faceted construct, rather it depends on two components of interdependence: the importance of resources (magnitude of exchange) and another partner's control of this important resource (discretion or ownership) [4,25]. In this vein, A's dependence on B relies on 1) that B has the resources that A needs; and 2) that B has the power to dispose of the resources needed by A (i.e., discretion). Most RDT studies focus on mitigating the power imbalance from the resource importance view (that is how to acquire resources from other places to mitigate the relative importance of resources in B), neglecting another fact of interdependence—discretion. Xia, Ma, Lu and Yiu [6] concluded "RDT assumes that all exchange actors have the discretion to diversify so as to reduce the constraining dependence on their current exchange partners. This assumption, however, may be less realistic since some actors do not have such discretion due to a lack of ownership control over the use and allocation of the firm's resources" [6]. By and large, discretion can be an effective way to manage interdependence between different actors and this effect is largely ignored in previous research.

Overlooking discretion limits the applications of RDT theoretically and empirically. In theory, the omission of discretion fails to fully capture the essence of interdependence. That is, not only resources matter, but the ownership of the resources is largely determined by the power advantage in a relationship. In practice, without understanding discretion, findings are hard to generalise to other dependence situations [6]. In fact, managing interdependence by ownership is not meant to mitigate the magnitude of exchange but rather to stabilise the exchange flow [2]. In this research context, considering ownership enables us to see how the firm-environment relationship alters in response to the involvement of firm ownership. This may offer us a more refined view of the antecedents of diversification beyond the simple consideration of a firm-environment relationship.

Recently, ownership has attracted much consideration, especially in emerging economies [26–28], and states have been considered powerful actors who can influence interdependence and capture its essence beyond the magnitude of exchange. In ownership research, China draws most attention since it has been considered as a transitional economy, which has state-owned enterprises as well as private firms [29,30]. Since the institutional reform and privatisation of firms in China, enterprises in transitional economies are now characterised by hybrid ownership [28,31], with the state holding various proportions of firm shares. In this situation, the state remains an influence in company decisions and strategy-making processes, to different extents, as well as facilitating firms by offering different institutional and policy support [32].

In this paper, we will investigate how ownership changes dyadic firm-environment interdependence through the exchange theory [12]. In the interdependence between A and B, when actor C comes enters the A-B relationship, the power advantage may be changed or mitigated if C forms a coalition with A against B [14]. On this occasion, the triadic relationship between A, B and C can become dyadic as "the proper representation of coalitions in a triad would be (AB)-C, (AC)-B, or (BC)-A. That is, a triadic network reduces to a coalition only if two members unite as a single actor in the process of dealing directly with the third." [12].

If we put this idea into the research context, state ownership is a powerful actor (i.e., actor C) that changes the interdependence between a firm (i.e., actor A) and the environment (i.e., actor B), State ownership thus represents a form of firm-state coalition in which the state and firm combine into one actor against the other actor. When the state is considered, the triad of firm, environment and state is reduced to a coalition, as the (state-firm)-environment. We argue that with different levels of state ownership, firms will respond to the environment differently, as the government serves as an alternative resource for firms to reduce the power imbalance from the external environment, and protects firms by reducing uncertainties through favourable policies and regulations.

2.3. Hypothesis

2.3.1. Antecedents of Technological Diversification Through Firm-Environment Interdependence

Since organisation theorists characterised organisations as open systems rather than closed systems [33], the environment's role in facilitating or hindering the organisational process, outcomes, structures and strategies are largely fulfilled. The environment of a firm is defined as "the totality of physical and social factors that are taken directly into consideration in the decision-making behaviour of individuals in the organization" (Duncan, 1972: [34]). In this vein, firms decide their diversification strategy on the basis of environmental factors such as uncertainty and competition, as these factors will shape the interdependence between firm and environment. The environment generates both opportunities and threats, forcing firms to respond [35]. If resources in the external environment are unstable, firms are more likely to implement a diversification strategy to release tensions and controls from a single source of technological and other resources. By contrast, in a resource-stable environment, the power of the environment is largely reduced to alternative resources which can be secured to mitigate uncertainty. For example, Peng and colleagues [36] found that firms in countries where institutional infrastructure is underdeveloped are more likely to diversify, due to their need to seek critical resources from other domains to complement the insufficient support of the institution. From the RDT view, this can be explained by a firm's desires to reduce its dependence on the environment by adding more resource providers and reducing uncertainties by implementing multiple projects [37].

The environment is a multifaceted phenomenon. Although many theorists have theorised dimensions of the environment, the most recognised is Dess and Beard's work. Following Aldrich [38], Dess and Beard [10] unpack the environment into three dimensions: dynamism, munificence and complexity. Perhaps an important reason making this paper seminal in the environmental study is that they also provide an explicit means to measure each dimension, with which subsequent papers can test their frameworks. The two dimensions are mostly mentioned in the literature as they are considered to be orthogonal and cover some aspects of complexity, especially in transition economies [39,40]. Following this lead, we also focus on the constructs of dynamism and munificence to measure the environment.

Environmental dynamism refers to the unpredictability, uncertainty and rate of change in an organisation's environment [41]. This construct captures to "some extent the underlying theme of unpredictable change" [42]. We argue that in a dynamic environment, firms will have more incentives to achieve a higher level of technological diversification. As noted by RDT, diversification is a strategy to address an interdependent relationship with the environment either within or beyond firms' boundaries. In a fast-changing and unpredictable environment, firms need to pay more attention to gaining access to resources from the environment. In this volatile situation, securing resources, especially technological resources, from a single source is far from realistic, as uncertainty is the main reason for unpredictability. By contrast, when an environment is stable and less fierce, firms can secure resources from a single source without losing autonomy. In this environment, diversification, although it can mitigate the interdependence of firms and environment, may have higher costs than potential profits, as searching for other alternatives in a stable environment is not necessary, and may even be harmful to existing paradigms [43]. In conclusion, in a dynamic environment, firms are

more likely to diversify in order to mitigate the power imbalance of the environment and manage interdependence by obtaining multiple technological resources [44]. Following this logic, we propose the hypothesis:

H1: *Environmental dynamism positively relates to technological diversification.*

Environmental munificence refers to the richness of external resources for future growth [45]. Although the research on munificence is limited compared with dynamism, its impact on organisational strategies [46], decision processes [47], firm structure [48], and firm output [49] is well documented. In this paper, we propose that in a munificent environment, firms are less likely to be technological diversifiers.

