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Political connection heterogeneity and corporate innovation

Rui Zhang[a,*], Zhengling Xiong[b], Honghuan Li[c], Baijun Deng[d,1]

[a] School of Finance, Renmin University of China, Beijing 100872, China
[b] The University of Queensland Business School, Queensland 4072, Australia
[c] School of Banking & Finance, University of International Business and Economics, Beijing 100029, China
[d] Research Center, Shenzhen Capital Group Co. Ltd., Shenzhen 518000, China

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ABSTRACT

This paper examines whether political connection heterogeneity plays a role in corporate innovation in a sample of all listed firms in China from 2008 to 2016. Our results show that connections with central government officials promote innovation, while connections with local government officials inhibit innovation. The nonconformity between the influence of federalism and that of the local authorities is associated with the personnel promotion and tenure requirements that induce differential innovation-promotion strategies. We use the Heckman two-stage estimation to address selection bias, and we adopt a setting as a quasi-natural experiment, leveraging the decrease in local GDP growth rates to abate endogeneity. Our results endure these econometric treatments and a series of robustness checks. In mechanism tests, we document evidence that the central government promotes corporate innovation by improving innovation efficiency, while the local government inhibits innovation by reducing both innovation inputs and efficiency. We also find that the effect is even larger on high-tech firms and that it can be mitigated by marketization.

Introduction

This paper revisits the contemporary issue of whether political connections facilitate or impede corporate innovation activities in the context of China. This is an important issue since innovation is one of the key ingredients in establishing economic efficiency and promoting sustainable growth (Hasan & Tucci, 2010). Understanding this association is particularly vital for emerging markets where the traditional planned economic model is considered to no longer be sustainable (OECD, 2008). In the past two decades, the central government of China has been impelling countrywide policies to forge an innovation-driven economy. It may be argued that these policies have assisted China to achieve a 200-fold increase in the number of patent applications over the last 20 years, with the figure surpassing that of the United States in 2019 for the first time (WIPO, 2019). Following the transition from an imitator to an innovator economy, attention from researchers has been drawn to studying the impact factors of innovation drivers in the Chinese market empirically.

We concentrate our research on the relationship between political connections and corporate innovations. Our motivation is to provide a political-based incentive to explain innovation and to focus on existing studies that report contradictory results. For instance, Su et al. (2019) suggested that firms with political connections are more active with innovations than non-connected firms. They considered that political connections could provide corporations with better access to external resources, including government subsidies and contracts from related institutions and governments. On the other hand, Hou et al. (2017) found that political connections impede innovation activities and efficiency, further suggesting this is due to the resource curse effect (Auty, 1993). In other words, corporations with political connections may be over-allocated resources from the government, and therefore, have fewer incentives to improve corporate performance and competitiveness. Hence, such corporations are more likely to concentrate on short-term outcomes instead of innovations that require long-term commitment.

The issue that produces these mixed results may stem from the fact that the influence and incentives of different levels of the government are dissimilar. The government system incorporated in China is a federalism system with centralized personnel control (Blanchard & Shleifer, 2001; Frye & Shleifer, 1997). Under this system, the central government is responsible for setting and distributing tasks to lower-level government bodies—in this case, setting a strategic target of sustainable long-term economic growth for the entire country. In contrast, as an ancient Chinese adage suggests, “The emperor is as far away as the sky.” In other words, local governments do not always

* Corresponding author.
E-mail address: wiskie@ruc.edu.cn (R. Zhang).

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act in line with the central government's plans (Qi et al., 2008; Wang et al., 2018). Instead, since their performance appraisal term is short and relies heavily on quantifiable performance indicators, they are often more biased towards short-term economic growth strategies that deliver short-term and popular local outcomes with promotion rewards in the local political ladder. Given the different foci between central and local governments, our main hypothesis is that the influence of political connections on corporate innovation under federalism is hierarchical: connections with central government officials promote innovation, while connections with local government officials inhibit innovation.

Using the data of listed firms in China from 2008 to 2016, we capture government hierarchies by having individual dummy variables for political connection at the local, provincial, and national levels. We find strong evidence that the officials' innovation-encouraging tendencies are stratified: the central government tends to promote innovation, while local government officials tend to inhibit innovation. This difference in tendencies further causes distinguishing impacts on firms' long-term profitability. In other words, firms linked with the central government have better future return on equity via corporate innovation, while a local government connection significantly reduces the profitability via innovation.

There are two major potential endogeneity issues that we need to address. The first one concerns the classic self-selection bias and the truncation of the invention patent ownership at zero. In other words, a more innovation-prone company may own more patents. We use the classic Heckman two-stage estimation to address the first concern. In the first-stage estimation, we estimate each firm's appetite for innovation, measuring the implied intention of each corporation to apply for invention patents. In the second-stage estimation, we find that the innovation appetite of a firm is indeed a crucial determinant of the number of patents applied for and granted. Therefore, we control the innovation appetite of the firm in order to mitigate the self-selection bias. Furthermore, our main results are not weakened even when the sample is shrunk to only include companies applying for at least one patent.

The second potential endogeneity issue is that innovation-active companies may be more likely to be connected with the central government, while low-innovation firms may be more inclined to seek the support of the local government. This is the central challenge confronted by our results. If this were the case, our evidence would be blurred, for the innovative nature of the company might also partially account for the increase and decrease in the number of patents applied for by companies with central government connections and local government connections, respectively.

In order to address this central challenge, we take advantage of the decrease in local GDP growth rates as an external experiment to carry out a time-varying difference-in-difference (DID) estimation. The decrease in GDP growth rate of companies' location is a de facto external shock rather than an endogenous decision by any part. A GDP growth rate decrease would add to local officials' pressure on regional competition against short-term quantifiable targets while having no impact on central government officials. We expect to see that the innovation of firms that have political connections with local governments would decrease when the local GDP growth rate decreases, while the innovation of firms that have political connections with the central government or have no political connections would not be significantly influenced. Our estimation presents supportive evidence for this claim.

Some studies focus on the influence of the administrative rank of the officials but overlook the impact of their government agencies' targets. Since the level of government agencies is highly correlated with the administrative rank of officials, we also control the administrative rank of the officials to carry out the placebo test. The significant coefficients on key variables remain. Our results suggest that the impact of political connections can effectively reflect the influence of the government system. Finally, we re-examine our main hypothesis using alternative samples and specifications of the main variable of interests. Our results remain qualitatively and quantitatively the same in all robustness tests.

In additional analysis, we identify two channels through which the government may affect the performance of corporate innovation: R&D investment, and innovation efficiency. We find that connections with local governments hinder corporate innovation by both squeezing out R&D investment and reducing innovation efficiency, while the central government mainly promotes corporate innovation by assisting firms' innovation efficiency.

Particularly related to our study is the paper of Hou et al. (2017) and Su et al. (2019). Hou et al. (2017) segregated political connections into government-official political connections and CPC/CPPCC (Communist Party of China/Chinese People's Political Consultative Conference) political connections. CPC/CPPCC members do not necessarily have any position in the government, and if they are government officials, they are dispersed across both central and local governments. Su et al. (2019) measured firms' political connections using an aggregated index. For connections with the government system, they consider the political rank and assign scores of 1, 2, 3, 4, and 5 to the county/division heads, deputy department heads, department heads, vice ministers, and ministers, respectively. The political connection index is the sum of scores for CEOs, board chairs, directors, and other senior managers of the sample firms. In this case, the index is highly dependent on whether the firm has political connections with the central government while weighing rather low on political connections with the local government. Thus, they find a significant positive relationship between political connections and corporate innovation, which is the same with our results on the influence of political connections with the central government. Ours departs from Hou et al. (2017) and Su et al. (2019) in a more nuanced manner, by providing a political-based incentive to explain the heterogeneous role that political connections play in corporate innovation.

