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Organization Capital and Corporate Innovation: Evidence from China

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ABSTRACT

In this paper, we examine the impact of organization capital on corporate innovation activities by using a large sample of Chinese data during the period of 2005-2015. The main findings suggest that organization capital is one important determinant of corporate innovation output. Additional cross-sectional tests show that both political connection and industrial concentration will moderate the positive effect of organization capital on corporate innovation. We further identify that ensuring sufficient funding support and accelerating internationalization are two possible channels by which organization capital contributes to positive innovation output. Robustness tests help rule out possible endogenous concerns.

Introduction

Innovation is a critical driving force for firms to maintain competitive advantage and guarantee sustainable economic growth (Solow, 1957). It can not only do good to exploit and utilize existing resources, integrate them with newly acquired ones seamlessly, and transform into company embedded operating features continuously, but also help companies tap potential value and improve competitiveness.

However, firms face a dilemma in innovation activities. On the one hand, innovation can help firms improve future performance (Xu and Tang, 2010), enhance firm value (Griliches, 1981), and facilitate future growth (Li et al., 2008). On the other hand, innovative activities have a high likelihood of failure. Differentiated from general productive processes, they are usually long-term, high-input, risky and idiosyncratic (Hirshleifer et al., 2012). Therefore, finding out the driving factors for successful innovation attracts a great deal of attention. He and Tian (2018) categorize all identified factors into the following three sections: country-level, market-level, and firm-level. Specifically, as for country-level factors, existing literature mainly focuses on the effects of a country's legal system and government policies on innovation decisions (Lerner, 2009; Williams, 2013). As for market-level factors, a large body of studies examines the relationship between product market competition and innovation (Aghion et al., 2005; Desmet and Rossi-Hansberg, 2012; Spulber, 2013). As for firm-level factors, a substantial amount of studies find that individual management features affect innovation output (Sapra et al., 2014; Aghion et al., 2013) such as CEO characteristics (Galasso and Simcoe, 2011), and CEO's compensation

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schemes and incentives (Ederer and Manso, 2013). Besides these observable factors, intangible assets like operating system and pattern could also reflect a company's risk tolerance, working efficiency, and executives' talents. Chemmanur et al. (2019) raise the puzzle that firms' innovation performance cannot be fully captured by human capital.

Serving as a burgeoning concept to evaluate the efficiency of corporate operating framework, organization capital has been recently quantified in accounting and finance studies by taking multiple-ingredients instead of human capital itself into consideration. Organization capital was first introduced by Prescott and Visscher (1980), and later defined as the mother of intangible assets by Lev and Radhakrishnan (2005). They point out that the components of organization capital include business processes and systems – commitment to rules, norms, and relationships, which can make resources more productive. To our best cognition, organization capital, proxied as the ability to convert various factors into final value, is an element closely related to both company patterns and managers' skills, and not restricted by the flow of human capital because of its difficult-imitable characteristic. Given the role played by organization capital (Tronconi and Marzetti, 2011; Eisfeldt and Papanikolaou, 2013), our paper aims to investigate whether organization capital enhances corporate innovation output.

Using the data of listed Chinese companies during the period of 2005-2015,[1] we find a positive relationship between organization capital and innovation output, and then we perform a change analysis to enhance the persuasiveness. We also use instrumental variable approach to address endogenous concerns. In addition, cross-sectional results show that both political connection and industrial concentration diminish the effectiveness of organization capital on innovation. We further investigate the possible channels that account for organization capital's contribution to corporate innovative output. Collectively, organization capital plays an active role in facilitating corporate innovation by ensuring sufficient funding supports and accelerating internationalization.