When the external resources are rich, the interdependence of a firm and the external environment are well organised, and any power imbalance is reduced, as firms can obtain resources from other providers in the environment. In this sense, firms can be specific in limited technological fields without an overemphasis on narrow niches of technology that would constrain the flexibility of the strategy as resources are available in the external environment. By contrast, when resources in the external environment are scarce, diversification is a practical strategy to avoid losing autonomy. In a resource-scarce environment, living on a single technology is potentially dangerous for firms. Because in this environment, firms that are technologically specific would rely on narrowed resource providers thus increasing dependence on the environment. From the perspective of RDT, firms would try to use a diversification strategy to escape from the constraints of single-source input from the environment, especially when the external resources are limited [1].

There is fruitful research evidence to support our argument. For example, Wan [50] found that a country's resource environment, including factors and institutions, would affect a firm's diversification patterns. He noted that in developed countries, "firms have efficient access to an abundant supply of environmental resources and competition is fierce ... low levels of product diversification allow firms to devote more attention to a single or a few related product markets to sharpen its competitive edge in production efficiency or enjoy economies of scope ... managing a diverse business portfolio may also cause significant strain on managerial information processing capacity, negatively affecting overall firm performance in these economies" [50].

In conclusion, we argue that in munificent environments, firms have fewer incentives to become diversifiers, as firms can rely on a limited source of technology input without compromising autonomy.

H2: *Environmental munificence is negatively related to technological diversification.*

2.3.2. Boundary Conditions of Ownership

As we expect that firm-environment interdependence would determine the diversification patterns of firms, we also suggest that this relationship is shaped by state ownership. Scholars believe that state ownership tends to be higher in emerging economies due to market failure and poor protection of property rights [51]. Most empirical research supports the adverse effect of state involvement, including lack of innovation, poor financial performance and increased corruption [51].

We expect the state ownership may exert different moderating effects on the relationship between environmental munificence, dynamism and technological diversification, however. In addition to adverse effects, ownership mechanisms can lead to relational advantages [52], as ownership-based arrangements can improve inter-organisational learning [53], and stabilise important supply relationships [24] and governance hierarchical coordination problems through internal communication and negotiation [26,54]. With the powerful actor involved, the power imbalance will be mitigated, as government and firms align as one party against the environment. In this paper, we summarise the effects of state ownership through its two roles: 1) supply resource and 2) supply protection.

We argue that state ownership negatively moderates the relationship between environmental dynamism and firm technological diversification. First, the government provides firms with resources that will become alternative sources to the external environment. This is especially the case in developing countries where institutional and market infrastructure are underdeveloped [55]. In these countries, due to market inefficiency, acquiring resources from the government is a more direct and easier method [56,57]. Coalition with the government thus gives firms more direct and easy access to the vital resources that they need. From the view of RDT, the alternative resources available will compromise the power imbalance between the firm and environment. Governments would buffer firms from the control of the external environment [58]. Governments will absorb turbulence and uncertainties on behalf of the firm. In this case, firms would maintain autonomy without compromising the power from their interdependence with the external environment. These firms thus have fewer incentives to engage in an escape strategy because they can be less dependent on the environment as either alternative resources available or by shielding the government from bargaining processes with the external stakeholders.

As argued earlier, in a dynamic environment, firms have incentives to become diversifiers in order to reduce the power imbalance from an unstable relationship. This argument, however, would change if we consider state ownership. With a higher level of state ownership, firms can either gain access to vital resources from the government or be protected by the government from the constraints of other resource providers [6]. We would thus expect that even in a dynamic environment, firms with higher levels of state ownership have less incentive to become diversifiers. In contrast, with a low level of state ownership, the relationship between firm and environment is irreplaceable. Firms are required to negotiate with the environment to gain access to resources, and are thus more constrained to the external environment. Following this logic, we propose:

H3: *State ownership negatively moderates the effect of environmental dynamism on technological diversification.*

On the other hand, in a munificent environment, as argued earlier, firms are less likely to become diversifiers. We argue that the negative effect between environment munificence and technological diversification will amplify with the buffer effects of government. To be specific, with resources and protection from the government, firms have even less incentive to diversify. The stable and abundant resources in the environment and government enable firms to invest and reconfigure their technology input into relatively narrow inches without compromising autonomy. Studies have confirmed that the concentration of state involvement is higher in emerging economies, than in developed countries [59], and government involvement would legitimate a firm's behaviour [60], thus making the firms' decisions stable without the intervention of the external constituents [61]. Thus,

H4: *State ownership positively moderates the effect of environmental munificence on technological diversification.*

We propose a framework for the study as suggested by the model in Figure 1.

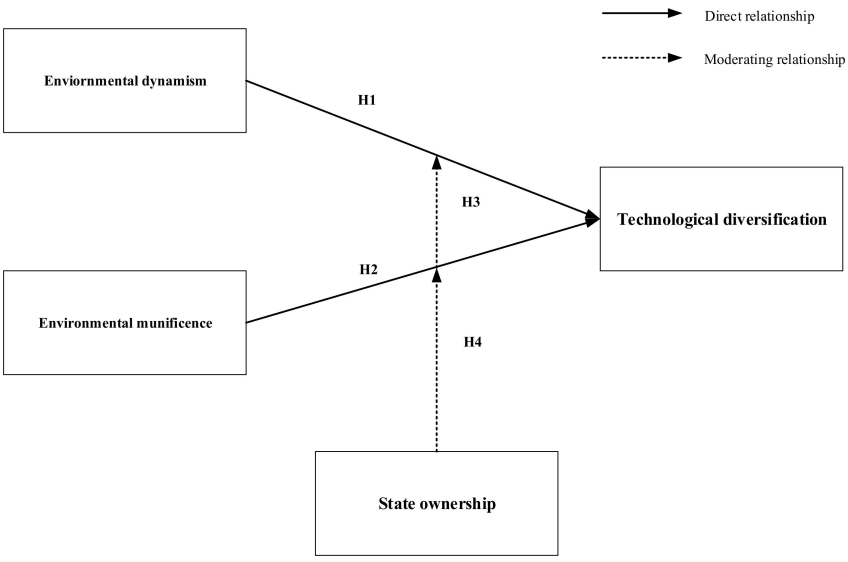

Figure 1. Conceptual framework.