A competing explanation for the mixed results of Hou et al. (2017) and Su et al. (2019) is sample differences. Hou et al. (2017) focuses on non-state owned enterprises (non-SOEs), while Su et al. (2019) covers both state owned enterprises (SOEs) and non-SOEs. Since political connections in SOE and non-SOEs are incomparable, the nonconformity of their findings may be due to sample distinctions. In order to rule out this competing explanation, we run our baseline regressions using only non-SOEs. The estimated coefficients of the main variables remain, indicating that our conclusions are not influenced by the sample selection bias.

We contribute to the literature in two ways. First, our research contributes to the ongoing debate on the relationship between political connections and corporate innovation. Previous studies hold mixed arguments on this issue. Some show that political connections can promote corporate innovation through preferential policies and external resources (Hou & Yuan, 2017). Others argue that political connections have a negative effect on innovation, confirming the resource curse hypothesis (Yuan, Hou, & Cheng, 2015). The disagreement is partly caused by the ignorance of the incentives of the political officials. The nature of political connections is the interaction between politicians and corporate board directors. Understanding the motivation of related officials is essential for the study of political connections. By segregating the connection type into central and local connections, we innovatively show that the disagreement in prior studies can be explained by incorporating the incentives of political officials from different sub-government levels.

Second, our results provide nuanced evidence on the negative effects of federalism with centralized personnel control, which supplements the literature on federalism and the "China puzzle." The design of the government system is a critical theme for both transitional countries and developing markets (Blanchard & Shleifer, 2001; Qian & Weingast, 1997). Previous studies mainly focus on the positive

effects of China-style federalism on economic growth. The difference between the innovation propensity of the central and local governments is rarely mentioned. We shed new light on this field. This is also an important lesson for developing countries that are seeking to mimic the Chinese government system in undertaking regime shift to an innovative economy.

The remainder of the paper is organized as follows. Section 2 develops hypotheses. Section 3 describes the sample data and empirical models. Section 4 presents empirical results. Section 5 reports robustness tests. Section 6 outlines additional analysis. Section 7 concludes the paper.

Literature review and hypothesis development

In China, the government not only leads the substantial economy through formal channels but also strengthens or distorts its influence/direction through informal channels, among which the connection between government and enterprise is a powerful one. Under federalism, while having centralized personnel control, Chinese government officials at all hierarchies (including sub-national politicians and bureaucrats) have a hand in running the economy. This manifests in fierce competition amongst personnel. In order to climb up the political ladder with such competition, government officials are willing to have connections with corporations and provide resources and discretion to guide corporations for their development in order to induce economic outcomes (Yang, 1997; Tan et al., 2009).

It is worth pointing out that, under the Chinese-style federalism, the evaluation mechanisms of the central government officials and regional officials are heterogeneous. Departments under the governance of the central government cooperate in a vertical line so that each department is in charge of a different theme with a focus on the formulation or implementation of policies to ensure long-term sustainable development. On the contrary, local governments are divided into blocks and their political goals are to ensure the social stability of the region with a focus on short-term growth (Cheng et al., 2022).

The heterogeneity of political objectives directly leads to significant differences in the promotion procedures for officials. The promotion assessment for central government officials is often conceptual, with a long assessment period and relatively vague assessment criteria. In contrast, local government officials are promoted mainly based on the one-vote veto regime as well as related economic growth and personal achievements over a relatively short-term period. Hence, this heterogeneity means that the central and local government officials have significant differences in guiding principles for the development of firms.

Since the Fifth Plenary Session of the 16th Central Committee[2] put forward a strategic plan to build an innovative country in an "all-around" way, the central government has issued a bevy of policies to encourage and promote firms' innovation and industrial upgrading. As a result, the resource and policy inclination of the central government towards related firms is often long-term innovation-oriented. Subsequently, this is reflected in the micro firm-level, with subsidies for innovation, information and technology support, and technology-related tax deduction and policy preference. Subsidies, tax deduction, and policy preference depend largely on the innovation outcomes of a firm, increasing the firms' incentive to innovate in turn (Bronzini & Piselli, 2016). Access to information and technology support also benefit firms' innovation process, leading to higher innovation efficiency. Thus, connections with the central government can significantly promote firms' innovation, especial through increasing innovation efficiency.

On the other hand, the condition is contradictory for firms connected with the local government. Given the GDP-led promotion criteria for local officials, they are more inclined to lead companies to invest in fixed assets, but neglect R&D investments that provide long-term outcomes with higher uncertainty and low employment absorption (Zhao & Hao, 2009). These resources and preferential policies for related local companies are manifested in external financing convenience (Claessens et al., 2008; Khwaja & Mian, 2005), exemption of land transfer fee (Jiang et al., 2012), utilities and tax subsidies (Adhikari et al., 2006), governmental assistance, and investment-class governmental procurement projects of fixed assets (Goldman et al., 2006). Hence, the guidance direction of these policies drives related firms to adopt shorter-term strategies in the competition (Li et al., 2012), thereby reducing innovation demand and R&D expenditure by firms. As a result, political connections with the local government would lower both the firm's R&D investment and its innovation efficiency.

Moreover, under the governance mechanism of decentralized authoritarian regimes, the hierarchical assessment mechanism determines that the assessment pressure faced by government officials at all levels of the hierarchy is increasingly short-term in focus. Therefore, the annual GDP assessment pressure of lower-level local government officials is greater than that of government officials at higher levels, and the inhibition effect of innovation by local governments is more obvious at the prefectural level and below. Accordingly, our main hypothesis is formulated as follows:

H1: The influence of political connections is hierarchical: connections with central government officials promote innovation, while connections with local government officials inhibit innovation.

Sample data and methodology

Sample description

This paper utilizes all the listed firms from the A-share market over 2008–2016 as the main sample to capture the innovation-driven tendency of central and local governments. We source both the political connection and corporate innovation activity data from the CNRDS database. We then define a firm as politically connected if the firm's senior members, directors, and supervisors have ever held government posts, are currently government officials, representatives to the NPC[3] or CPPCC members[4], or occupy other political positions. We further identify whether political connections are associated with the central government, provincial governments, or prefectural and municipal governments given the intention of comparative analysis of the heterogeneous impact of different hierarchies of governments on a firm's innovation.

In addition, the natural logarithm of the number of patent applications and patents granted are used to measure corporate innovation activity. Finally, firms' basic information, such as financial performance and corporate governance and macroeconomic information, including province-level GDPs, are downloaded from CSMAR and RESSET databases, respectively. Detailed explanations of all variables are contained in Table 1.

[2] The Communist Party of China must convene a national congress every five years, and the central committee election should be held in the congress every five years. Additionally, all the members of the central committee should have a conference once a year, that is, the Plenary Session of the Central Committee. On October 8th to 11th, 2005, the Fifth Plenary Session of the 16th Central Committee of the Communist Party of China was held in Beijing.

[3] The representatives of National People's Congress are deputies to the National People's Congress from different provinces, cities, towns, counties and districts in China.

[4] The National Committee of the Chinese People's Political Consultative Conference consists of representatives of the Communist Party of China, democratic parties, non-partisans, people's organizations, ethnic minorities, people from different industries, etc.