Our paper makes the following contributions to the existing literature. First, archival literature and practical fields strongly emphasize the importance of organization capital around the world (Liu et al., 2017; Chemmanur et al., 2019). Eisfeldt et al. (2013) show that the average return of firms with more organization capital is 4.6% higher than that of firms with less organization capital. Our study provides evidence on the importance of organization capital in emerging markets. Second, it expands the innovation literature by focusing on firms' intangible wealth. Archival literature mainly studies the external factors determining corporate innovation. Our study is one of several papers analyzing firms' intrinsic value in regard to determining innovation. What's more, to the best of our knowledge, this paper is the first study to use citation-based metrics to measure innovative activities which are more informative to reflect the quality of corporate innovation and focus on the incremental value of innovation. Third, our study explores special mechanisms through which organization capital affects Chinese firms' innovation output including the assurance of abundant financing resources and internationalization. Our paper is closely related to the study of Francis et al. (2015) which focuses on the U.S. setting and studies the impact of organization capital on innovation. Our study aims to provide supplementary evidence on emerging markets. As the largest emerging economy around the world, analyzing the stimulating role of organization capital on corporate innovation is of great significance. China is a rapidly expanding corporate sector and China's securities markets are becoming increasingly integrated with the global economy. However, China is still lagging behind in regard to innovation (Lin et al., 2011). The Chinese central government launched a series of policies to stimulate corporate innovation including innovation awards and "The Thousand Talents Plan". In addition, China is one of typical countries with weaker legal institutions and a poorer external information environment. Therefore, analyzing the impact of firms' intrinsic value on corporate innovation is meaningful (Yuan and Wen, 2018).

The rest of the paper is structured as follows. Section 2 describes the sample and measurement of variables and shows our research design. Section 3 reports our empirical results. Section 4 concludes.

2. Sample and measurement of variables

2.1. Data and Sample

Our sample consists of firms listed on the Chinese A-share market over the period from 2005 to 2015. We collect the patent citation information from CNRDS database and the firm-year financial information from CSMAR database, and then impose the following filters to get our final sample: (1) eliminate ST and ST* companies; (2) eliminate listed companies in financial industries; and (3) eliminate companies with incomplete data. The sample selection process finally yields 9,794 firm-year observations used in our baseline regression. We winsorize all continuous variables at the top and bottom 1%.

2.2. Measurement of variables

According to Eisfeldt and Papanikolaou (2013), we quantify organization capital using perpetual inventory method. Since SG&A in US financial statement is equivalent to SA in Chinese financial statements, we first calculate the beginning year organization capital by deflating SA_1:

$$OC_0 = \frac{SA_1}{g + \delta_0}$$

[1] We thank the reviewer's comments very much. In order to ensure the validity of citation-based innovation proxy, we leave a 4-year gap and limit our sample period to 2005-2015.

Table 1
Descriptive Statistics.

	Observations	Standard deviation	Mean	P25	Median	P75
INNOVATION	9,794	1.496	2.304	1.168	2.157	3.246
OC	9,794	1.344	17.900	16.955	17.755	18.684
SIZE	9,794	1.272	22.144	21.239	21.920	22.834
AGE	9,794	0.372	2.652	2.485	2.807	2.890
LEVERAGE (%)	9,794	14.211	16.564	3.560	14.486	26.258
TANGIBILITY (%)	9,794	15.964	24.157	11.965	21.044	33.822
CAPEX (%)	9,794	0.598	0.188	0.000	0.000	0.000
RD (%)	9,794	0.554	0.180	0.000	0.000	0.000
ROA (%)	9,794	5.728	4.043	1.446	3.703	6.722
BM	9,794	0.148	0.303	0.194	0.278	0.389
ANNUALRETURN (%)	9,794	74.899	39.814	-12.316	22.627	72.290
HHI	9,794	0.127	0.122	0.048	0.078	0.144
HHI_SQR	9,794	0.080	0.031	0.002	0.006	0.021
INSTITUTION	9,794	2.729	1.768	0.000	0.730	2.276

Note: This table presents the descriptive statistics of main variables. The sample period is from 2005 to 2015. All the continuous variables are winsorized at the top and bottom 1%.

Table 2
Organization capital and innovation.

