A Moderated Mediation Model of Slack Resources and Innovation Performance： Based on the Hierarchical Multiple Regression of Panal data

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Abstract. This paper examines the impact of slack resources on innovation performance based on the multiple regression analysis using panel data via the STATA software. Besides, a moderated mediator model is discussed, resource commitment is taken as the mediator, and the network embeddedness as the moderating factors. With these methods, our research provides not only a theoretical basis for the entrepreneurial enterprises to improve the efficiency of resource allocation, but help achieve the sustainable innovative development.

Keywords: hierarchical multiple regression; slack resources; resource commitment; network embeddedness; innovation performance

1   INTRODUCTION

The Resource-based view restores the source of innovation to the internal of enterprises, it holds that even in the environment with no external differences, still existing significant differences on the firms' performances [1]. The endowment and allocation of internal resources are the main reasons for these differences. The resources, owned by the enterprises providing the basis for the implementation of strategic decision-making of performance improvement. Due to resource constraints, enterprises always have to be faced with the dilemma of resource decision-making in the process of development. As a core concept of resource-based view, resource commitment can be understood as "the willingness of organizations to inject resources into innovative management activities", which means that effective resource allocation and utilization ability is the basis for enterprises to improve their efficiency and implement innovation strategy, and further to achieve sustainable competitive advantages. The process of resources to support innovation activities is the essential part of resource commitment, without resource commitment, it is difficult to carry out innovation activities to gain competitive advantages [2]. Therefore, in the process of innovation development, enterprises must allocate resources matching with the strategic planning. Based on this, slack resources, which are left over to maintain organizational operations, received much attention due to its ability to buffer firms from shortages of funds and its potential

to foster innovation. Slack resources are defined as "potentially available resources, beyond its needs for maintaining normal organizational output, which are available to divert and redeploy to achieve the organizational goals". According to the organizational theory, slack resources not only can resolve internal conflicts, but also serve as back-ups for enterprises to cope with changes or pressures from outside. In addition, it provides the basis for strategic decisions and promotes the innovation performance of enterprises. But the agency theory argues that slack resource is wasteful, inefficient, and accumulates due to managers' self-serving interests.

2   LITERATURES REVIEW AND EMPIRICAL HYPOTHESIS

2.1   Slack Resources and Innovation Performance

Different types of slack show different characteristics, which can be divided into two categories in accordance with their mobility: the unabsorbed slack resources and the absorbed slack resources [3]. Existing researches indicate that different types of slack exert different influences on innovation [4-5]. Specifically, unabsorbed slacks are defined as the readily-available uncommitted resources, such as cash flows, retained earnings. They can be easily recovered or assimilated into activities of the firm. Unabsorbed slack can improve the innovation performance through reduction of internal restrictions, encouragement of innovation atmosphere, resolution of resource conflicts, it may also act as an inducement to experiment leading to risk-taking decisions and proactive strategic choices, which in turn can enhance innovation performance, it is an important catalyst which can provide supports for high-risk innovative activities in cases of uncertainty. Nevertheless, unabsorbed slack is likely to trigger inefficiency, incumbency inertia, or other agency problems. When a mass of unabsorbed slack at hand, managers may trap into the expanded "slack search", which can easily induce opportunistic behaviors, such as agents' arbitrary decision-making, improper usage of resources as well as excessive investment [6]. This may even lead to the deterioration of innovation performance. So an appropriate range of unabsorbed slack exits to innovation performance. Therefore, a hypothesis can be made:

H1a: The relationship between unabsorbed slack resources and innovation performance shows an inverted U-shaped curve.

