Political Connections and Corporate Innovation Productivity

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Preliminary version; please do not circulate, cite, or quote without author permission. Dated 10Jan2016.

Abstract

We find that political connections amplify corporate innovation productivity among public firms in the United States. Patent quantity and quality increase with the incidence and strength of political connections over the period 1999 to 2010. Results are robust to controlling for the endogenous choice of establishing political connections with the strongest effects for firms operating in the high-tech sector, under greater financial constraint, and in competitive environments. We demonstrate that politically connected firms outperform their peers with regard to federal grant awards, which are shown to improve innovation productivity. This innovation amplification channel illustrates an important mechanism linking political influence to corporate innovation productivity.

JEL classification: D72, H32, H81, O31, O38

Keywords: innovation, political connections, political geography, government grants

1. Introduction

Long after the seminal work of Schumpeter (1934), academics continue to investigate the relationship between value, politics, and innovation. Optimal innovation policy remains central to academic focus with research on limits to technology policy (Cohen (1994)), benefits of R&D subsidies (Einiö (2014)), positive externalities of government R&D expenditures (Guellec and Van Pottelsberghe De La Potterie (2003)), marginal benefits of government-industry R&D programs (Wallsten (2000)), advocates for government championship (Caerteling, Halman, Song, Dorée, and Bij (2013)), how to finance medical innovation (Fagnan, Fernandez, Lo, and Stein (2013)), and even the political discourse surrounding the word 'innovation' (Perren and Sapsed (2013)). Along with this innovation policy research, major literature streams focusing on the politics-value and innovation-value dynamics continue to grow.

Corporate political connections play an important role in explaining firm value. One major stream of literature demonstrates the linkage between the political environment and firm value (see, e.g., Fisman (2001); Faccio (2006); Goldman, Rocholl, and So (2009); Kim, Pantzalis, and Park (2014); Chen, Parsley, and Yang (2015)). Political contributions are associated with better stock returns (Cooper, Gulen, and Ovtchinnikov (2010)) and firm performance (Ovtchinnikov and Pantaleoni (2012)). Political connections increase firm value through a variety of mechanisms, such as more favorable allocation of government contracts (Goldman, Rocholl and So (2013)), preferential access to government capital investments and bank financing (Faccio, Masulis, and McConnell (2006); Leuz and Oberholzer-Gee (2006); Claessens, Feijen, and Laeven (2008); Duchin and Sosyura, (2012); Adelino and Dinc (2014)) and politically connected firms are more tax aggressive than non-connected firms. (Kim and Zhang, 2014). While additional mechanisms linking political influence and firm value await exploration, we focus on innovation. Given the uncertain nature of innovation activities, political connections may help firms reduce future political uncertainties, enjoy more favorable policies, navigate regulations, or acquire disproportionate government resources thereby improving innovation productivity. We address this gap in extant literature by illustrating the impact of political connections on firm value stemming from innovation productivity.

Innovation plays a pivotal role in economic development and greatly impacts the future value of the firm. The literature stream focusing on innovation and firm value shows a strong positive relationship (see, e.g., Chesbrough and Rosenbloom (2002); Hall, Jaffe, and Traitenberg (2005); Cohen (2010)). However, innovation requires placing value at risk. Extensive literature documents a number of elements that foster innovation as well as various factors that diminish innovation activities such as innovation and market dynamics including bankruptcy codes (Acharya and Subramanian (2009)), liquidity (Fang, Tian, and Tice (2014)), earnings guidance (Chen, Huang, and Lao (2014)), and analyst coverage (He and Tian (2013)). If political connections do help encourage risk-taking behavior, provide easier access to capital, mitigate uncertainties, reduce regulatory frictions, facilitate more favorable policies, and improve government resource allocation, then differential political connections should manifest on the innovation front.

With direction from these two fast-growing business literature streams, we investigate how political connections impact corporate innovation productivity. Our study joins the emerging debate regarding the impact of political connections on corporate innovation. Ovtchinnikov, Reza, and Wu (2015), henceforth ORW, show that political activism increases innovative output as a result of reduction in political uncertainty. Conversely, Brogaard, Denes, and Duchin (2015), henceforth BDD, find that political connections are positively related to federal contract awards but negatively related to innovation. Bellettini, Ceroni, and Prarolo (2013) also report evidence consistent with political connections leading to reduced innovation. Both of these negative results are consistent with the Shleifer and Vishny (1994) notion of rent extraction. Given this controversy, we test the hypothesis:

H_1: Politically connected firms are associated with higher levels of innovation productivity.