3. Data and Method

3.1. Sample Collection

The data of this paper comes from a combination of two different sources. First, we manually collected the patent data of Chinese listed firms from the China National Intellectual Property Administration (CNIPA) and obtained 846,838 observations. This part data was used to calculate technological diversification.

We then accessed the financial data of each listed firm from the China Stock Market and Accounting Research (CSMAR) database. CSMAR contains all the financial data collected from the annual report of Chinese listed firms. This dataset has been found reliable and extensively used regarding the Chinese firm's governance performance [62], social responsibility behaviour [63], outward foreign direct investment [6] and other related management fields.

3.2. Variable Definitions

3.2.1. Dependent Variable

The dependent variable in this paper is technological diversification (*TD*). There are various measures identifying technological diversification, including the Herfindahl-Hirschman Index (HHI) [64], revealed technological advantage (RTA) [65] and entropy index [66]. Jacquemin and Berry [67] demonstrated that the entropy value is a more effective measurement of the degree of diversification. They compared diversification values using the Herfindahl index and entropy index and verified the effectiveness of the entropy value [68]. Here, we follow the research of Wang, et al. [69] and Wang, et al. [70], taking the entropy index to measure technological diversification. This measure considers both the number of patents active in a region as well as the relative distribution of patents across the patent classes. The measurement of TD is as follows:

$$TD = \sum P_i \ln 1/P_i \quad (1)$$

where P_i represents the share of patents accounted for by the i_{th} technology in each firm. In this study, the standard IPC classification of the patent was taken into consideration which consists of eight classes (see Appendix A). As a result, these indicators suggest how even firms' technological patents are distributed.

3.2.2. Independent Variables

In this paper environmental munificence (EM) and environmental dynamism (ED) are the independent variables. The unit of analysis is the profit of a focal firm's industry. Following the seminal work of Dess and Beard [10], environmental munificence is operationalised as the growth rate in the value of profit, which is the regression slope coefficient for this period divided by the industry mean. Similarly, environmental dynamism (ED) is the standard error for this period divided by the industry mean.

3.2.3. Moderating Variable

The moderating variable is state ownership. Unlike previous research (e.g., Marquis and Qian [63]) which treated state ownership as a 0-1 dummy. This paper argues that different levels of state involvement affect the firm-environment relationship to different extents. We therefore construct a continuous variable to indicate different levels of government involvement. Following the research of Wei and Varela [71], we measure state ownership as the ratio of state equity within the firm.

3.2.4. Control Variables

In this paper, we control a series of variables. First, at the firm level, several firm characteristics are introduced. We control for firm size (Size) measured as the number of employees and firm age (Age) measured as the number of years between the firm's founding year and the current year. Second, we control for several corporate governance variables. Z score (Shrz) is measured as the ratio of the first shareholder's shareholding proportion divided by the second shareholder's shareholding proportion. This metric indicates the relative power control of the first shareholder [72]. The Herfindahl 3 (Shrhfd3) index is measured as the sum of squares of the first three shareholders' shareholding proportions. Leverage (Leverage) is defined as total debt divided by total assets. We also controlled for R&D and advertising intensity (R&D intensity) by including both, scaled by total sales. Under the current accounting regulations, Chinese firms do not report R&D spending [73], however, they provide R&D and advertising expenses as a combined figure. At last, we also control for the time effect by introducing the year dummies.

3.3. Estimation Methods

This study adopts a generalised estimating equation (GEE) to estimate the parameters. This is because the variables, such as technological diversification and firm age, are variables with limited values, and thus the generalised estimating method is more appropriate for this kind of data [74]. It has been demonstrated that GEE is more efficient than other panel data methodologies because it provides multiple correlation matrix structures to best match the data [75].

The dependent variable is abnormally distributed and over-dispersed, which means we cannot select the distribution as normal, however, linear regression modules would lead to biased, inefficient, and inconsistent estimates in cases in which the dependent variable is not normally distributed, and therefore, we have to adopt a non-linear method to meet the needs. In conclusion, the abnormal and over-dispersion, along with the limited values of the variables, made a non-linear model implemented by GEE best suited to the data.

3.4. Statistical Interpretation

Given the non-linear nature of the models, previous studies suggest that the estimated coefficients do not represent marginal effects, making the interpretation of results difficult [76]. We adopt the recent methodology advanced by Wiersema and Bowen [77] and Bowen [78], who proposed that the moderate effect of non-linear models consists of a non-linear part and a so-called secondary effect. In this paper, we conduct the regression and present the results following the recommendation of Wiersema and Bowen [77].

4. Results

Table 1 reports the descriptive statistics and correlations of all hypothesised and control variables. No correlations are above the 0.65 threshold, suggesting that the estimations are not likely to be biased by multicollinearity problems [79]. All the variance inflation factors are below 10, indicating that there is no multicollinearity problem [80]. We find that EM is negatively related to technological diversification, while ED is positively related to technological diversification, which provides preliminary support for the hypothesis.

Please note that we report both the regular coefficient and marginal effect at variable means to reveal the nature of the non-linear model. Table 3 shows the results of the GEE regression models. Model 1 is the base model, including all the control variables. Models 2 to 5 separately test the main effect and the moderating effect of state ownership respectively. The value of χ^2 statistics suggests that all the models are statistically significant.Hypothesis 1 predicts that environmental dynamism positively relates to technological diversification. In Model 2a, we find that the coefficient of environmental dynamism is 0.836, and significant at 5% level, and moreover, the marginal effect on technological diversification at environmental dynamism means in Model 2b is also positive and significant ($\beta = 0.428, p < 0.05$). Thus, Hypothesis 1 is supported.

Hypothesis 2 predicts that technological diversification stems from environmental munificence. In Model 3a, we find that the coefficient of environmental munificence is negative and significant ($\beta = -4.570, p < 0.01$), and the marginal effect on technological diversification at environmental munificence mean in Model 3b is also negative and significant ($\beta = -2.349, p < 0.01$). Thus, hypothesis 2 is supported.