Panel A		Panel B	
Dep. Var.=	***INNOVATION***	Dep. Var.=	***ΔINNOVATION***
OC	0.058**	*ΔOC*	0.269***
	(2.46)		(4.03)
SIZE	0.545***	*ΔSIZE*	0.211*
	(19.47)		(1.82)
AGE	0.125*	*ΔAGE*	3.116***
	(1.71)		(4.37)
LEVERAGE	-0.014***	*ΔLEVERAGE*	-0.001
	(-6.56)		(-0.15)
TANGIBILITY	-0.003*	*ΔTANGIBILITY*	0.006
	(-1.74)		(1.50)
CAPEX	-1.435***	*ΔCAPEX*	-0.964*
	(-4.12)		(-1.75)
RD	1.783***	*ΔRD*	1.217**
	(4.72)		(2.06)
ROA	-0.003	*ΔROA*	0.001
	(-0.78)		(0.22)
BM	-1.473***	*ΔBM*	-0.937***
	(-8.27)		(-2.77)
ANNUALRETURN	-0.001***	*ΔANNUALRETURN*	-0.008
	(-3.80)		(-0.23)
HHI	-2.735***	*ΔHHI*	1.987
	(-4.88)		(1.64)
HHI_SQR	3.698***	*ΔHHI_SQR*	-2.957*
	(4.50)		(-1.80)
INSTITUTION	0.016**	*ΔINSTITUTION*	0.025**
	(2.37)		(2.50)
_cons	-11.107***	*_cons*	-0.114
	(-17.00)		(-0.70)
Year FE	Yes	*Year FE*	Yes
Industry FE	Yes	*Industry FE*	Yes
Cluster firm	Yes	*Cluster firm*	Yes
Observations	9.794	*Observations*	7,779
adj. R-sq	0.372	*Pseudo R-sq*	0.044

Note: This table presents results of the influence of organization capital on corporate innovation and change analysis. The sample period for our main regression is from 2005 to 2015. For the change analysis, all variables are in first differences between year *t* and *t-1*. The statistical significance of the estimates is denoted with asterisks: ***, ** and * correspond to 1%, 5% and 10% levels of significance, respectively.

where OC_0 represents the company's beginning organization capital; SA_1 is the selling and administrative expenses disclosed in the financial report for the beginning year; g is the annual arithmetic average growth rate of SA at the company level. δ_0 is the depreciation rate of R&D expenses. Following Eisfeldt and Papanikolaou (2013), we choose δ_0 to be 15%.

Then we recursively construct organization capital by cumulating the deflated value of SA:

$$OC_{it} = (1-\delta_0)OC_{it-1} + \frac{SA_{it}}{cpi_t}$$

Table 3
Cross-sectional analyses.

Dep. Var.=	***INNOVATION*** **(1)**	***INNOVATION*** **(2)**
OC	0.088***	0.023
	(3.14)	(0.79)
OC_HHI		0.252**
		(2.07)
PC	1.000*	
	(1.86)	
OC_PC	-0.056*	
	(-1.85)	
SIZE	0.548***	0.539***
	(19.56)	(19.11)
AGE	0.121*	0.137*
	(1.65)	(1.86)
LEVERAGE	-0.014***	-0.013***
	(-6.59)	(-6.42)
TANGIBILITY	-0.003*	-0.004*
	(-1.72)	(-1.91)
CAPEX	-1.436***	-1.437***
	(-4.13)	(-4.11)
RD	1.784***	1.785***
	(4.73)	(4.71)
ROA	-0.003	-0.003
	(-0.82)	(-0.68)
BM	-1.479***	-1.427***
	(-8.30)	(-8.15)
ANNUALRETURN	-0.001***	-0.001***
	(-3.73)	(-3.82)
HHI	-2.739***	-7.191***
	(-4.89)	(-3.24)
HHI_SQR	3.723***	3.552***
	(4.52)	(4.46)
INSTITUTION	0.016**	0.015**
	(2.37)	(2.34)
_cons	-11.703***	-10.382***
	(-15.94)	(-13.62)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Cluster firm	Yes	Yes
Observations	9.794	9.794
adj. R-sq	0.375	0.373

Note: This table presents cross-sectional analyses. *PC* is a dummy variable, which equals to one if *company i*'s ratio of the number of managements with political connection to the whole size of management is above the average level in the same year. We use *HHI* to reflect the degree of competition. A higher *HHI* indicates a less-competitive environment. The sample period for our main regression is from 2005 to 2015. The statistical significance of the estimates is denoted with asterisks: ***, ** and * correspond to 1%, 5% and 10% levels of significance, respectively.

where subscripts i and t represent firm i in year t, and cpi_t is the consumer price index at the end of year t.