How corporations motivate and nurture innovation receives an enormous amount of attention from both academics and policy makers (see, e.g., the organizational and policy implications of Teece (1986; 2006)). Executive and employee risk behavior is an important determinant of innovation. Chang, Fu, Low and Zhang (2015) show that on the employee level employee risk taking behavior leads to higher innovation performance. While risk-taking behavior is associated with higher innovation productivity, managers and employees are often concerned about the career risk they may face if the innovative activities do not succeed. Manso (2011) establishes a theory that firms should implement incentive contracts that are tolerant for short-term failure and long-term success because managers may be reluctant to engage in risky projects due to the high probability of failure. Tian and Wang (2014) empirically test this model using a sample of VC-backed IPO firms and find that IPO firms backed by failure-tolerant VCs are substantially more innovative compared to IPO firms backed by less failure-tolerant VCs. In a similar line of reasoning, Aghion, Van Reenen, and Zingales (2013) document a positive association between institutional ownership and corporate innovation productivity, arguing this stems from reduced manager career risk in firms with high institutional ownership. Chemmanur and Tian (2013) document that anti-takeover provisions shield managers from short-term pressure and therefore encourage long-term value enhancing innovation. Additional finance literature focuses on innovation and labor dynamics including human capital (Chemmanur, Kong, Krishnan, and Yu (2015)), employee treatment (Mao and Weathers (2015)), and labor law (Acharya, Baghai, and Subramanian (2013; 2014)). Hirshleifer, Low and Teoh (2012) find evidence that suggests CEO overconfidence can benefit shareholders by increasing investment in risky projects. The corporate innovative process is fraught with incentive alignment problems stemming from the agency conflict between owners and inventors. These human capital dynamics are critical aspects of the innovative process and extend into the political realm.[1]

Since high-technology firms are high-risk in terms of capital – human, financial, and opportunity cost – we focus on them to illustrate the power of political connections in mitigating risk. Research suggests that high-technology innovation is more sensitive than low-tech and may be more sensitive to policy. Teece (1992) shows that technical innovation challenges lead to more complex business organization. There is more innovation among high-technology manufacturing firms (Thornhill (2006)), knowledge sharing methods amplify innovation differentially based on the technological intensity of firms (Sáenz, Aramburu, and Rivera (2009)), and innovation generates non-linear returns for 'superstar' fast-growth firms (Coad and Rao (2008)). Since patents in a dynamic high-technology field may create more innovative friction than incentive to innovate, there are calls for using open innovation to skirt the patent process (see, e.g., Chesbrough (2003); Christensen, Olesen, and Kjær (2005)). While the concept of open innovation is most prevalent among high-tech firms that are not high-tech may also benefit (Chesbrough and Crowther (2006)). Hart (2001) reports that high-tech firms use business political action committees (PACs) to extract rent from the government. If high-tech firms'

[1] For example, Julie Gerberding served as director of Centers for Disease Control and Prevention (CDC) before she took the President position at Merck, one of the largest pharmaceutical companies in the world. With strong support from Gerberding, Merck makes 14 of the 17 pediatric vaccines recommended by the CDC, and 9 of the 10 recommended for adults.

patentable innovations face greater policy risk, political connections may be especially beneficial:

H_2: The positive association between political connections and corporate innovation productivity is stronger for high-tech firms.

Expanding beyond the high-tech firms, we broaden the investigation to firms facing financial constraint. Financial constraints present a substantial challenge to risky innovation, especially for small and high-tech firms (Himmelberg and Petersen (1994); Canepa and Stoneman (2008)). Innovative projects may fail due to firms' financial constraint and the expensive cost of raising capital for high risk projects (Savignac (2008)). Researchers also illustrate that public policy can mitigate financing market failures surrounding innovation (Qian and Xu (1998); Hyytinen and Toivanen (2005); Zúñiga-Vicente, Alonso-Borrego, Forcadell, and Galán (2014)). Investments in innovative activities are highly risky and consequently require higher rates of return (Hedge and Mishra (2014). Arrow (1962) argues that R&D driven innovation is difficult to finance using external funds because of its intangible nature, uncertain outcome, and severe information asymmetry problems. Hall and Lerner (2009) echo Arrow (1962) in noting that it is costly to finance R&D investment and unless the inventor is already wealthy or the firm is already profitable, some innovations will fail because external financing is too expensive. Some firms may not even initiate R&D investment due to concerns that the project would be terminated in the future due to financial constraint (Hall (2010)). Therefore, external financing is a major challenge faced by innovative firms. If political connections affect firm innovation through cheaper and easier access to financing, then financially constrained firms should benefit disproportionately from political connections.