Table 1
Definitions of variables.

Variables	Definitions
Dependent Variables	
INNOV	The logarithm of the number of invention patent applications plus 1
INNOV2	The logarithm of the number of invention patents applied independently plus 1
INNOV3	The logarithm of the number of granted invention patents plus 1
INNOV4	The logarithm of the number of granted invention patents applied independently plus 1
INNOV5	The logarithm of the number of granted invention patents at previous period plus 1
INNOV6	The number of invention patent applications scaled by the firm's market capitalization
INNOV7	The number of invention patent applications scaled by the firm's total sales
R&D_INT	The firm's R&D intensity is calculated by the firm's R&D investment after the standardization of operating revenue.
INNOV_EFFCY	The firm's innovation efficiency (Hirshleifer et al., 2013); the patents granted in the previous period / (R&D expenditure in the current period + 0.8 * R&D expenditure in the lag period + 0.6 * R&D expenditure in the lag two periods + 0.4 * R&D expenditure in the lag three periods + 0.2 * R&D expenditure in the lag four periods) (R&D expenditure unit: 10 million)
Independent Variables	
PC_ALL	Whether there is any political connection among the firm's senior managers, directors, and supervisors; if yes, it is defined as 1 and 0 otherwise.
PC_NATION	Whether the firm's senior managers, directors, and supervisors have a political connection with the central government; if yes, it is defined as 1 and 0 otherwise.
PC_PROVIN	Whether the firm's senior managers, directors, and supervisors have a political connection with the provincial governments; if yes, it is defined as 1 and 0 otherwise.
PC_LOCAL	Whether the firm's senior managers, directors, and supervisors have a political connection with the local governments at or below the prefecture level; if yes, it is defined as 1 and 0 otherwise.
Dummy Variables	
GDP_RED	Whether the province's GDP growth rate in current year is lower than that in the previous year; if yes, it is defined as 1 and 0 otherwise.
HIGH_TECH	Whether the firm's industry belongs to the high-tech industry announced by the National Bureau of Statistics; if yes, it is defined as 1 and 0 otherwise.
HIGH_MKT	Whether the Marketization Index of the headquarter province is larger than the median level of the year; if yes, it is defined as 1 and 0 otherwise.
Panel D: Control Variables	
STATE_OWN	State shareholdings percentage
TOP5_OWN	The equity concentration of firms (the sum of the shareholding ratios of the top five shareholders)
SIZE	The logarithm of the firm's total assets
AGE	Firm age
ROE	Firm's return on equity
LEV	Firm's leverage ratio
CEO_DUAL	Whether the firm's CEO is concurrently the board chairperson; if yes, it is defined as 1 and 0 otherwise.

Empirical models

The baseline model is expressed as follows:

$$INNOV_{it} = \alpha + \beta PC_{it} + \gamma CONTROLS_{it} + YEARFE + INDUSTRYFE + \varepsilon_{it} \quad (1)$$

We proxy $INNOV_{it}$ as the logarithm of the number of patent applications for firm i at year t plus one. PC_{it}, as the main variable of interest, consists of three dummy variables that are associated with political connections at the central (PC_NATION_{it}), provincial (PC_PROVIN_{it}), and local (PC_LOCAL_{it}) levels. We include control variables ($CONTROLS_{it}$) that may affect corporate innovation, as suggested in prior literature: *STATE_OWN*, state shareholdings as of the total shares outstanding of the firm defined in percentage; *TOP5_OWN*, the sum of the shareholding ratios of the top five shareholders; *SIZE*, the natural logarithm of the total assets at the end of the year; *LEV*, the total liability divided by the total assets at the end of the year; *ROE*, net income divided by equity; *CEO_DUAL*, a dummy variable that is equal to 1 if the CEO is also the chairman of the board and 0 otherwise; and *AGE*, the number of years that firm i has been listed on a stock exchange at the end of year t. We further include year and industry fixed effects to control for time and industry invariant factors and cluster standard errors at the industry level (Petersen, 2009; Cameron et al., 2011).

Table 2
Descriptive Statistics. This table reports the descriptive statistics of the sample variables. All the continuous variables are winsorized at the 1% level to avoid outliers. Detailed explanations are described in Table 1.

VARIABLE	N	MEAN	SD.	MIN.	MAX.
INNOV	20752	1.330	1.410	0.000	8.590
INNOV2	20752	1.250	1.360	0.000	8.580
INNOV3	20751	0.860	1.100	0.000	8.040
INNOV4	20751	0.800	1.060	0.000	8.030
R&D_INT	14204	0.040	0.040	0.000	0.240
INNOV_EFFCY	3325	0.460	0.870	0.000	18.910
PC_ALL	21040	0.890	0.310	0.000	1.000
PC_NATION	21040	0.410	0.490	0.000	1.000
PC_PROVIN	21040	0.430	0.500	0.000	1.000
PC_LOCAL	21040	0.520	0.500	0.000	1.000
GDP_RED	20706	0.620	0.480	0.000	1.000
HIGH_TECH	21040	0.390	0.490	0.000	1.000
HIGH_MKT	20706	0.817	0.387	0.000	1.000
STATE_OWN	20694	6.030	15.100	0.000	67.590
TOP5_OWN	20695	0.530	0.160	0.180	0.910
SIZE	20704	21.860	1.300	19.020	25.780
AGE	20703	15.280	5.370	4.000	31.000
ROE	20424	7.280	12.870	-60.920	40.270
LEV	20747	0.750	2.620	0.050	24.940
CEO_DUAL	19640	0.240	0.430	0.000	1.000

Main results

Descriptive statistics

Table 2 reports the descriptive statistics of the sample. All the continuous variables are winsorized at the 1% level to avoid outliers[5]. We find that 89% of the listed firms in our sample have political connections: 41% have political connections with the central government, 43% have political connections with provincial governments, and 52% have political connections with local and municipal governments. In addition, sample firms on average submitted 3 patent applications each year during 2008–2016; however, not all listed firms would

[5] We also conducted an empirical test using the financial data without winsorization. The regression results remain robust.

Table 3
Regression Results of the Baseline Model. This table presents the results from the baseline regression of the relationship between political connections and corporate innovation from 2008 to 2016. The dependent variable is INNOV, measured as the logarithm of the number of invention patent applications plus 1. The definitions of all the variables are listed in Table 1. Robust standard errors are in parentheses. Standard errors are clustered at industry level. ***, **, and * and represent statistically significancy at the 0.01, 0.05, and 0.10 levels, respectively.

	INNOV			
VARIABLES	(1)	(2)	(3)	(4)
PC_ALL	-0.055***			
	(0.013)			
PC_NATION		0.035***		
		(0.011)		
PC_PROVIN			0.015	
			(0.014)	
PC_LOCAL				-0.089***
				(0.009)
STATE_OWN	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
TOP5_OWN	-0.440**	-0.447**	-0.446**	-0.441**
	(0.189)	(0.188)	(0.188)	(0.189)
SIZE	0.407***	0.404***	0.406***	0.405***
	(0.090)	(0.090)	(0.090)	(0.090)
AGE	-0.011**	-0.011**	-0.012**	-0.011**
	(0.005)	(0.005)	(0.005)	(0.005)
ROE	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
LEV	-0.184**	-0.181**	-0.183**	-0.182**
	(0.084)	(0.084)	(0.084)	(0.084)
CEO_DUAL	0.060***	0.062***	0.062***	0.062***
	(0.017)	(0.017)	(0.017)	(0.017)
Intercept	-7.939***	-7.946***	-7.976***	-7.901***
	(2.093)	(2.094)	(2.093)	(2.101)
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	19,397	19,397	19,397	19,397
R-sq	0.337	0.338	0.336	0.340

have patent applications given the fact that the minimum value for INNOV is equal to 0. We also find that there are roughly 911 firms (39%) from the high-tech industry and 523 firms (24%) in which the CEO is also the chairperson of the board for each sample year. The ownership of the sample firms is relatively concentrated given that, on average, 53% of firms' shares are owned by the top five shareholders. Finally, firms in our sample are relatively old, with an average of 15 years in the market and a mean of 3 billion Chinese Yuan (equivalent to about $466 million under the current February 2021 exchange rate) worth of total assets.