To measure corporate innovation, we refer to Hall et al. (2001) and Francis et al. (2015) for the proxy and construct citation-based metric to measure a firm's innovation activities (*INNOVATION*). We first sum up the number of citations (self-citation excluded) of all firms received regarding each patent applied for in the same year, scaled it by the number of patents in the count of every year, and name the ratio as the average number of citations. We then divide the citated number of each patent (self-citation excluded) in a given fiscal year by the corresponding average number of citations. Given the adjusted citation on each patent, we add it up by firm and finally take the logarithm value of one plus firm level citation.[2]

We also control for a series of firm-specific variables according to prior literature including firm size (*SIZE*), firm age (*AGE*), leverage ratio (*LEVERGAGE*), asset tangibility (*TANGIBILITY*), capital expenditures (*CAPEX*), R&D (*RD*), return on asset (*ROA*), book-to-market ratio (*BM*), annual stock return (*ANNUALRETURN*), competition level (*HHI*), Herfindahl Index squared (*HHI_SQR*), and institutional ownership (*INSTITUTION*).

[2] Due to the data limitation, we could just extract citation information from CNRDS. Until now, in the Chinese market, there are no public data for patent grant information and technology class as in the US. Therefore, we use the citation truncation adjustments as our main innovation proxy.

Table 4
Channel Tests.

Panel A: Financing resources		
	Panel A1: Regression of organization capital on financing resources	Panel A2: Regression of financing resources on innovation
Dep. Var.=	***EXFIN***	***INNOVATION***
	(1)	**(2)**
OC	0.095***	0.057**
	(4.50)	(2.42)
EXFIN		0.111***
		(3.08)
SIZE	-0.281***	0.551***
	(-12.68)	(19.71)
AGE	-0.043	0.124*
	(-0.58)	(1.70)
LEVERAGE	0.005***	-0.014***
	(2.71)	(-6.88)
TANGIBILITY	0.034***	-0.004**
	(21.21)	(-2.09)
CAPEX		-1.439***
		(-4.13)
RD	0.108***	1.785***
	(2.67)	(4.72)
ROA		-0.006
		(-1.52)
BM	-6.772***	-1.345***
	(-30.42)	(-7.34)
ANNUALRETURN		-0.001***
		(-4.04)
HHI		-2.717***
		(-4.87)
HHI_SQR		3.678***
		(4.50)
INSTITUTION		0.016**
		(2.38)
_cons	4.784***	-11.257***
	(9.26)	(-17.10)
Year FE	Yes	Yes
Industry FE	No	Yes
Cluster firm	Yes	Yes
Observations	9.794	9.794
Pseudo R-sq/ adj. R-sq	0.141	0.376
Panel B: Internationalization		
	Panel B1: Regression of organization capital on the number of countries that overseas subsidiaries in	**Panel B2: Regression of the number of countries that overseas subsidiaries in on innovation**
Dep. Var.=	***NCOS***	***INNOVATION***
	(1)	**(2)**
OC	0.298***	0.256***
	(10.29)	(14.22)
NCOS		0.294***
		(6.90)
SIZE	0.274***	0.117***
	(8.94)	(5.62)
AGE	-0.313***	-0.042
	(-2.98)	(-0.64)
LEVERAGE	0.004	-0.010***
	(1.47)	(-5.34)
TANGIBILITY		0.003*
		(1.86)
CAPEX		-0.332
		(-0.97)
RD		0.427
		(1.15)
ROA	0.016**	0.021***
	(2.46)	(5.68)
BM	-0.492*	-0.375**
	(-1.84)	(-2.12)
ANNUALRETURN		-0.000
		(-0.44)
HHI		-0.868*
		(-1.76)

(*continued on next page*)

Table 4 (*continued*)

Panel A: Financing resources		
	Panel A1: Regression of organization capital on financing resources	Panel A2: Regression of financing resources on innovation
Dep. Var.=	***EXFIN*** **(1)**	***INNOVATION*** **(2)**
HHI_SQR		0.806
		(1.07)
INSTITUTION	0.004	0.009
	(0.40)	(1.37)
_cons	-11.700***	-5.647***
	(-15.73)	(-11.51)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Cluster firm	Yes	Yes
Observations	4,794	4,794
Pseudo R-sq/ adj. R-sq	0.092	0.307