Absorbed slack resources, which have been absorbed as costs into operations, can be redeployed in times of adversity, such as incompletely leveraged equipment, facilities and surplus of production capacity. Different from unabsorbed slack, the absorbed slack is usually embedded in the key business processes of enterprise. Thus, the arbitrariness can be limited, which can also reduce agency problems. In addition, absorbed slack plays as the "core protector" in face of uncertain environment. Therefore, the role of "buffer" of slack resources is more played by absorbed slack. In addition, the characteristics of absorbed slack resources, like scarcity, values, heterogeneity which are hard to imitate are the keys for enterprises to obtain sustainable competitive advantages [7]. However, absorbed slack resources always need high operation, maintenance and

even sunk costs, its strong specificity could also limit resource reconfiguration. According to the "threat-ossification" theory, massive absorbed slack can lead to the ossification of enterprises due to lack of flexibility, form obstacles to innovation. Moreover, slack may give an illusion of security that restrains firms' motivation for innovation. In sum, less of absorbed slack might aggravate the risks under environmental uncertainty and reduce the investment in innovation activities [8]. Nevertheless, when the amount of absorbed slack accumulates, it is easy to make behaviors rigid and sluggish. Therefore, a hypothesis can be proposed:

H1b: The relationship between absorbed slack resources and innovation performance shows an inverted U-shaped curve.

2.2   Slack Resources and Resource Commitment

As an important aspect of organizational behaviors theory, the notion of commitment indicates that the state of mind holds organizations for the standard of behaviors [9]. Innovation resource commitment refers to the efforts to allocate resources on organizational innovation activities, that is, the willingness of an organization to inject its own resources into innovation. It is actually a strategic decision-making process that aims to make optimal allocation and configuration of slack resources, and further enhance the organizational outcomes and attain competitive advantages [10]. In short, the resource commitment is defined as the innovation efforts committed by organizations, enable firms to coordinate activities and make use of slack resources [11]. According to the Resource Dependence Theories, the organizational innovation development is actually a dynamic process of strategic decisions that makes adjustments continuously based on its own resource endowment. The commitment, a pattern of resource allocation, only can be realized on the basis of slack resources while meeting the needs of the enterprise operation. When faced with resource limitations, firms tend to adopt a narrower strategic focus, and rely more on their familiar domains of knowledge and skills to address short-term obligations and solve the existing problems. As more resources accumulate, the resource commitment will get better guarantee to pursue innovation strategy. The availability of unused resources enables firms to commit to take advantage of opportunities and pay more attention to distal search. However, once the slack resource goes too far, it might cause the "escalating commitment" effect, leading to risk-ignoring as well as path dependence. Specifically, abundance of slack resources relaxes the structural and mental constraints for managers to make commitment. For instance, if firms are in the presence of high levels of unabsorbed slack resources, it is more likely for firms to overinvest to high risky projects or untried strategies with impulse that would have not been considered feasible in terms of scarcity. In addition, it is easy to run into a certain development path with a large amount of continuous investment in the project due to inertia, even if it is proved unreasonable at a later stage, so that the development process will be locked in a specific path and move towards inefficiency. Therefore, the hypothesis can be made:

H2a: The relationship between unabsorbed slack resources and resource commitment shows an inverted U-shaped relationship.

H2b: The relationship between absorbed slack resources and resource commitment shows an inverted U-shaped relationship.

2.3   The Mediating Role of Resource Commitment

As an attitude of organizations toward resources, resource commitment has the potential to affect the relationship between slack resources and innovation performance [12]. Resource commitment is characterized as a willingness to exert considerable effort on behalf of the organization to achieve the organization's performances. In this regard, resource commitment can help assure the value and support organizations in designing and optimizing their strategies. In addition, resource commitment helps an organization effectively gather and employ slack resources in a manner that would enhance organizational capabilities [13]. It not only ensures that slack resources would not be abused, but also lead to the formation of their efficient management and allocation routines. Therefore, it is believed that resource commitment is crucial in innovative process. Some examples are given to deeply illustrate it, the commitment to resources reflects the belief of the possible constructive strategies to organizations. When such commitment is improper, firms may neglect or misuse the slack resources on unpromising projects, instead of dedicating to improve organizational innovation performance. The conclusion can therefore be drawn that resource commitment plays a crucial role in realizing sustainable competitive advantages and achieving valuable innovation performance from organizational slack. The paper further contends that the mediating effects of resource commitment of different slack resources vary in innovation performance. The commitment of unabsorbed slacks reflects the flow resource efforts in function can be directly controlled by innovative orientation, conducive to improving the subjective initiative of firms in the process of innovation and bringing about continuous innovation performance; While the commitment of absorbed slack resources are supposed to provide material, intellectual and other heterogeneous resources for innovative strategies. Only by adopting timely and effective commitment to decisions, can enterprises realize the utilization of resources [14]. It is likely to be translated into innovation performance. Moreover, slack resources do   not always lead to high innovation performance, investigating the mediating role of resource commitment can alleviate the agency problem, and contribute to a better understanding of the determinants of innovation. Therefore, a hypothesis can be drawn as follows:

H3a: Resource commitment mediates the relationship between unabsorbed slack resources and innovation performance.