Baseline regression results

Table 3 reports the regression results of the baseline model. Consistent with prior literature, the overall impact of political connections on enterprise innovation is significantly negative, and the establishment of political connections reduces the number of patent applications by 5.63%. However, after classifying the political connections by government hierarchy, we find that the tendency of governments toward firms' innovation differs: the central government has a significant positive impact on a firm's innovation, provincial governments have no significant impact,[6] and local or prefecture governments have a significant tendency to inhibit innovation. Moreover, firms' political connections with local governments at or below the prefecture level reduce the number of invention patent applications by 8.99%. Furthermore, the estimated coefficients of control variables are also in line with previous literature; ownership concentration, age and the asset-liability ratio, and firm size all have a significant negative impact on innovation; an increase in the firm's ROE and the existence of the CEO duality significantly increases innovation.

Heckman two-stage regression results

We use the Heckman two-stage method to deal with potential sample selection bias. In the first stage, the Probit model, as follows, is used to estimate the probability of firms' patent application in each year.

$$Pr(PatentApplication)_{i,t} = \alpha + \beta PC_{i,t} + \gamma CONTROLS_{i,t} + YEARFE + INDUSTRYFE + \varepsilon_{i,t}, \quad (2)$$

The fitted probability is then reflected in an inverse mills ratio $InverseMillsRatio_{i,t}$ from model (2). In the second stage, we rerun model (1) but with the inverse mills ratio $InverseMillsRatio_{i,t}$ incorporated in order to mitigate the heterogeneity of a firm's innovation tendency. The regression results of the second stage are reported in Table 4. After controlling for selection bias, the estimated coefficients consistently have the same signs as the previous ones and are still statistically significant.

Table 4
Heckman Two-Stage Regression Results. This table shows the results of the Heckman two-stage regression after controlling the heterogeneity of a firm's innovation tendency and the truncation problem from 2008 to 2016. The dependent variable is INNOV measured as the logarithm of the number of invention patent applications plus 1. *InverseMillsRatio* is an inverse mills ratio capture the probability of firm's patent application in each year. The definitions of all other variables are listed in Table 1. Robust standard errors are in parentheses. Standard errors are clustered at industry level. ***, **, and * and represent statistically significancy at the 0.01, 0.05, and 0.10 levels, respectively.

	INNOV			
VARIABLES	(1)	(2)	(3)	(4)
PC_ALL	-0.058***			
	(0.014)			
PC_NATION		0.104***		
		(0.025)		
PC_PROVIN			0.033***	
			(0.013)	
PC_LOCAL				-0.200***
				(0.030)
STATE_OWN	-0.003***	-0.002***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
TOP5_OWN	-0.518***	-0.535***	-0.525***	-0.520***
	(0.170)	(0.172)	(0.169)	(0.169)
SIZE	0.735***	0.726***	0.733***	0.728***
	(0.020)	(0.019)	(0.020)	(0.020)
AGE	-0.030***	-0.030***	-0.030***	-0.0230***
	(0.006)	(0.006)	(0.006)	(0.006)
ROE	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
LEV	-0.505***	-0.500***	-0.505***	-0.500***
	(0.032)	(0.032)	(0.032)	(0.032)
CEO_DUAL	0.153***	0.156***	0.154***	0.156***
	(0.014)	(0.014)	(0.014)	(0.013)
InverseMillsRatio	1.433***	1.425***	1.428***	1.413***
	(0.047)	(0.0470)	(0.048)	(0.048)
Intercept	-16.732***	-16.615***	-16.741***	-16.464***
	(0.446)	(0.443)	(0.445)	(0.463)
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	19,397	19,397	19,397	19,397
R-sq	0.378	0.380	0.377	0.381

[6] The influence of provincial governments is insignificant and unstable. This is due to the fact that the provincial government officials include ministerial officials, bureau-level officials, and those holding lower positions. Therein, the ministerial officials are under the direct jurisdiction of the central government, and their political goals are subject to the central political goals. However, the government officials at the bureau level and below are still under the jurisdiction of local governments. This leads to relatively complex political goals and promotion and selection mechanisms for provincial government officials; therefore, they are not entirely targeting short-term social stability and economic growth.

DID analysis

The empirical results from model (1) may also be affected by unobservable factors that are not controlled for. For instance, the impact of different levels of hierarchy of governments on enterprise innovation may be driven by the potential reason that firms with high (low) innovation ability are more (less) likely to establish a connection with the central government. In order to deal with this endogenous issue, we carry forward the Heckman two-stage method from model (2) to mitigate the selection bias and further implement a DID estimation based on a quasi-natural experiment.

Under the decentralized authoritarian system in China, one of the key indicators in the promotion process for local officials is regional economic growth. When the GDP growth rate of a province in the current year tends to be lower than the one in the previous year, the political pressure on non-central officials to improve the short-term economic growth rate may rise sharply. As a result, local government demands for long-term investment, such as innovation, may be further reduced; however, political connections are less likely to be affected by this GDP-related event (GDP_RED_{it}). Consequently, we recognize the downward GDP growth rate as the exogenous shock in our quasi-natural experiment. Furthermore, we define the treatment group as those firms that have a pre-specified political connection type (PC_NATION_{it}, PC_PROVIN_{it}, or PC_LOCAL_{it}) and then the control group that includes all other firms that do not have that specific type of political connection. The interaction term between that specific type of political connection and GDP_RED_{it} is the difference-in-difference that captures the casual impact of the government officials induced by the GDP growth reduction on corporate innovation. Hence, we have the DID regressions written as follows:

$$INNOV_{it} = \alpha + \beta_1 PC\_LOCAL_{it} + \beta_2 GDP\_RED_{it} + \beta_3 PC\_NATION_{it} \times GDP\_RED_{it} + \gamma CONTROLS_{it} + YEARFE + INDUSTRYFE + \varepsilon_{it}, \quad (3)$$

$$INNOV_{it} = \alpha + \beta_1 PC\_LOCAL_{it} + \beta_2 GDP\_RED_{it} + \beta_3 PC\_PROVIN_{it} \times GDP\_RED_{it} + \gamma CONTROLS_{it} + YEARFE + INDUSTRYFE + \varepsilon_{it}, \quad (4)$$

$$INNOV_{it} = \alpha + \beta_1 PC\_LOCAL_{it} + \beta_2 GDP\_RED_{it} + \beta_3 PC\_LOCAL_{it} \times GDP\_RED_{it} + \gamma CONTROLS_{it} + YEARFE + INDUSTRYFE + \varepsilon_{it}, \quad (5)$$

Here, GDP_RED_{it} is a dummy variable that takes the value 1 if firm i is located at a province that was suffering a reduction in GDP growth rate in year t relative to GDP growth rate in the last year and 0 otherwise. If our baseline results from model (1) are robust, we should observe that political connections with local governments should have a greater negative impact on enterprise innovation when the GDP growth rate falls, compared with non-local government connections. However, we do not expect that the impact of provincial and central government on corporate innovation would change dramatically. This is due to the fact that the provincial government is more durable than the local government and can distribute the stress to local governments. Likewise, the central government is unlikely to be affected by the GDP reduction for some provinces.