Hypothesis 3 predicts that state ownership negatively moderates the relationship between environmental dynamism and technological diversification. In Model 4a, we find that the coefficient of environmental dynamism is still positive and significant, indicating that the findings for Hypothesis 1 are robust. The interaction term of state ownership and environmental dynamism is negative and significant ($\beta = -0.197, p < 0.01$). The marginal effect of the interaction terms on its means in Model 4b also gave the same result ($\beta = -0.099, p < 0.01$). Figure 2 elaborates the marginal effect of environmental dynamism on technological diversification through state ownership. We can see from Figure 2 that the marginal effect is decreasing with ownership, indicating a negative moderating role. In conclusion, Hypothesis 3 is supported.

Table 1. Descriptive statistics and zero-order correlations [abc.]

	Variable	Mean	SD	VIF	1	2	3	4	5	6	7	8	9	10
1	Diversity	0.57	0.47											
2	EM	0.03	0.02	1.07	−0.045									
3	ED	0	0.09	1.11	0.055	−0.243								
4	Ownership	0.13	0.22	1.32	0.008	0.010	0.056							
5	Size	7.63	1.17	1.18	0.222	−0.041	0.140	0.197						
6	Age	10.89	4.8	1.14	0.077	0.016	0.055	−0.183	0.146					
7	Shrz	18.06	47.52	1.21	0.033	−0.009	0.024	0.285	0.137	−0.009				
8	Shrhfd3	0.19	0.13	1.42	0.088	−0.014	0.050	0.421	0.207	−0.220	0.382			
9	Rndintensity	0.06	0.09	1.13	−0.046	0.007	−0.053	−0.130	−0.053	0.050	−0.071	−0.086		
10	Leverage	0.43	0.29	1.21	0.052	0.050	0.120	0.116	0.228	0.145	0.070	0.007	0.265	
11	Ownership	0.13	0.22	1.32	0.008	0.010	0.056	1.000	0.197	−0.183	0.285	0.421	−0.130	0.116

Notes: [a] 1657 firms, 7359 observations, [b] correlations >0.02 in magnitude are statistically significant at 0.05 level or higher, [c] The year dummies are not included.

Table 2. GEE estimations of the antecedents of technological diversification.

DV:Tobin's Q	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b	Model 5a	Model 5b
	Coefficient	Marginal Effect at Variable Means	Coefficient	Marginal Effect at Variable Means	Coefficient	Marginal Effect at Variable Means	Coefficient	Marginal Effect at Variable Means	Coefficient	Marginal Effect at Variable Means
Size	0.122 ***	0.062 ***	0.118 ***	0.060 ***	0.119 ***	0.061 ***	0.108 ***	0.054 ***	0.104 ***	0.052 ***
	(7.06)	(7.02)	(4.72)	(4.65)	(6.73)	(6.69)	(6.29)	(6.25)	(6.23)	(6.18)
Age	0.029 ***	0.015 ***	0.028 ***	0.015 ***	0.030 ***	0.015 ***	0.026 ***	0.013 ***	0.028 ***	0.014 ***
	(8.66)	(8.68)	(5.03)	(5.02)	(8.77)	(8.79)	(8.05)	(8.00)	(8.59)	(8.52)
Shrz	−0.000	0.000	−0.000	0.000	−0.000	0.000	−0.000	0.000	−0.000	0.000
	(−0.99)	(−0.99)	(−0.57)	(−0.57)	(−1.02)	(−1.02)	(−0.92)	(−0.92)	(−0.40)	(−0.40)
Shrhfd3	0.214	0.110	0.199	0.102	0.219	0.112	0.071	0.036	0.026	0.013
	(1.44)	(1.44)	(0.80)	(0.81)	(1.47)	(1.47)	(0.47)	(0.47)	(0.17)	(0.17)
Rndintensity	−0.294 *	−0.151 *	−0.266	−0.136	−0.313 *	−0.161 *	−0.164	−0.083	−0.326 *	−0.164 *
	(−1.69)	(−1.68)	(−0.92)	(−0.92)	(−1.77)	(−1.77)	(−0.94)	(−0.94)	(−1.73)	(−1.73)
Leverage	−0.114	−0.059	−0.139	−0.071	−0.103	−0.053	−0.176 **	−0.089 *	−0.114	−0.057
	(−1.53)	(−1.53)	(−1.27)	(−1.27)	(−1.35)	(−1.35)	(−2.41)	(−2.42)	(−1.47)	(−1.48)

Table 3. GEE estimations of the antecedents of technological diversification.

DV:Tobin's Q	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b	Model 5a	Model 5b
	Coefficient	Marginal Effect at Variable Means	Coefficient	Marginal Effect at Variable Means	Coefficient	Marginal Effect at Variable Means	Coefficient	Marginal Effect at Variable Means	Coefficient	Marginal Effect at Variable Means
Ownership	−0.335 ***	−0.172 ***	−0.341 ***	−0.175 ***	−0.326 ***	−0.168 ***	−0.287 ***	−0.145 ***	−0.340 ***	−0.171 ***
	(−4.39)	(−4.47)	(−3.21)	(−3.22)	(−4.31)	(−4.38)	(−3.05)	(−3.09)	(−3.62)	(−3.65)
ED			0.836 **	0.428 **			0.857 ***	0.432 ***		
			(2.24)	(2.24)			(3.68)	(3.70)		
EM					−4.570 ***	−2.349 ***			−8.499 ***	−4.271 ***
					(−5.22)	(−5.28)			(−6.93)	(−7.24)
ED*Ownership							−0.197 ***	−0.099 ***		
							(−6.54)	(−6.69)		
EM*Ownership									0.171 ***	0.086 ***
									(7.51)	(7.93)
Cons	−1.842 ***		−1.788 ***		−1.683 ***		−1.634 ***		−1.387 ***	
	(−14.63)		(−9.64)		(−12.79)		(−12.86)		(−9.02)	
chi2	229.394		108.271		260.932		314.364		315.943	
chi2_dev	2111.787		2103.512		2129.053		3195.694		3368.652	
p	0.000		0.000		0.000		0.000		0.000	

Notes: 8065 observations; unstandardized coefficients are reported, with standard errors in parentheses; DV, Dependent variable; Dummy variables are not included; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

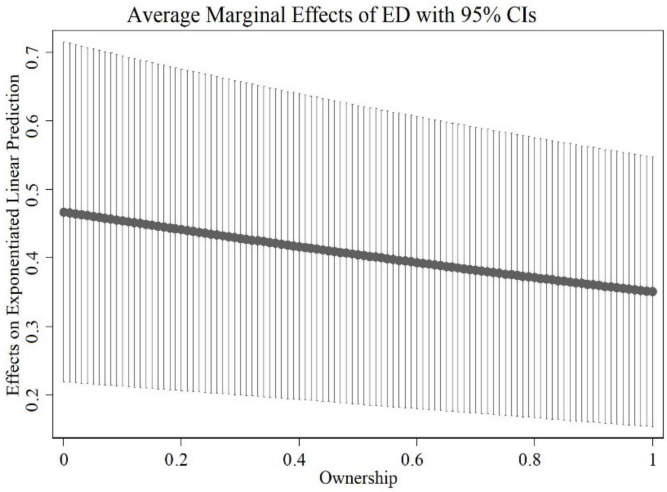

Figure 2. The marginal effect of environmental dynamism on technological diversification over ownership.