H3b: Resource commitment mediates the relationship between absorbed slack resources and innovation performance.

2.4   The Moderating Role of Network Embeddedness

The network-based entrepreneurial research emphasizes that network embeddedness, as an channel of information dissemination, determines the opportunities encountered by firms [15], hence affect innovation performances through information gathering, strategic choices, and utilization of slack resources. Specifically, network

embeddedness within appropriate range can facilitate the investment expansion for two reasons: resource aggregation and resource synergies. For the former one, the open innovation theory was proposed to provide that the essence of openness is to effectively obtain and utilize external resources. Network embeddedness is supposed to have implications for the extent of commitment, sharing and cooperation that exist among firms [16]. These in turn dictate the diversity of information that travel through networks. Hence, firms with superior embeddedness have greater access to valuable information, increasing resource commitment relevant for firms' innovation. For the latter, synergistic effect, that is, the integration of slack resources and network embeddedness which can cooperate with each other through the interaction of internal and external governance mechanisms to achieve increasing marginal effects. Consequently, firms are likely to make better resource commitment to promote innovation. Hence the proper network embeddedness can positively moderate the relationship between slack resources and innovation performance. However, according to the "paradox of embeddedness", excessive embeddedness may lead to passive effects such as "embedded inertia" [17] and rent-seeking. On one hand, due to the stickiness of relationship, social network may be prone to path dependence, thus generating the embedded inertia, resulting to the "lock-in" effect like exclusiveness or closure [18]. What's more, it can also prevent organizations from obtaining the information from the outside, and further reduce the resource commitment tendency to improve innovation performance [19]. On the other hand, excessive embeddedness is likely to cause rent-seeking, which incurs high transaction costs, and reduces the resource allocation efficiency [20]. Firms have to devote lots of financial slack to maintaining social relations, and the rest of slack resources thus may not be committed to improving the performance of organizational innovation. As a result, excessive network embeddedness can strengthen the inhibition effect of slack resources on innovation performance. Therefore, hypothesis can be made as follows:

H4a: Network embeddedness moderates the relationship between unabsorbed slack resources and innovation performance through the mediating effect of resource commitment.

H4b: Network embeddedness moderates the relationship between absorbed slack resources and innovation performance through the mediating effect of resource commitment.

3   METHODOLOGY

3.1   Sample and Data Collection

The data was gathered from Chinese GEM listed companies from 2013 to 2018, 404 companies were selected as samples. The patent data was collected from the website of China National Intellectual Property Administration. In terms of network embeddedness, the background information on companies' independent directors were collected and sorted. The related financial and accounting data is obtained from CSMAR and Wind databases. Other data comes from the Chinese Annual Statistical Yearbooks.

3.2   Measures

1) Dependent variable. Innovation Performance (IP) refers to the proportion of "the patent stock granted in the total assets at the end of the year". The method is constructed as:

$$K_{i,t} = (1 - \theta)\, K_{i,t-1} + r_{i,t}$$

Where, $K_{i,t}$ represents the patent stock of firm i in the year t ; θ is the depreciation rate of the patent stock set to 15% in accordance with prior work; and $r_{i,t}$ is the ultimately granted patents applied by firm i in year t .

2) Independent variables. Slack resources are divided into unabsorbed slack (UAS) and absorbed slack (AS). To be specific, the "current ratio" is taken to measure the unabsorbed slack, because the current ratio can most directly reflect the liquidity of assets, reflect the short-term debt repayment and investment ability of enterprise. Besides, the study takes the "proportion of general and administrative expenses to sales revenue" as the measurement of the absorbed slack, for absorbed slack is always embedded in the general management activities of enterprises, and has stronger constraints on its utilization and transformation.