We report the DID estimation results in Table 5. The impact of political connections on corporate innovation is still hierarchical: political connections with the central government significantly promote corporate innovation, while political connections with local governments significantly inhibit innovation. In addition, the regression results of the interaction term indicate that the pressure of GDP assessment undertaken by local governments in the promotion tournaments has a significantly negative impact on the innovation output of companies that have political connections with the local governments. In other words, the greater the annual economic assessment pressure on local governments, the more significant their tendency to restrain corporate innovation is. Accordingly, since central government officials are not affected by the local officials' promotion tournament, while provincial governments are at the beginning of the tournament, and their performance appraisals have not been increased, they will not be affected by the rising pressure of local officials' assessment in economic growth.

Table 5
Quasi-natural Designed DID Regression Results. This table reports the results of quasi-natural designed DID after controlling self-selection bias using the Heckman two-stage model. The dependent variable is INNOV, measured as the logarithm of the number of invention patent applications plus 1. GDP_RED is a dummy variable equal to 1 if the firm is located in a province where the GDP growth rate in current year is lower than that in the previous year and 0 otherwise. *InverseMillsRatio* is an inverse mills ratio capture the probability of firm's patent application in each year. The definitions of all other variables are listed in Table 1. Robust standard errors are in parentheses. Standard errors are clustered at industry level. ***, **, and * and represent statistically significancy at the 0.01, 0.05, and 0.10 levels, respectively.

	INNOV			
VARIABLES	(1)	(2)	(3)	(4)
PC_ALL	-0.035			
	(0.035)			
PC_ALL*GDP_RED	-0.045			
	(0.058)			
PC_NATION		0.094***		
		(0.035)		
PC_NATION*GDP_RED		0.019		
		(0.020)		
PC_PROVIN			0.035*	
			(0.018)	
PC_PROVIN*GDP_RED			-0.004	
			(0.019)	
PC_LOCAL				-0.129***
				(0.025)
PC_LOCAL*GDP_RED				-0.115***
				(0.017)
GDP_RED	-0.083***	-0.133***	-0.121***	-0.061*
	(0.022)	(0.032)	(0.031)	(0.032)
STATE_OWN	-0.003***	-0.003***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
TOP5_OWN	-0.509***	-0.525***	-0.515***	-0.512***
	(0.169)	(0.169)	(0.166)	(0.167)
SIZE	0.731***	0.723***	0.729***	0.724***
	(0.020)	(0.019)	(0.020)	(0.020)
AGE	-0.029***	-0.029***	-0.029***	-0.029***
	(0.006)	(0.006)	(0.006)	(0.006)
ROE	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
LEV	-0.501***	-0.496***	-0.501***	-0.497***
	(0.032)	(0.032)	(0.033)	(0.033)
CEO_DUAL	0.152***	0.156***	0.154***	0.157***
	(0.014)	(0.014)	(0.014)	(0.014)
InverseMillsRatio	1.411***	1.408***	1.411***	1.394***
	(0.047)	(0.046)	(0.048)	(0.048)
Intercept	-16.530***	-16.416***	-16.549***	-16.302***
	(0.446)	(0.4490)	(0.444)	(0.465)
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	19,397	19,397	19,397	19,397
R-sq	0.378	0.380	0.378	0.381

Robustness tests

Alternative samples

In this section, we retest our main hypothesis based on three alternative samples. In the original sample, we include every firm-year observation regardless of whether there is a patent application or not. However, this data processing procedure resulted in many zeros for the innovation variable such that one would suspect that our prior regression results may be biased. Therefore, in the first alternative sample, we only retain firm years that have patent applications greater than zero and rerun the baseline model.

Table 6
Alternative Samples. This table shows the results of the robustness tests based on three alterative samples: firm-years with at least one patent application (Panel A), firms in high-tech industries (Panel B) and firm-years during the non-global financial crisis (GFC) period. The dependent variable is INNOV, measured as the logarithm of the number of invention patent applications plus 1. The definitions of all the variables are listed in Table 1. Robust standard errors are in parentheses. Standard errors are clustered at industry level. ***, **, and * and represent statistically significancy at the 0.01, 0.05 and 0.10 levels, respectively.

Panel A: Retain only firm-years with patent application				
	INNOV			
	(1)	(2)	(3)	(4)
PC_ALL	-0.046**			
	(0.018)			
PC_NATION		0.049***		
		(0.011)		
PC_PROVIN			-0.005	
			(0.011)	
PC_LOCAL				-0.0796***
				(0.012)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	12,325	12,325	12,325	12,325
R-sq	0.276	0.277	0.276	0.278
Panel B: Retain only high-tech firms				
	INNOV			
	(1)	(2)	(3)	(4)
PC_ALL	-0.061***			
	(0.013)			
PC_NATION		0.029**		
		(0.013)		
PC_PROVIN			0.016	
			(0.011)	
PC_LOCAL				-0.088***
				(0.010)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	15,648	15,648	15,648	15,648
R-sq	0.301	0.302	0.301	0.304
Panel C: Exclude the GFC period				
	INNOV			
	(1)	(2)	(3)	(4)
PC_ALL	-0.053***			
	(0.015)			
PC_NATION		0.054***		
		(0.014)		
PC_PROVIN			0.005	
			(0.013)	
PC_LOCAL				-0.083***
				(0.011)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	14,679	14,679	14,679	14,679
R-sq	0.326	0.338	0.336	0.339

In addition, Yuan et al. (2015) pointed out that firms with industry codes A, D, F, H, J, K, L, and M have a relatively lower demand for innovation activities. Hence, another alternative sample based on firms in industries with non-A, D, F, H, J, K, L, and M industry codes is used to retest our main hypothesis.

Finally, the financial crisis had a severe impact on the government's public governance goals, and it may affect the relationship between political connections and corporate innovation. Therefore, we also use the sample that excludes the financial crisis period to test

Table 7
Alternative Innovation Measurements, This table reports the robustness test results based on four alternative innovation measurements. In Panel A, the dependent variable is INNOV2, measured as the logarithm of the number of invention patents applied independently plus 1. In Panel B, the dependent variable is INNOV3, measured as the logarithm of the number of granted invention patents plus 1. In Panel C, the dependent variable is INNOV4, the logarithm of the number of granted invention patents applied independently plus 1. In Panel D, the dependent variable is INNOV5, the logarithm of the number of granted invention patents at previous period plus 1. In Panel E, the dependent variable is INNOV6, measured as the number of invention patent applications scaled by the firm's market capitalization. In Panel F, the dependent variable is INNOV7, measured as the number of invention patent applications scaled by the firm's total sales. The definitions of all the variables are listed in Table 1. Robust standard errors are in parentheses. Standard errors are clustered at industry level. ***, **, and * and represent statistically significancy at the 0.01, 0.05, and 0.10 levels, respectively.