Hypothesis 4 predicts that state ownership positively moderates the relationship between environmental munificence and technological diversification. In Model 5a, we find that the coefficient of environmental munificence is still negative and significant, indicating that the finding of Hypothesis 2 is rather robust. The interaction term of state ownership and environmental munificence is positive and significant ($\beta = 0.171, p < 0.01$). The marginal effect of the interaction terms on its means in Model 5b also indicates the same result ($\beta = 0.086, p < 0.01$). Figure 3 elaborates the marginal effect of environmental munificence on technological diversification through state ownership. We can see from Figure 3 that the marginal effect increases with ownership, indicating a positive moderating role. In conclusion, Hypothesis 4 is supported.

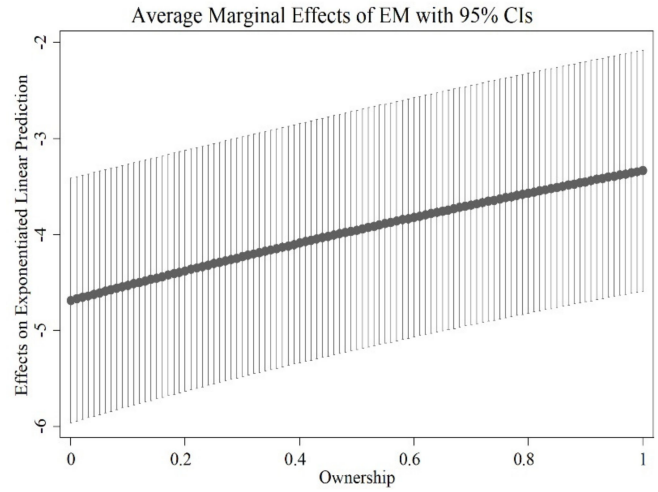

Figure 3. The marginal effect of environmental munificence on technological diversification over ownership.

5. Discussion

Motivated by the insufficient discussion of diversification from the perspective of resource dependence theory (RDT), this paper tries to explain this antecedent of technological diversification and further investigate the boundary effect of RDT through the coalition of ownership. The results suggest that diversification is largely a result of incentives to manage the interdependence of the firm-environment relationship. In a dynamic environment, firms have more incentives to be versatile, as this action can be effective to mitigate the dependence of sole technology. In contrast, in a munificent environment, firms can gain access to resources more easily and directly, making diversification more

expensive and less necessary. We argue that this dependence is altered when considering another actor, state ownership. State ownership affects firm-environment interdependence by merging with the firm into a (state-firm) coalition, thus changing the interchange relationship with the external environment.

My research contributes to the technological diversification literature by investigating the nuanced antecedents. The previous study mainly focuses on different perspectives of technological diversification to solve the inconsistent findings on its financial implications. For instance, Pan, Chen and Ning unpacked the technological diversification into explorative and exploitative dimensions and suggested the ignorance of either dimension will lead to mixed results [81]. The present research will complement those studies which focused on consequences by providing the interactions of different environmental antecedents and their interactions through the lens of RDT. This perspective thus, offers important insights regarding the incentives of reducing uncertainties and gaining autonomy rather than merely increasing profits suggested by previous studies [82].

5.1. Implications for RDT

This study complements existing knowledge about RDT in three distinct ways. First, we investigated the antecedent of technological diversification through the lens of RDT. Although an important phenomenon first proposed in RDT to mitigate uncertainty and interdependence, diversification is less researched from an RDT perspective than joint ventures, and mergers and acquisitions. This is partly due to the widely accessible database of joint ventures, and mergers and acquisitions. Diversification research, although limited, focuses on its effect, that is, its roles in promoting economic and innovation performance [69,83]. Less is known about its antecedents, especially from an RDT view. This paper focuses on the antecedents of technological diversification through RDT, thus enriching the literature by considering the interdependence of the firm-environment relationship.

We extend RDT by identifying and examining boundaries. As stated by Xia, Ma, Lu and Yiu [6], RDT has been criticised for its ambiguities regarding boundary conditions. Although many studies have made efforts to clarify the conditions since the seminal work of Finkelstein [21], progress has been slow. This ambiguity impairs the theoretical progress of RDT and the application of empirical findings. This paper adds to the RDT literature by investigating the boundary conditions of state ownership. This study deepens understanding and provides a more-refined model of theoretical prediction [84].

Third, the study advances the theory of RDT by context. RDT was developed based on organisations in developed countries, especially the U.S. [8,18]. Scholars are calling for more research to be conducted in different regions, and especially in emerging economies. Whether the RDT is applicable in developing countries remains to be investigated. The study eliminates this gap by investigating the antecedents of technological diversification through RDT embedded in a developing country context and further expands the boundary conditions of this resource dependence logic.

5.2. Implications for Diversification Research

This paper's main contribution to diversification is to identify the antecedent of diversification. Compared to the post-effects, research on the antecedents of technological diversification is rather limited. This paper, thus, enriches the diversification research by moving the focus back to the antecedents. If technological diversification really matters [69], we should know what constitutes technological diversification and under what conditions this relationship matters. This study focuses on the dimensions of the external environment and the moderating effect of state ownership, and thus complements diversification research through the investigation of antecedents and boundary conditions.