Note: This table presents possible channels through which organization capital enhances corporate innovation. *EXFIN* is a dummy variable measuring the easiness of external financing, which means that the value of one indicates more access to external financing. We initially use operating cash flow$_t$ to asset$_{t-1}$, dividend$_t$ to asset$_{t-1}$, leverage$_t$, and Tobinq$_t$ to construct *EXFIN*. The sample period for financing channel is from 2005 to 2015. *NCOS* is a dummy variable reflecting internationalization, namely the number of countries where subsidiaries are established is above the mean value, otherwise 0. The sample period for internationalization is from 2013 to 2015. The statistical significance of the estimates is denoted with asterisks: ***, ** and * correspond to 1%, 5% and 10% levels of significance, respectively.

2.3. Model specification

We construct the following OLS model to verify the impact of organization capital on innovation output:

$$INNOVATION_{i,t} = \alpha + \beta_1 \times OC_{i,t} + \gamma \times Controls_{i,t} + \sum Industry + \sum Year + \varepsilon$$

where $INNOVATION_{i,t}$ indicates the innovative quality for firm i in year t; $OC_{i,t}$ reflects company organization capital. All control variables are defined in the appendix in detail.

3. Empirical results

3.1. Descriptive statistics

Table 1 presents summary statistics for the major variables. The mean (median) value of $INNOVATION_{i,t}$ is 2.304 (2.157).

3.2. Multivariate Regression

Panel A, Table 2 reports the result from our baseline regression controlling for industry and year fixed effects. The coefficient of *OC* is positive and significant at the 5% level after we cluster standard errors at the firm level, suggesting that organization capital is capable of increasing firms' innovation output. The economic effect is that a one standard deviation increase in *OC* is associated with a 5.8% increase in corporate innovation index. Furthermore, we run change analysis so as to mitigate the potential risk of confounding the effects of organization capital on innovation. The results are presented in Panel B, Table 2. We define *ΔOC* as 1 if organization capital increases in the following year, and 0 otherwise. For control variables, we also use change values for consistency. The result is consistent with our main findings.

3.3. Cross-sectional analyses

In Table 3, we examine the cross-sectional effect of political connection and industrial competition on the effectiveness of organization capital. *PC* is defined as 1 if the proportion of political connected management is above the mean level, and 0 otherwise. From Column (1), Table 3, the coefficient of interaction term (*OC_PC)* is negative and significant which indicates that political connection weakens the role of organization capital in relation to corporate innovation. Column (2), Table 3 presents the results of industrial competition. We use *HHI* to reflect industrial competition. A higher *HHI* indicates a less competitive environment. The interaction term, *OC_HHI,* is positive and significant, suggesting that firms located in highly concentrated industries have priority in regard to resources, thus moderating the role of organization capital.

3.4. Channel tests

Innovation activity is widely known to be a long-term, risky and idiosyncratic process. Firms need the strong support of sufficient

funds. Following previous studies (Brown et al., 2012), we examine whether organization capital enhances corporate innovation through the assurance of abundant financing resources. To construct the indicator (*EXFIN*), we use the ratio of operating cash flow to last year's total asset book value, dividends to last year's total asset book value, leverage and Tobin Q together as our basic criteria, and then sort our sample into two groups based on rank. Specifically, firms with a higher rank can easily obtain financial support. *EXFIN* is denoted as 1 for the top 50%, and 0 for the rest. The results are documented in Columns (1) and (2) of Panel A, Table 4. In the first step (Panel A (1)), the coefficient of *OC* is positive and significant, supporting the idea that firms with higher organization capital are likely to access more external financing resources. In the second step, we explore the effect of organization capital and external financing ability together. In Panel A (2), the coefficients of *OC* and *EXFIN* are both positive and significant, which indicates that external financing ability is partially an intermediary between organization capital and innovation.

In addition, Chinese firms nowadays try to enlarge their innovative output through seeking international sources. Therefore, we also try to test whether internationalization is another mechanism through which organization capital promotes corporate innovation. We use the number of countries that overseas subsidiaries are located in to describe internationalization. *NCOS* equals 1 if the number of countries where subsidiaries are established is above the mean value, otherwise 0. Panel B (1) shows the first stage regression where firms with higher organization capital are more likely to increase their internationalization of business. In the second stage (Panel B (2)), we add *OC* and *NCOS* together and find that positive results still exist in both terms of *OC* and *NCOS*. In summary, Panel B shows that internalization is another channel through which organization capital increases corporate innovative output.