To the extent that financial constraint hampers corporate innovation activity, corporate political connections may reduce this barrier thereby fostering corporate innovation productivity. Research documents that politically connected firms can afford to make more risky investments as corporate political connections mitigate corporate financial risk. Duchin and Sosyura (2012) and Faccio et al. (2006) show that firms with political ties are more likely to be bailed out during economic downturns. Boubakri et al. (2013) report a positive relationship between political connections and firms' propensity to take risks. Additionally, there is a line of research suggesting that politically connected firms have easier access to capital compared to their non-connected counterparts. For example, Boubakri et al. (2012) find that investors require a lower cost of equity for politically connected firms, and Houston, Lin, and Ma (2014) find that politically connected firms have lower cost of bank loans. If politically connected firms are less likely to be constrained by access to external financing and the cost of raising capital, then these firms should be more likely to accept innovative projects that would otherwise be rejected due to financial constraint, which in turn should lead to higher innovation productivity. Another possibility is that politically connected firms enjoy superior information with respect to political and economic prospect in the future because of their closeness to policy makers. This view is consistent with the ORW notion that firms with political ties may be able to increase innovation productivity through reduced political uncertainty. Firms may receive favorable policy treatment and resource allocation as a result of their proximity to political power and expenditures on politics such as lobbying expenses and campaign contributions:

H_3: The positive association between political connections and corporate innovation productivity is stronger for financially constrained firms.

We next consider firms operating in different competition environments as product market competition is an often regulated force that shapes firms' behavior. Even ancient man knew that competitive pressure motivates innovation and political structure is essential for innovation to thrive with Plato (360 B.C.E) stating, "… the true creator is necessity, who is the mother of our invention." The patent, as a State-sponsored monopoly in an otherwise competitive market, is a manifestation of this ancient insight. The relationship between political connections, innovation, and competition is well illustrated by the patent application of William Lee (Acemoglu and Robinson (2012)). Queen Elizabeth refused his stocking frame knitting machine patent in 1589 due to competition concerns, "Consider thou what the invention could do to my poor subjects. It would assuredly bring to them ruin by depriving them of employment, thus making them beggars." However, even the modern US patent system may not produce sufficient innovation incentives to justify the costs of resultant monopolistic limitations on product market competition (Boldrin and Levine (2013)). Scholars demonstrate that greater product market competition stimulates innovation (Blundell, Griffith, and Van Reenen (1999); Aghion, Bloom, Blundell, Griffith, and Howitt (2005); Aghion, Blundell, Griffith, Howitt, and Prantl (2009)). Brou and Ruta (2013) model a competitive innovation environment with rent-seeking showing that political interference can reduce innovation. When politicians shape policy regarding protections for innovation and product market competition, connected firms may benefit the most. Additionally, firms' marginal benefit from favorable policies and resource allocation should increase proportional to market competition. In an oligopolistic industry, the presence of political ties may not necessarily change firms' incentive to innovate due to the lack of competition and the firm's strong market power. On the other hand, in a competitive product market where firms have been shown to be more motivated to innovate, favorable political policies or resource allocation can be a valuable asset that boosts connected firms' innovation productivity. This leads us to propose:

H_4: The positive association between political connections and corporate innovation productivity is stronger for firms operating in competitive industries.

We further posit a channel through which political connections may affect innovation productivity. Disproportionate resources and funding, such as federal grants, allocated to firms with political ties may amplify innovation productivity. Several previous studies find evidence that political connections are effective in steering contracts towards their affiliate firms (Goldman, Rocholl, and So (2013); Auriol, Straub, and Flochel (2016)). A federal grant is an award of financial assistance from a federal agency to a recipient to carry out projects that serves specific purposes. These grants often receive criticism because of the seemingly arbitrary federal decision-making as a small number of firms receive a majority of the federal funding.[2] For example, Honeywell International received a grant worth $11.4 million from the Department of Energy in 2009 to develop Smart Grid technology and has a history of strong political ties.[3] Honeywell was one of the only four companies to receive funding from the program under the American Recovery and Reinvestment Act (2009). We use publicly available federal grant data to test whether valuable resources are indeed more likely to be channeled to politically connected firms.

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[2] Fisker and Tesla are among very few firms receiving large federal grants (nearly $1 billion combined) from the Department of Energy. In both these cases, political connections may have played an important role in securing the government funding. Federal financial assistance could also take the form of federal loans. For example, the Loan Program Office (LPO) initiated by the US Department of Energy aims to guaranteeing loans to eligible clean energy projects through its Title XVII program (Energy Policy Act (2005)) and by providing direct loans to eligible manufacturers of advanced technology vehicles and components through the Advanced Technology Vehicles Manufacturing (ATVM) program (Energy Independence and Security Act (2007)).