5.3. Implications for Open Innovation

This paper also contributes to open innovation literature. Previous studies mainly focus on the positive effect of open innovation on firm performance [85]. The negative side has been ignored. In fact, according to resource dependence theory, when the external resources are rich, firms seek from the resource from outside, the interdependence of a firm and the external environment is

unbalanced. That means even though open innovation can provide multiple resources for firms, it also brings constraint and power on firm, which may have negative effect on firm performance. Thus, the relationship between open innovation and technological diversification need more attention in future study.

6. Conclusions

To investigate the antecedents of technological diversification, this paper investigates how environmental factors (i.e., dynamism and munificence) affect firms' technological diversification from resource dependence theory and how ownership shapes the interrelationship between those two factors. The findings suggest that environmental dynamism positively relates to technological diversification, while environmental munificence negatively relates to technological diversification. These relationships changed when state ownership is considered. Our findings offer important insights regarding the incentives of technological diversification in terms of reducing uncertainty and maintain autonomy rather than seeking profits that previous studies offered.

Funding: This research received no external funding.

Conflicts of Interest: I declare no conflict of interest in this paper.

Appendix A

Table A1. IPC classification used in this paper.

Classification	Name
A	Human necessities
B	Performing operations; Transporting
C	Chemistry; Metallurgy
D	Textiles; Paper
E	Fixed constructions
F	Mechanical Engineering; Lighting; Heating; Weapons; Blasting
G	Physics
H	Electricity

References

1. Pfeffer, J.; Salancik, G.R. *The External Control of Organizations: A Resource Dependence Perspective*; Haper Row Publishers: London, UK, 1978.
2. Gulati, R.; Sytch, M. Dependence asymmetry and joint dependence in interorganizational relationships: Effects of embeddedness on a manufacturer's performance in procurement relationships. *Adm. Sci. Q.* **2007**, *52*, 32–69. [CrossRef]
3. Rogan, M.; Greve, H.R. Resource dependence dynamics: Partner reactions to mergers. *Organ. Sci.* **2015**, *26*, 239–255. [CrossRef]
4. Hillman, A.J.; Withers, M.C.; Collins, B.J. Resource dependence theory: A review. *J. Manag.* **2009**, *35*, 1404–1427. [CrossRef]
5. Zona, F.; Gomez-Mejia, L.R.; Withers, M.C. Board interlocks and firm performance: Toward a combined agency–resource dependence perspective. *J. Manag.* **2018**, *44*, 589–618. [CrossRef]
6. Xia, J.; Ma, X.; Lu, J.W.; Yiu, D.W. Outward foreign direct investment by emerging market firms: A resource dependence logic. *Strateg. Manag. J.* **2014**, *35*, 1343–1363. [CrossRef]
7. Dyer, J.H.; Singh, H. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Acad. Manag. Rev.* **1998**, *23*, 660–679. [CrossRef]

8. Davis, G.F.; Adam Cobb, J. Resource dependence theory: Past and future. In *Stanford's Organization Theory Renaissance, 1970–2000*; Schoonhoven, C.B., Dobbin, F., Eds.; Emerald Group Publishing Limited: Amsterdam, The Netherlands, 2010; pp. 21–42.
9. Pfeffer, J. Beyond management and the worker: The institutional function of management. *Acad. Manag. Rev.* **1976**, *1*, 36–46. [CrossRef]
10. Dess, G.G.; Beard, D.W. Dimensions of organizational task environments. *Adm. Sci. Q.* **1984**, *29*, 52–73. [CrossRef]
11. Drees, J.M.; Heugens, P.P.M.A.R. Synthesizing and extending resource dependence theory: A meta-analysis. *J. Manag.* **2013**, *39*, 1666–1698. [CrossRef]
12. Emerson, R.M. Power-dependence relations. *Am. Sociol. Rev.* **1962**, *27*, 31–41. [CrossRef]
13. Kamps, J.; Pólos, L. Reducing uncertainty: A formal theory of Organizations in Action. *Am. J. Sociol.* **1999**, *104*, 1776–1812. [CrossRef]
14. Willer, D. Power-at-a-distance. *Soc. Forces* **2003**, *81*, 1295–1334. [CrossRef]
15. Jacobs, D. Dependency and vulnerability: An exchange approach to the control of organizations. *Adm. Sci. Q.* **1974**, *19*, 45–59. [CrossRef]
16. Casciaro, T.; Piskorski, M.J. Power imbalance, mutual dependence, and constraint absorption: A closer look at resource dependence theory. *Adm. Sci. Q.* **2005**, *50*, 167–199. [CrossRef]
17. Volberda, H.W.; Weerdt, N.V.D.; Verwaal, E.; Stienstra, M.; Verdu, A.J. Contingency fit, institutional fit, and firm performance: A metafit approach to organization–environment relationships. *Organ. Sci.* **2012**, *23*, 1040–1054. [CrossRef]
18. Nienhüser, W. Resource dependence theory-How well does it explain behavior of organizations? *Manag. Rev.* **2008**, *19*, 9–32. [CrossRef]
19. Oliver, C. Network relations and loss of organizational autonomy. *Hum. Relat.* **1991**, *44*, 943–961. [CrossRef]
20. Hillman, A.J.; Cannella, A.A.; Paetzold, R.L. The resource dependence role of corporate directors: Strategic adaptation of board composition in response to environmental change. *J. Manag. Stud.* **2000**, *37*, 235–256. [CrossRef]
21. Finkelstein, S. Interindustry merger patterns and resource dependence: A replication and extension of Pfeffer (1972). *Strateg. Manag. J.* **1997**, *18*, 787–810. [CrossRef]
22. Pfeffer, J. Size and composition of corporate boards of directors: The organization and its environment. *Adm. Sci. Q.* **1972**, *17*, 218–228. [CrossRef]
23. Katila, R.; Rosenberger, J.D.; Eisenhardt, K.M. Swimming with sharks: Technology ventures, defense mechanisms and corporate relationships. *Adm. Sci. Q.* **2008**, *53*, 295–332. [CrossRef]
24. Pfeffer, J. Merger as a response to oganizational interdependence. *Adm. Sci. Q.* **1972**, *17*, 382–394. [CrossRef]
25. Biniari, M.G.; Simmons, S.A.; Monsen, E.W.; Pizarro Moreno, M.I. The configuration of corporate venturing logics: An integrated resource dependence and institutional perspective. *Small Bus. Econ.* **2015**, *45*, 351–367. [CrossRef]
26. Peng, M.W.; Bruton, G.D.; Stan, C.V.; Huang, Y. Theories of the (state-owned) firm. *Asia Pac. J. Manag.* **2016**, *33*, 293–317. [CrossRef]
27. Liang, H.; Ren, B.; Sun, S.L. An anatomy of state control in the globalization of state-owned enterprises. *J. Int. Bus. Stud.* **2015**, *46*, 223–240. [CrossRef]
28. Bruton, G.D.; Peng, M.W.; Ahlstrom, D.; Stan, C.; Xu, K. State-owned enterprises around the world as hybrid organizations. *Acad. Manag. Perspect.* **2015**, *29*, 92–114. [CrossRef]
29. Peng, M.W.; Chen, H. Strategic responses to domestic and foreign institutional pressures. *J. Manag. Org.* **2011**, *41*, 88–105. [CrossRef]
30. Luo, L.; Yang, Y.; Luo, Y.; Liu, C. Export, subsidy and innovation: China's state-owned enterprises versus privately-owned enterprises. *Econ. Pol. Stud.* **2016**, *4*, 137–155. [CrossRef]
31. Yigitcanlar, T.; Sabatini-Marques, J.; Costa, E.; Kamruzzaman, M.; Ioppolo, G. Stimulating technological innovation through incentives: Perceptions of Australian and Brazilian firms. *Technol. Forecast. Soc. Chang.* **2019**, *146*, 403–412. [CrossRef]
32. Tajeddini, K.; Trueman, M. Environment-strategy and alignment in a restricted, transitional economy: Empirical research on its application to Iranian state-owned enterprises. *Long Range Plan.* **2016**, *49*, 570–583. [CrossRef]