Panel A: Alternative innovation measurement INNOV2				
	INNOV2			
	(1)	(2)	(3)	(4)
PC_ALL	-0.070***			
	(0.012)			
PC_NATION		0.021**		
		(0.008)		
PC_PROVIN			0.022*	
			(0.013)	
PC_LOCAL				-0.095***
				(0.014)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	19,397	19,397	19,397	19,397
R-sq	0.322	0.323	0.322	0.325
Panel B: Alternative innovation measurement INNOV3				
	INNOV3			
	(1)	(2)	(3)	(4)
PC_ALL	-0.066***			
	(0.016)			
PC_NATION		0.040**		
		(0.020)		
PC_PROVIN			0.009	
			(0.009)	
PC_LOCAL				-0.069***
				(0.026)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	13,838	13,838	13,838	13,838
R-sq	0.308	0.311	0.308	0.311
Panel C: Alternative innovation measurement INNOV4				
	INNOV4			
	(1)	(2)	(3)	(4)
PC_ALL	-0.080***			
	(0.017)			
PC_NATION		0.048***		
		(0.019)		
PC_PROVIN			0.004	
			(0.009)	
PC_LOCAL				-0.073***
				(0.020)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	13,838	13,838	13,838	13,838
R-sq	0.299	0.302	0.299	0.301
Panel D: Alternative innovation measurement INNOV5				
	INNOV5			
	(1)	(2)	(3)	(4)
PC_ALL	-0.056*			
	(0.030)			

(*continued*)

PC_NATION		0.035**		
		(0.015)		
PC_PROVIN			0.006	
			(0.019)	
PC_LOCAL				-0.075***
				(0.016)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	16,473	16,473	16,473	16,473
R-sq	0.332	0.333	0.332	0.335

Panel E: Alternative innovation measurement INNOV6

	INNOV6			
	(1)	(2)	(3)	(4)
PC_ALL	-0.010**			
	(0.005)			
PC_NATION		0.009***		
		(0.003)		
PC_PROVIN			0.007	
			(0.005)	
PC_LOCAL				-0.020***
				(0.005)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	18,838	18,838	18,838	18,838
R-sq	0.250	0.251	0.255	0.249

Panel F: Alternative innovation measurement INNOV7

	INNOV7			
	(1)	(2)	(3)	(4)
PC_ALL	-0.050**			
	(0.021)			
PC_NATION		0.081***		
		(0.030)		
PC_PROVIN			-0.057	
			(0.055)	
PC_LOCAL				-0.038*
				(0.022)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	14,680	14,680	14,680	14,680
R-sq	0.197	0.198	0.197	0.201

the baseline model. The results are reported in Panels A, B, and C of Table 6, with the coefficients on key variables of interests remaining consistent with our baseline regression.

Alternative variable specifications

In this section, we consider a few different measurements that proxy for corporate innovation. We use the logarithm of the number of patents independently applied for by firms, the logarithm of the number of patents granted by firms, the logarithm of the number of patents granted by firms when applied independently and the logarithm of the one-year lagged the number of patent applications, the number of invention patent applications scaled by the firm's market capitalization, the number of invention patent applications scaled by the firm's total sales as the dependent variables and retest our main baseline model (1). The regression results are reported in Table 7. The estimated coefficients of the main variables exhibit very similar magnitudes and the same signs as the previous. Hence, we conclude that our baseline conclusions are robust to these alternative corporate innovation measurements.

Using a restricted sample with only non-SOEs

An alternative explanation for the nonconforming findings of governments' influence on corporate innovation is sample difference.

Table 8
Restricted Samples with Only Non-SOEs. This table shows the results of the robustness tests based on the sample excludes SOEs. The dependent variable is INNOV, measured as the logarithm of the number of invention patent applications plus 1. The definitions of all the variables are listed in Table 1. Robust standard errors are in parentheses. Standard errors are clustered at industry level. ***, **, and * and represent statistically significancy at the 0.01, 0.05, and 0.10 levels, respectively.

	INNOV			
VARIABLES	(1)	(2)	(3)	(4)
PC_ALL	-0.083***			
	(0.015)			
PC_NATION		0.040***		
		(0.008)		
PC_PROVIN			0.007	
			(0.014)	
PC_LOCAL				-0.058**
				(0.024)
STATE_OWN	0.006**	0.006**	0.006**	0.006**
	(0.003)	(0.003)	(0.003)	(0.003)
TOP5_OWN	-0.607***	-0.615***	-0.613***	-0.609***
	(0.182)	(0.180)	(0.181)	(0.182)
SIZE	0.381***	0.378***	0.380***	0.380***
	(0.081)	(0.081)	(0.081)	(0.082)
AGE	-0.011***	-0.011***	-0.011***	-0.011***
	(0.003)	(0.003)	(0.003)	(0.003)
ROE	0.003	0.003	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
LEV	-0.096*	-0.092*	-0.095*	-0.092*
	(0.053)	(0.053)	(0.053)	(0.053)
CEO_DUAL	0.084***	0.087***	0.087***	0.087***
	(0.012)	(0.011)	(0.011)	(0.011)
Intercept	-7.142***	-7.157***	-7.188***	-7.151***
	(1.886)	(1.886)	(1.893)	(1.887)
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	11,218	11,218	11,218	11,218
R-sq	0.281	0.283	0.282	0.283

For instance, Su et al. (2019) suggested that firms with political connections are more active with innovations than non-connected firms, using all listed firms in China as the sample. However, Hou et al. (2017) shows a contradictory finding with a sample excluding SOEs. In order to rule out this competing explanation, in this section, we examine whether the baseline conclusions remain only for non-SOEs. The regression results are reported in Table 8. The estimated coefficients of the main variables remain consistent with our baseline regression. Hence, we conclude that the mixed results of the previous literature on the relationship between political connection and corporate innovation is due to political connection heterogeneity rather than sample selection.

Additional analysis

Economic consequences

Innovation is the core means of long-term sustainable growth and competitive power for corporations (Hsu, 2009; Nanda & Rhodes-Fropf, 2013). Given that firms with political connections from different government hierarchies have distinguishing innovation performance, we conjecture that political connections indirectly affect future corporate performance by influencing corporate innovation. Hence, we use model (6) to analyze these economic effects.

$$ROE_{i,t+1} = \alpha + \beta_1 INNOV_{it} + \beta_2 PC_{it} + \beta_3 PC_{it} \times INNOV_{it} + \gamma CONTROLS_{it} + YEARFE + INDUSTRYFE + \varepsilon_{it}, \quad (6)$$

Here, $ROE_{i,t+1}$ is measured as the firm's return on equity in the forward year; β_1 measures the average effect of corporate innovation on the firm's future profitability; β_2 measures the average impact of

Table 9
Economic Consequences. This table reports the results of the relationship between political connections, corporate innovation, and firm performance. The dependent variable is $ROE_{i,t+1}$, measured as the firm's return on equity in the forward year. The main independent variables are INNOV, PC_ALL, PC_NATION, PC_PROVIN, PC_LOCAL, and their interactions. The definitions of all these variables are listed in Table 1. Robust standard errors are in parentheses. Standard errors are clustered at industry level. ***, **, and * and represent statistically significancy at the 0.01, 0.05, and 0.10 levels, respectively.