3.5. Instrumental variable approach

In order to address the endogeneity issue, we also use instrument variables (IV) two-stage least squares (2SLS) approach. Following

Table 5
Instrumental variable analysis.

Dep. Var.=	***OC***	***INNOVATION***
	(1)	**(2)**
IV	-1.342***	
	(-2.64)	
FITTED_OC		1.032*
		(1.83)
SIZE	0.532***	0.277
	(53.55)	(0.09)
AGE	-1.349***	1.439*
	(-41.91)	(1.89)
LEVERAGE	-0.013***	-0.001
	(-13.19)	(-0.10)
TANGIBILITY	-0.003***	-0.001
	(-3.37)	(-0.31)
CAPEX	-0.258	-1.187***
	(-1.24)	(-3.47)
RD	0.249	1.543***
	(1.11)	(4.25)
ROA	0.009***	-0.012**
	(4.41)	(-1.96)
BM	0.550***	-2.010***
	(6.00)	(-5.92)
ANNUALRETURN	-0.000	-0.001**
	(-0.66)	(-2.10)
HHI	0.085	-2.836***
	(0.31)	(-6.96)
HHI_SQR	-0.169	3.904**
	(-0.42)	(6.34)
INSTITUTION	-0.034***	0.048**
	(-8.46)	(2.44)
_cons	10.081***	-20.4226***
	(40.79)	(-3.77)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Observations	9,794	9,794
Test of endogeneity		
Durbin $\chi 2$	5.242**	
Wu-Hausman	5.222**	
Weak identification statistic		
F-statistic	6.992***	

Note: This table presents the results of instrumental variable analysis. *IV* measures the growth uncertainty within each industry to which firm belongs. The sample period is from 2005 to 2015. The statistical significance of the estimates is denoted with asterisks: ***, ** and * correspond to 1%, 5% and 10% levels of significance, respectively.

Carlin et al. (2012), Li et al. (2018), and Francis et al. (2015), we use the growth uncertainty of the industry to which the firm belongs as an instrument for organization capital. Industry-level growth uncertainty captures the demand-side consideration for firms to invest in organization capital and provides the plausibly exogenous variation required to implement the IV methodology. We first compute the quarterly asset growth rates of each firm, adjust them by season, and then calculate the standard deviation of seasonally-adjusted asset growth rate using four quarters on a firm basis. Secondly, we take the industry-median of firm-level standard deviation. In order to mitigate the industry-specific innovativeness noise, we finally follow Francis et al. (2015), summing up the adjusted number of patent citations of all firms in the same industry and year. Then, we perform the following regression for each industry:

$$SIC(AGU)_{j,t} = \alpha + Ln\ Cit_{j,t} + \varepsilon_{j,t}$$

The residual from the regression is used as the instrument (denoted as *IV*). The results are presented in Table 5. Column (1) shows the first stage regression which indicates that the instrument is negatively correlated with *OC* and statistically significant. Column (2) shows the second stage result indicating that the coefficient on the fitted value of *OC* is positive and significant. In summary, the result is consistent with the baseline regression.

We further show the validity of our chosen instrumental variable. The Durbin $\chi 2$ test statistic is 5.242 (p-value=0.022) and Wu-Hausman F-statistic is 5.222 (p-value=0.022), which together reject the null hypothesis that organizational capital is exogenous to innovation. What's more, to ensure the relevance of our chosen instrumental variable, we perform an F-test in the first-stage regression with the null hypothesis that the instruments do not explain the variation of organizational capital. This shows that we reject the null hypothesis at the 1% level.

3.6. Alternative proxies

To enhance the robustness of our main results, we also use alternative proxies to measure innovation. Following Lanjouw et al.'s

Table 6
Robustness check.