3) Mediating variable. Resource commitment is constructed as follows:

$$RC_{it} = \sqrt{(x_{it} - 0)^2 + (y_{it} - 0)^2} = \sqrt{x_{it}^2 + y_{it}^2}$$

Where $x_{i,t}$ indicates the R&D revenue to sales of firm i; $y_{i,t}$ represents the proportion of the net cash flow in investment activities to sales revenue of firm i ; and $RC_{i,t}$ represents the intensity of resource commitment of firm i.

4) Moderating variable. The formula of network embeddedness is provided as follow:

$$Degree = X_{AD}(i)\,(n-1)$$

Where, $X_{AD}(i)$ denotes the number of that firm i ties to other firms; n is the total number of firms in the network.

5) Control variables. For the additional variables that may affect slack and innovation performance are also controlled, including firm size, intangible assets, return on assets, leverage, the ratio of independent directors to total directors, Tobin's Q; The provincial-level characteristic by GDP per capita growth rate is also controlled.

4   EMPIRICAL ANALYSES

In order to examine the moderated mediating effect, the hierarchical multiple regression models are analyzed (Table 1). Both industry-fixed effects and year-fixed effects are added into models to control the influence of industry and year factors. In the estimation of all regression models, heteroskedastic-consistent probability values rejecting the null hypotheses of zero coefficients are reported in parentheses.

Table 1. Stepwise multivariate regression

DV	Innovation Performance			Resource Commitment		Innovation Performance		Resource Commitment		Innovation Performance		
Model	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Constant	1.422***	1.389***	1.227***	-11.430***	-14.425***	1.447***	1.421***	-11.940***	-14.901***	1.174***	1.310***	1.353***
	(0.261)	(0.264)	(0.269)	(3.435)	(3.443)	(0.254)	(0.253)	(3.459)	(3.466)	(0.273)	(0.258)	(0.257)
asset	-0.120***	-0.121***	-0.114***	1.065***	1.227***	-0.130***	-0.131***	1.097***	1.256***	-0.111***	-0.123***	-0.120***
	(0.022)	(0.021)	(0.021)	(0.295)	(0.292)	(0.021)	(0.020)	(0.297)	(0.294)	(0.021)	(0.020)	(0.199)
intangible	-0.028	-0.009	-0.054	18.389***	17.270***	-0.174	-0.285	18.264***	17.155***	-0.067	-0.223	-0.214
	(0.246)	(0.244)	(0.237)	(4.665)	(4.810)	(0.250)	(0.253)	(4.641)	(4.785)	(0.239)	(0.250)	(0.250)
ROA	-0.240	-0.225	-0.198	-23.629***	-23.006***	0.006	0.022	-23.855***	-23.226***	-0.222	-0.010	0.002
	(0.234)	(0.233)	(0.229)	(5.003)	(5.018)	(0.223)	(0.226)	(5.014)	(5.033)	(0.228)	(0.220)	(0.215)
Leverage	-0.191**	-0.132	0.003	-3.551**	-1.537	-0.053	0.008	-3.687**	-1.673	-0.012	0.003	0.005
	(0.089)	(0.094)	(0.094)	(1.469)	(1.479)	(0.079)	(0.078)	(1.475)	(1.484)	(0.095)	(0.094)	(0.093)
OUT	0.052	0.052	-0.029	-0.871	-2.607	0.068	0.022	-0.901	-2.627	-0.031	-0.007	-0.065
	(0.193)	(0.193)	(0.188)	(2.435)	(2.302)	(0.190)	(0.185)	(2.432)	(2.301)	(0.188)	(0.186)	(0.179)
tobin Q	0.034	0.007	0.008	0.324***	0.328***	0.004	0.002	0.327***	0.328***	0.008	0.005	0.005
	(0.005)	(0.005)	(0.005)	(0.079)	(0.078)	(0.005)	(0.005)	(0.078)	(0.078)	(0.005)	(0.005)	(0.005)
GDP	0.001*	0.001**	0.001*	0.007	0.006	0.001**	0.001*	0.006	0.005	0.001*	0.001	0.007
	(0.000)	(0.000)	(0.000)	(0.006)	(0.006)	(0.004)	(0.004)	(0.006)	(0.006)	(0.320)	(0.000)	(0.000)
UAS		0.003	0.009***	0.407***	0.488***			0.408***	0.488***	0.009***	0.005	0.006*
		(0.002)	(0.003)	(0.077)	(0.108)			(0.077)	(0.108)	(0.003)	(0.003)	(0.003)
AS		0.003	0.012***	0.020***	0.433***			0.198***	0.432***	0.011***	0.008**	0.008***
		(0.001)	(0.003)	(0.043)	(0.046)			(0.043)	(0.046)	(0.003)	(0.003)	(0.003)
UAS^2			-0.001**		-0.001*				-0.001*	-0.001**	-0.001**	-0.001**
			(0.000)		(0.001)				(0.001)	(0.000)	(0.000)	(0.000)
AS^2			-0.003***		-0.005***				-0.005***	-0.002***	-0.002***	-0.002***
			(0.000)		(0.001)				(0.001)	(0.001)	(0.000)	(0.000)
RC						0.010***	0.025***			0.009***		0.002*
						(0.003)	(0.005)			(0.003)		(0.002)
RC^2							-0.003***					
							(0.001)					
degree								0.189**	0.181**	0.020***	0.019***	-0.016*
								(0.083)	(0.084)	(0.006)	(0.006)	(0.015)
RC×degree												0.005**
												(0.002)
Industry	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
R-squared	0.1092	0.1105	0.1250	0.3734	0.3913	0.1303	0.1486	0.3755	0.3931	0.1319	0.1470	0.1634
Observations	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020