	$ROE_{i,t+1}$							
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
INNOV		0.840***		0.727***		0.646***		0.638***
		(0.169)		(0.140)		(0.123)		(0.111)
PC_ALL	0.290*	0.636**						
	(0.154)	(0.270)						
PC_ALL*INNOV		-0.241**						
		(0.120)						
PC_NATION			0.330***	0.505**				
			(0.119)	(0.207)				
PC_NATION*INNOV				0.365***				
				(0.136)				
PC_PROVIN					-0.225	-0.099		
					(0.164)	(0.296)		
PC_PROVIN*INNOV						-0.069		
						(0.110)		
PC_LOCAL							0.179	0.316
							(0.222)	(0.306)
PC_LOCAL*INNOV								-0.179**
								(0.071)
STATE_OWN	-0.014	-0.0145	-0.014	-0.015	-0.014	-0.014	-0.014	-0.014
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
TOP5_OWN	5.160***	5.402***	5.148***	5.377***	5.144***	5.381***	5.162***	5.400***
	(0.613)	(0.546)	(0.603)	(0.547)	(0.610)	(0.548)	(0.620)	(0.563)
SIZE	0.546***	0.247**	0.522***	0.249***	0.558***	0.260***	0.555***	0.254***
	(0.129)	(0.098)	(0.127)	(0.096)	(0.127)	(0.098)	(0.124)	(0.096)
AGE	0.033*	0.041**	0.033**	0.040**	0.033*	0.041**	0.032*	0.040**
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
ROE	0.381***	0.377***	0.381***	0.377***	0.381***	0.377***	0.381***	0.377***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
LEV	-3.350**	-3.080**	-3.305**	-3.055**	-3.336**	-3.070**	-3.357**	-3.085**
	(1.562)	(1.493)	(1.561)	(1.504)	(1.563)	(1.504)	(1.558)	(1.503)
CEO_DUAL	0.030	-0.055	0.033	-0.060	0.023	-0.061	0.021	-0.067
	(0.144)	(0.143)	(0.147)	(0.142)	(0.145)	(0.143)	(0.144)	(0.143)
Intercept	-10.423***	-4.782**	-9.776***	-4.388*	-10.267***	-4.389*	-10.464***	-4.537*
	(1.916)	(2.259)	(1.917)	(2.248)	(1.929)	(2.400)	(1.844)	(2.445)
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	16,442	16,442	16,442	16,442	16,442	16,442	16,442	16,442
R-sq	0.193	0.197	0.193	0.197	0.193	0.197	0.193	0.197

political connections of different hierarchies on the firm's future profitability, and β_3 measures how political connections influence a firm's transforming efficiency of innovation outcomes.

The estimation results are reported in Table 9. The coefficients of patents applied ($INNOV_{it}$) are all significantly positive, indicating that patent application can promote future ROE. Furthermore, the economic consequences of political connections are still hierarchical. In other words, political connections with the central government can promote business profitability by both boosting innovation activities and helping with the transforming efficiency of innovation outcomes. On the other hand, political connections with local governments not only inhibit innovation, but also have significantly negative effects on a firm's patent transforming abilities, eventually decreasing the firm's future performance.

The asymmetric impacts of political connections on corporate innovation

Are the impacts of political connections on corporate innovation asymmetric between different firms or in different markets? If they are, this would shed light on the policy designs for China and other emerging markets using the federalism system or in an industrial upgrading period. To answer this fundamental question, we run two grouped empirical tests using whether the firm is a high-tech firm ($HIGH\_TECH_{it}$) and whether the firm is located in high-marketization areas ($HIGH\_MKT_{it}$) as grouping variables.

First, we investigate whether the heterogeneity impact of political connections would alter for firms in high-tech and non-high-tech industries. To identify the high-tech firms, we match our firm industry codes to the high-tech industry classification catalog from the National Bureau of Statistics with the second-level industry code (2012) from China Securities Regulatory Commission (CSRC); subsequently, we generate a dummy variable $HIGH\_TECH_{it}$ that takes the value 1 if firm i in year t is classified as a high-tech firm and 0 otherwise. Built upon the baseline model (1), we further add the $HIGH\_TECH_{it}$ and the interaction term of $HIGH\_TECH_{it}$ and political connection variable to run regression tests.

As reported in Table 10, we find that political connections with the central government mainly promotes firms in high-tech industries. Furthermore, the negative impact of connections with local governments on corporate innovation is exacerbated for high-tech firms.

Then, we investigate whether the heterogeneity impact of political connections would alter for firms in high-marketization and low-marketization areas. Similar to prior literature, we use the National Economic Research Institute (NERI) Marketization Index constructed

Table 10
The Asymmetric Impacts: High-Tech Firms Vs. Non-High-Tech Firms. This table shows the results of the hierarchical impacts of political connections on innovation classified by high-tech industries. The dependent variable is INNOV, measured as the logarithm of the number of invention patent applications plus 1. HIGH_TECH is a dummy variable equals 1 if the firm is a high-teach firm and 0 otherwise. The definitions of all the variables are listed in Table 1. Robust standard errors are in parentheses. Standard errors are clustered at the industry level. ***, **, and * and represent statistically significancy at the 0.01, 0.05, and 0.10 levels, respectively.

	INNOV			
VARIABLES	(1)	(2)	(3)	(4)
PC_ALL	-0.079*			
	(0.044)			
PC_ALL * HIGH_TECH	0.019			
	(0.084)			
PC_NATION		-0.008		
		(0.019)		
PC_NATION * HIGH_TECH		0.074***		
		(0.021)		
PC_PROVIN			0.021	
			(0.020)	
PC_PROVIN * HIGH_TECH			0.003	
			(0.022)	
PC_LOCAL				-0.068***
				(0.021)
PC_LOCAL * HIGH_TECH				-0.067**
				(0.034)
HIGH_TECH	0.444***	0.432***	0.460***	0.492***
	(0.068)	(0.022)	(0.025)	(0.018)
STATE_OWN	-0.001	-0.001	-0.001	-0.001
	(0.007)	(0.001)	(0.001)	(0.001)
TOP5_OWN	-0.374*	-0.377*	-0.382*	-0.374*
	(0.210)	(0.210)	(0.208)	(0.209)
SIZE	0.387***	0.386***	0.386***	0.386***
	(0.091)	(0.090)	(0.090)	(0.091)
AGE	-0.010**	-0.010**	-0.010**	-0.010**
	(0.005)	(0.005)	(0.005)	(0.005)
ROE	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
LEV	-0.148**	-0.146**	-0.147**	-0.147**
	(0.069)	(0.068)	(0.069)	(0.069)
CEO_DUAL	0.054***	0.056***	0.055***	0.056***
	(0.014)	(0.015)	(0.015)	(0.015)
Intercept	-7.632***	-7.668***	-7.682***	-7.618***
	(2.090)	(2.117)	(2.117)	(2.110)
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	19,397	19,397	19,397	19,397
R-sq	0.341	0.343	0.340	0.344

Table 11
The Asymmetric Impacts: High-Marketization Areas Vs. Low-Marketization Areas. This table shows the results of the influence of political connections at different hierarchies of governments on innovation classified by the Marketization Index constructed by Fan et al. (2016). The dependent variable is INNOV, measured as the logarithm of the number of invention patent applications plus 1. HIGH_MKT is a dummy variable equals 1 if the Marketization Index of the headquarter province is larger than the median level of the year; otherwise, it is 0. The definitions of all the variables are listed in Table 1. Robust standard errors are in parentheses. Standard errors are clustered at industry level. ***, **, and * and represent statistically significancy at the 0.01, 0.05, and 0.10 levels, respectively.