33. Scott, W.R.; Davis, G.F. *Organizations and Organizing: Rational, Natural and Open Systems Perspectives*; Routledge: London, UK, 2007.
34. Duncan, R.B. Characteristics of organizational environments and perceived environmental uncertainty. *Adm. Sci. Q.* **1972**, *17*, 313–327. [CrossRef]
35. Baum, J.A.C.; Oliver, C. Toward an institutional ecology of organizational founding. *Acad. Manag. J.* **1996**, *39*, 1378–1427.
36. Peng, M.W.; Lee, S.-H.; Wang, D.Y.L. What determines the scope of the firm over time? A focus on institutional relatedness. *Acad. Manag. Rev.* **2005**, *30*, 622–633. [CrossRef]
37. Lin, C.; Chang, C.-C. The effect of technological diversification on organizational performance: An empirical study of S&P 500 manufacturing firms. *Technol. Forecast. Soc. Chang.* **2015**, *90*, 575–586.
38. Aldrich, H.E. *Organizations and Environments*; Stanford University Press: Redwood City, CA, USA, 1979.
39. Su, Z.; Xie, E.; Li, Y. Organizational slack and firm performance during institutional transitions. *Asia Pac. J. Manag.* **2009**, *26*, 75–91. [CrossRef]
40. Peng, M.W.; Zhang, S.; Li, X. CEO duality and firm Performance during China's institutional transitions. *Manag. Organ. Rev.* **2007**, *3*, 205–225. [CrossRef]
41. Eisenhardt, K.M.; Furr, N.R.; Bingham, C.B. CROSSROADS—Microfoundations of performance: Balancing efficiency and flexibility in dynamic environments. *Organ. Sci.* **2010**, *21*, 1263–1273. [CrossRef]
42. Goll, I.; Rasheed, A.A. The moderating effect of environmental munificence and dynamism on the relationship between discretionary social responsibility and firm performance. *J. Bus. Ethics* **2004**, *49*, 41–54. [CrossRef]
43. Schilke, O. On the contingent value of dynamic capabilities for competitive advantage: The nonlinear moderating effect of environmental dynamism. *Strateg. Manag. J.* **2014**, *35*, 179–203. [CrossRef]
44. Kim, H.; Hoskisson, R.E.; Wan, W.P. Power dependence, diversification strategy, and performance in keiretsu member firms. *Strateg. Manag. J.* **2004**, *25*, 613–636. [CrossRef]
45. Amezcua, A.S.; Grimes, M.G.; Bradley, S.W.; Wiklund, J. Organizational sponsorship and founding environments: A contingency view on the survival of business-incubated firms, 1994–2007. *Acad. Manag. J.* **2013**, *56*, 1628–1654. [CrossRef]
46. Wan, W.P.; Yiu, D.W. From crisis to opportunity: Environmental jolt, corporate acquisitions, and firm performance. *Strateg. Manag. J.* **2009**, *30*, 791–801. [CrossRef]
47. Tang, J. Environmental munificence for entrepreneurs: Entrepreneurial alertness and commitment. *Int. J. Entrep. Behav. Res.* **2008**, *14*, 128–151. [CrossRef]
48. Titus, V.K.; Anderson, B.S. Firm structure and environment as contingencies to the corporate venture capital–parent firm value relationship. *Entrepreneursh. Theory Pract.* **2018**, *42*, 498–522. [CrossRef]
49. Li, Y.; Wei, Z.; Zhao, J.; Zhang, C.; Liu, Y. Ambidextrous organizational learning, environmental munificence and new product performance: Moderating effect of managerial ties in China. *Int. J. Prod. Econ.* **2013**, *146*, 95–105. [CrossRef]
50. Wan, W.P. Country resource environments, firm capabilities, and corporate diversification strategies. *Manag. Stud.* **2005**, *42*, 161–182. [CrossRef]
51. La Porta, R.; Lopez-De-Silanes, F.; Shleifer, A. Government ownership of banks. *J. Financ.* **2002**, *57*, 265–301. [CrossRef]
52. Santos, F.M.; Eisenhardt, K.M. Organizational boundaries and theories of organization. *Organ. Sci.* **2005**, *16*, 491–508. [CrossRef]
53. Meyer, K.E.; Estrin, S.; Bhaumik, S.K.; Peng, M.W. Institutions, resources, and entry strategies in emerging economies. *Strateg. Manag. J.* **2009**, *30*, 61–80. [CrossRef]
54. Jensen, M.C.; Meckling, W.H. Theory of the firm: Managerial behavior, agency costs and ownership structure. *J. Financ. Econ.* **1976**, *3*, 305–360. [CrossRef]
55. Peng, M.W.; Luo, Y. Managerial ties and firm performance in a transition economy: The nature of a micro-macro link. *Acad. Manag. J.* **2000**, *43*, 486–501.
56. Peng, M.W. Outside directors and firm performance during institutional transitions. *Strateg. Manag. J.* **2004**, *25*, 453–471. [CrossRef]
57. Lebedev, S.; Peng, M.W.; Xie, E.; Stevens, C.E. Mergers and acquisitions in and out of emerging economies. *J. World Bus.* **2015**, *50*, 651–662. [CrossRef]
58. Meyer, K.E.; Ding, Y.; Li, J.; Zhang, H. Overcoming distrust: How state-owned enterprises adapt their foreign entries to institutional pressures abroad. *J. Int. Bus. Stud.* **2014**, *45*, 1005–1028. [CrossRef]