***, **, * denote statistical significance at the 1%, 5%, 10% levels, respectively.

As the regression results presented above, M1 is the baseline model; M2 contains the independent variables, both their coefficients are positive without statistical significance; And then, their second-order are added respectively in M3 which show negatively significance, implying that either UAS or AS has inverted U-shaped relation with innovation performance, and thus, H1a and H1b are assumed to be valid. The dependent variable of M4 and M5 is resource commitment, the mediating variable, the quadratic term of UAS and AS, the first-order of UAS and AS are positive, and UAS^2 and AS^2 show negative significance. Thus, H2a and H2b are supported. In addition, M6 and M7 show that first- order of RC is positive and the quadratic term is negative significance.

The hypothesis of H3a and H3b are verified respectively. Further evidence is provided regarding the moderated mediating effect by introducing the moderator to the regressions. M11shows that all of the independent variables and moderating variable are positively significant; M12 further includes the interaction of mediating and moderating variables, the result presents that RC×degree are all significant. Thus, it can be confirmed that degree moderates the inverted U-shaped relationship between slack resource and innovation performance through the mediating effect of resource commitment. Therefore, the hypothesis H4a and H4bare both supported.

5   CONCLUSION

This paper examines the inverted U-shaped relationships between slack resources and innovation performance. In addition, the resource commitment plays a mediating role, to some extent, revealing the transformation "black box" of resource to performance. Considering that all economic activities of enterprises having the network embeddedness characteristics [21], a moderated mediating model is verified, which is of certain significance for improving the innovative development. The following main conclusions are drawn: On one hand, organizational slack resources not only have direct inverted U-shaped effect on innovation performance, but also strengthen the effect through the mediating role of resource commitment. The results indicate that slack resources are crucial to the development of new venture enterprises. However, as the accumulation of resources exceeds the proper threshold, enterprises are likely to show path- dependent entrepreneurial inertia gradually, resulting to the stagnation of inefficient innovation activities. Hence, only with the proper resource commitment, can the enterprises get better guarantee to pursue innovation strategies, promoting the continuous improvement of innovation performances. On the other hand, the "resources-strategy-performance" chain is enriched by introducing the moderating variable "network embeddedness", and conceived as the important dynamic capability, influencing the performance of new ventures in combination with strategic commitment. Therefore, enterprises embedded in networks should pay more attention on the development of social relations, deploy effective social capital, improve their embeddedness centrality and occupy superior positions to obtain more external information channels, in order to better play the role in the regulation and governance of enterprise innovative development.

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