Dep. Var.=	*INNO_PATENT1* (1)	*INNO_PATENT2* (2)
OC	0.289***	0.259***
	(10.89)	(10.12)
SIZE	0.113***	0.125***
	(3.03)	(3.48)
AGE	-0.051	-0.089
	(-0.52)	(-0.95)
LEVERAGE	-0.012***	-0.010***
	(-4.69)	(-4.07)
TANGIBILITY	0.001	0.001
	(0.51)	(0.55)
CAPEX	-0.386	-0.365
	(-1.00)	(-0.95)
RD	0.487	0.471
	(1.14)	(1.12)
ROA	0.017***	0.015***
	(4.02)	(3.76)
BM	-0.463**	-0.296
	(-2.16)	(-1.46)
ANNUALRETURN	-0.000	-0.000
	(-1.56)	(-1.16)
HHI	-1.089	-1.344**
	(-1.62)	(-2.11)
HHI_SQR	1.453	1.745*
	(1.45)	(1.82)
INSTITUTION	0.011	0.009
	(1.56)	(1.36)
_cons	-6.159***	-6.011***
	(-7.10)	(-7.26)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Cluster firm	Yes	Yes
Observations	9,794	9.794
adj. R-sq	0.301	0.307

Note: This table presents the results of robustness check, in which we use alternative indicators to measure company's innovation level. *INNO_PATENT1* is calculated as the logarithm of one plus the number of granted patents, which include invention patents, utility model patents and design patents. *INNO_PATENT2* is calculated as the logarithm of one plus the number of granted patents, subtracting design patents. The sample period is from 2005 to 2015. The statistical significance of the estimates is denoted with asterisks: ***, ** and * correspond to 1%, 5% and 10% levels of significance, respectively.

(1998) proxy, we use the natural logarithm of one plus the number of granted patents (*INNO_PATENT1*). Granted patents include invention patents, utility model patents, and design patents. What's more, we repeat the regression by excluding design patents (*INNO_PATENT2*).[3] The results are presented in Table 6 and are consistent with our baseline findings.

4. Conclusion

In this paper, we study the link between corporate innovation and organization capital based on the panel set of Chinese publicly listed firms from 2005 to 2015. The results are robust to several alternative model specification tests. We also find that the effectiveness of organization capital becomes weak in firms which have strong political bonds and located in highly competitive industries. Additionally, we further identify financial support and internationalization as two possible channels through which organization capital is of great use in nurturing corporate innovation.

Author Statement

Cui Huijie: Conceptualization; Data curation; Validation; Roles/Writing - original draft.
Dai Lixuan: Formal analysis.
Zhang Yanan: Funding acquisition; Investigation; Methodology; Writing - review & editing.

Appendix: Variable definition

Variable	Definition
INNOVATION	Natural logarithm of one plus the sum of time adjusted citations received on patents within each firm. We define time adjusted citations as the ratio of citations received on each patent to according average citation, which is the sum of citations received on all patents applied in the same year scaled by the number of patents.
OC	The logarithm value of organization capital in year *t*, which is constructed by cumulating firm *i*'s CPI-deflated selling and administrative (SA) expenses using a perpetual inventory method (Eisfeldt & Papanikolaou, 2013). A 15% depreciation rate is used in calculation.
SIZE	Natural logarithm of total assets at the end of each year.
AGE	Natural logarithm of one plus the number of years that firm *i* has been listed.
LEVERAGE	Ratio of sum of short- and long-term debt to book value of total assets of firm *i* in year *t*.
TANGIBILITY	Ratio of net property, plant and equipment (PPE) to book value of total assets of firm *i* in year *t*.
CAPEX	Ratio of capital expenditures to book value of total assets of firm *i* in year *t*.
RD	Ratio of research and development expenditures to book value of total assets of firm *i* in year *t*.
ROA	Ratio of net profit to book value of total assets of firm *i* in year *t*.
BM	Ratio of book value of total equity to market value.
ANNUALRETURN	Annual stock return with cash dividend reinvested.
HHI	Herfindahl index. Measure the concentration ratio of firm's industry. It is calculated as $\Sigma(X_i/X)^2$, in which X_i signifies revenue from main business of company *i*, and X is the sum of revenue of all companies within the industry.
HHI_SQR	Squared term of Herfindahl index of firm.
INSTITUTION	The sum of shareholding proportion by pressure-sensitive institutional investors (brokers, entrusts, insurance companies, finance companies, and banks).

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[3] We appreciate the reviewer's comments suggesting us to exclude the design patents from our calculation as they are not that novel.

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