59. Connelly, B.L.; Hoskisson, R.E.; Tihanyi, L.; Certo, S.T. Ownership as a form of corporate governance. *J. Manag. Stud.* **2010**, *47*, 1561–1589. [CrossRef]
60. Meyer, K.E.; Peng, M.W. Theoretical foundations of emerging economy business research. *J. Int. Bus. Stud.* **2016**, *47*, 3–22. [CrossRef]
61. Stevens, C.E.; Xie, E.; Peng, M.W. Toward a legitimacy-based view of political risk: The case of Google and Yahoo in China. *Strateg. Manag. J.* **2016**, *37*, 945–963. [CrossRef]
62. Zhang, Y.; Qu, H. The impact of CEO succession with gender change on firm performance and successor early departure: Evidence from China's publicly listed companies in 1997–2010. *Acad. Manag. J.* **2016**, *59*, 1845–1868. [CrossRef]
63. Marquis, C.; Qian, C. Corporate social responsibility reporting in China: Symbol or substance? *Org. Sci.* **2014**, *25*, 127–148. [CrossRef]
64. Gambardella, A.; Torrisi, S. Does technological convergence imply convergence in markets? Evidence from the electronics industry. *Res. Policy* **1998**, *27*, 445–463. [CrossRef]
65. Cantwell, J.; Vertova, G. Historical evolution of technological diversification. *Res. Policy* **2004**, *33*, 511–529. [CrossRef]
66. Zander, I. Technological diversification in the multinational corporation—Historical evolution and future prospects. *Res. Policy* **1997**, *26*, 209–227. [CrossRef]
67. Jacquemin, A.P.; Berry, C.H. Entropy measure of diversification and corporate growth. *J. Ind. Econ.* **1979**, *27*, 359–369. [CrossRef]
68. Gemba, K.; Kodama, F. Diversification dynamics of the Japanese industry. *Res. Policy* **2001**, *30*, 1165–1184. [CrossRef]
69. Wang, Y.; Pan, X.; Li, J.; Ning, L. Does technological diversification matter for regional innovation capability? Evidence from China. *Technol. Anal. Strat.* **2016**, *28*, 323–334. [CrossRef]
70. Wang, Y.; Sutherland, D.; Ning, L.; Pan, X. The evolving nature of China's regional innovation systems: Insights from an exploration–exploitation approach. *Technol. Forecast. Soc. Chang.* **2015**, *100*, 140–152. [CrossRef]
71. Wei, Z.; Varela, O. State equity ownership and firm market performance: Evidence from China's newly privatized firms. *Glob. Financ. J.* **2003**, *14*, 65–82. [CrossRef]
72. Attig, N.; Guedhami, O.; Mishra, D. Multiple large shareholders, control contests, and implied cost of equity. *J. Corp. Financ.* **2008**, *14*, 721–737. [CrossRef]
73. Cheung, Y.-L.; Kong, D.; Tan, W.; Wang, W. Being good when being international in an emerging economy: The case of China. *J. Bus. Ethics* **2015**, *130*, 805–817. [CrossRef]
74. Hardin, J.W.; Hilbe, J.M. Generalized Estimating Equations. In *Wiley Encyclopedia of Clinical Trials*; John Wiley Sons Inc.: Hoboken, NJ, USA, 2007.
75. Liang, K.-Y.; Zeger, S.L. Longitudinal data analysis using generalized linear models. *Biometrika* **1986**, *73*, 13–22. [CrossRef]
76. Zelner, B.A. Using simulation to interpret results from logit, probit, and other nonlinear models. *Strateg. Manag. J.* **2009**, *30*, 1335–1348. [CrossRef]
77. Wiersema, M.F.; Bowen, H.P. The use of limited dependent variable techniques in strategy research: Issues and methods. *Strateg. Manag. J.* **2009**, *30*, 679–692. [CrossRef]
78. Bowen, H.P. Testing moderating hypotheses in limited dependent variable and other nonlinear models: Secondary versus total interactions. *J. Manag.* **2012**, *38*, 860–889. [CrossRef]
79. Tabachnick, B.G.; Fidell, L.S. *Using Multivariate Statistics*, 6th ed.; Pearson: New York, NY, USA, 2012.
80. Kleinbaum, D.G.; Kupper, L.L.; Nizam, A.; Muller, K.E. *Applied Regression Analysis and Other Multivariate Methods*, 4th ed.; Duxbury Press: Belmont, CA, USA, 2007.
81. Pan, X.; Chen, X.; Ning, L. Why do inconsistencies occur? Detangling the relationship between technological diversification and performance in Chinese firms. *Asian J. Technol. Innov.* **2017**, *25*, 407–427. [CrossRef]
82. Pan, X.; Chen, X.; Ning, L. Exploitative technological diversification, environmental contexts, and firm performance. *Manag. Decis.* **2018**, *56*, 1613–1629. [CrossRef]
83. Chen, Y.-M.; Yang, D.-H.; Lin, F.-J. Does technological diversification matter to firm performance? The moderating role of organizational slack. *J. Bus. Res.* **2013**, *66*, 1970–1975. [CrossRef]

84. Davis, G.F. Celebrating organization theory: The after-party. *J. Manag. Stud.* **2015**, *52*, 309–319. [CrossRef]
85. Aldieri, L.; Carlucci, F.; Vinci, C.; Yigitcanlar, T. Environmental innovation, knowledge spillovers and policy implications: A systematic review of the economic effects literature. *J. Clean. Prod.* **2019**, *239*, 118051. [CrossRef]