	INNOV			
VARIABLES	(1)	(2)	(3)	(4)
PC_ALL	-0.067			
	(0.054)			
PC_ALL * HIGH_MKT	0.014*			
	(0.008)			
PC_NATION		0.052***		
		(0.018)		
PC_NATION * HIGH_MKT		-0.021**		
		(0.010)		
PC_PROVIN			0.075***	
			(0.027)	
PC_PROVIN * HIGH_MKT			-0.072**	
			(0.029)	
PC_LOCAL				-0.067**
				(0.032)
PC_LOCAL * HIGH_MKT				0.028*
				(0.015)
HIGH_MKT	0.171***	0.192***	0.218***	0.200***
	(0.045)	(0.034)	(0.028)	(0.044)
STATE_OWN	-0.000	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)
TOP5_OWN	-0.454**	-0.461**	-0.457**	-0.454**
	(0.182)	(0.182)	(0.182)	(0.184)
SIZE	0.409***	0.406***	0.408***	0.407***
	(0.090)	(0.090)	(0.090)	(0.091)
AGE	-0.011**	-0.011**	-0.011**	-0.011**
	(0.005)	(0.005)	(0.005)	(0.005)
ROE	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
LEV	-0.178**	-0.174**	-0.177**	-0.177**
	(0.084)	(0.084)	(0.084)	(0.084)
CEO_DUAL	0.058***	0.060***	0.059***	0.060***
	(0.016)	(0.015)	(0.015)	(0.016)
Intercept	-8.072***	-8.096***	-8.152***	-8.060***
	(2.068)	(2.115)	(2.103)	(2.127)
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	19,397	19,397	19,397	19,397
R-sq	0.347	0.348	0.346	0.35

by Fan et al. (2016) to form our grouping variable ($HIGH\_MKT_{it}$). $HIGH\_MKT_{it}$ is a dummy variable that equals 1 if the marketization index of the firm's headquarter province is higher than the median of the index for all provinces in the year and 0 otherwise. Analogous to the previous high-tech test, we add the dummy variable $HIGH\_MKT_{it}$ and the interaction term into the regression.

Table 11 presents the regression results. We find that, with less corporate discrimination, the positive effect of political connections with both central government officials and local government officials impacts against the reduction of corporate innovation[7].

We also investigate whether the heterogeneity impact of political connections would alter for firms in high-competition and low-competition industries and for SOE and non-SOE firms. The coefficients of our key variables stay unchanged in these two sets of regressions, while the interaction terms are all insignificant, indicating that the effects of political connections on corporate innovation are unlikely to be influenced by competition intensity, and our findings are suitable for both SOE and non-SOE firms.

Mechanism analysis

Hou et al. (2017) suggested that political connections impact corporate innovation via affecting research & development expenditure (R&D) and innovation efficiency. In this section, we further explore whether these channels would be differently impacted by the heterogeneity of political connections. If as documented in the baseline model the attitudes of central and local government officials towards corporate innovation are unlike from each other, we expect that firms with a central government connection should have higher R&D and better innovation efficiency compared with firms that are linked with a local government.

We adapt the baseline model (1), but replace the dependent variable with the standardized R&D expenditure (R&D) and with innovation efficiency measured according to Hirshleifer et al. (2013). Since the information disclosure quality of R&D expenditure is various across firms, missing R&D expenditure is treated as a missing value

[7] Several studies have shown that the southern coastal provinces are more marketized in comparison to inland and northern provinces (Fan et al, 2016; Naughton, 2006; Zhou, 2014). Thus, we also use the variable of whether the firm is located in a southern coastal province as an alternative grouping proxy instead of High_Marketized$_{it}$. The results remain robust.

Table 12
Mechanism analysis. This table reports the regression results of the two channels through which political connections influence corporate innovation. The dependent variables in Panel A and Panel B are firm R&D intensity (R&D_INT), calculated as the firm's R&D investment after the standardization of operating revenue (Panel A) and innovation efficiency (INNOV_EFFCY), measured as the patents granted in the previous period / (R&D expenditure in the current period + 0.8 * R&D expenditure in the lag period + 0.6 * R&D expenditure in the lag two periods + 0.4 * R&D expenditure in the lag three periods + 0.2 * R&D expenditure in the lag four periods), respectively. The definitions of all the variables are listed in Table 1. Robust standard errors are in parentheses. Standard errors are clustered at industry level. ***, **, and * and represent statistically significancy at the 0.01, 0.05, and 0.10 levels, respectively.

Panel A: The input channel				
	R&D Intensity			
	(1)	(2)	(3)	(4)
PC_ALL	-0.001			
	(0.001)			
PC_NATION		0.000		
		(0.001)		
PC_PROVIN			0.000	
			(0.001)	
PC_LOCAL				-0.0010***
				(0.000)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	13,717	13,717	13,717	13,717
R-sq	0.303	0.303	0.303	0.304
Panel B: The efficiency channel				
	Innovation Efficiency			
	(1)	(2)	(3)	(4)
PC_ALL	-0.000			
	(0.013)			
PC_NATION		0.025*		
		(0.014)		
PC_PROVIN			-0.003	
			(0.016)	
PC_LOCAL				-0.035***
				(0.013)
Intercept	YES	YES	YES	YES
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Observations	3,208	3,208	3,208	3,208
R-sq	0.025	0.025	0.025	0.025

for robustness[8]. The regression results for testing the influence on R&D and innovation efficiency are reported in Panel A and Panel B in Table 12, respectively. We find that political connections with a local government have a significant squeeze-out effect on the firm's R&D investment, but connections with central or provincial governments do not affect the R&D expenditure of the sample firms. In addition, we find that the effect of political connections at different hierarchies of governments on firm's innovation efficiency is also hierarchical: political connections with the central government can significantly improve firms' innovation efficiency, while political connections with local governments impede innovation efficiency.

Conclusion

This paper examines the conundrum of whether political connections promote or impede corporate innovation. We find evidence that prior inconsistent results were induced by federalism and the associated personnel control systems incorporated in China. We document that, due to the differentiation in evaluation mechanisms and tenure requirements, the officials' innovation-promoting tendencies are stratified: central government officials tend to promote innovation, while local government officials tend to inhibit innovation. To mitigate the selection bias and endogeneity issue, we use the Heckman two-stage estimation and design a quasi-natural experiment taking advantage of the decrease in local GDP growth rates. Our results are robust to these econometric treatments and a series of further robustness checks.

Furthermore, we show that a firm's long-term profitability via corporate innovation is also affected by federalism, with a positive impact from the central government but a negative influence from the local governments. In addition, we also find that the effect is even larger on high-tech firms and that marketization can mitigate it.

We contribute to the literature in two ways. First, our research contributes to the ongoing debate on the relationship between political connections and corporate innovation. Previous studies hold mixed arguments on this issue. By segregating the connection type into central and local connections, we innovatively show that the disagreement in prior studies can be explained by incorporating incentives of political officials from different sub-government levels.

Second, our results provide nuanced evidence on the effects of federalism with centralized personnel control, which supplements the literature on federalism and the "China puzzle." Previous studies mainly study the positive effects of China-style federalism on economic growth. The difference between the innovation propensity of central government and local government is rarely mentioned. We shed new light on this.

This is also an important lesson for developing countries that are seeking to mimic the Chinese government system in undertaking a regime shift to an innovative economy. Our findings reveal that, rather than the local government, the central government is more capable and motivated to implement innovation promotion policies in a government system such as China. Besides, short-term-oriented performance examining systems for government officials may boost the economy temporarily while sacrificing long-term achievements, such as innovation in the long run.

[8] As a robustness check, we also replace the missing R&D expenditure values with 0. The main coefficients on our interest variables remain similar to those in the baseline regressions. Due to the space limit, the results are presented upon request.

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