[3] "Founded in 1906, Honeywell is the sponsor of one of the more active political action committees in the United States, donating to politicians from both political parties. Honeywell International routinely spends close to $7 million each year on federal lobbying efforts aimed at dozens of agencies including both chambers of Congress, the Department of Defense and the Federal Aviation Administration." Source is Open Secrets https://www.opensecrets.org/orgs/summary.php?id=D000000334

H_5: Politically connected firms are more likely to receive federal grant awards.

We document that corporate political connections, proxied by the presence of former politicians on the board, lobbying expenditure, and political campaign contributions, foster innovation productivity. Correlation between political connections and corporate innovation productivity, however, is potentially endogenous. As firms' decide to build political connections, it is possible that innovation driven firms are more likely to establish political ties in order to receive favorable political treatment. As a result, the causal relation between political ties and corporate innovation productivity may go in both directions. To mitigate this concern, we adopt a Heckman two step procedure to control for firms' endogenous decision on political connections. After controlling for firms' political connection decision, the results hold, although we cannot completely rule out endogeneity as a confounding factor. Additionally, the effects of political connections are more pronounced for high-tech firms, firms facing greater financial constraint, and firms operating in competitive industries. To the extent that these three groups of firms are constrained by human capital, fungible capital, and opportunity for capital respectively, the findings suggest that political connections are particularly valuable to firms facing the greatest capital constraints.

Given this positive association between political connections and firm innovation productivity, we investigate the channel through which political ties influence corporate innovation. ORW argues that connected firms improve innovation productivity through reduction of future uncertainty. We provide another, perhaps more direct, mechanism in this paper: federal grant funding. We first show that federal grants boost innovation productivity and then document that politically connected firms are significantly more likely to receive federal grants.

This study contributes to extant literature in several ways. First, we add a channel to the research examining how political activism affects firm value (see, e.g., Fisman (2001); Faccio (2006); Goldman et al. (2009); Kim et al. (2014); Chen et al. (2015). Secondly, we add support for the linkage between innovation and firm value (see, e.g., Blundell et al. (1999); Chesbrough and Rosenbloom (2002); Cohen (2010)). Thirdly, we add to the literature regarding determinants of corporate innovation (see, e.g., Tian and Wang (2014); Chemmanur et al. (2015); Mao and Weathers (2015); Acharya et al. (2013; 2014); Acharya and Subramanian (2009); Aghion et al. (2013); Fang et al. (2014); Chen et al. (2014); He and Tian (2013)). While several studies examine the impact of political activism on corporate innovation and report mixed results, using three different proxies for political ties, we document a strong and consistent positive relation between political connections and innovation productivity. We further provide a direct channel through which political connections influence innovation: federal grant awards.

The rest of the paper is organized as follows. Section 2 describes the sample, measurement of variables, and descriptive statistics. Section 3 provides main results. In Section 4 we examine mechanism through which political connections impact innovation and provide robustness checks. Section 5 concludes.

2. Sample

2.1. Data

The sample used in this study includes US headquartered public firms listed in Compustat and CRSP over the period of 1999 to 2010. Our sample period starts in 1999 because one of the indicators of political ties (i.e., lobbying efforts) is only available beginning in the second half of 1998. We develop a comprehensive dataset of corporate political connections following Kim and Zhang (2014). Specifically, we consider three types of corporate political activism: the employment of former politicians as corporate directors, corporate lobbying expenditures, and corporate campaign contributions. Political connection data comes from the following sources: EDGAR database for politically connected directorships, Senate Office of Public Records for lobbying expenditure data, and the Federal Election Commission for campaign contribution data. Our innovation data comes from the patent dataset created by Kogan, Papanikolaou, Seru, and Stoffman (2015), henceforth KPSS. To calculate the control variables, we collect financial statement items from Compustat and institutional holdings data from Thomson's CDA/Spectrum database (form 13F). The sample selection process yields 44,381 firm-year observations from 1999 to 2010.

2.2. Variables

2.2.1. Political Connection Measures

2.2.1.1. Board of Directors

We assign a political connection director dummy (PC_Dir = 1) for each firm-year observation where at least one member of the board of directors has national political experience. We manually extract the name and background of each board member for each firm–year observation from SEC filings, including DEF 14a, 10-K, and 8-K. National political experience is defined by one of the following former positions: president, presidential candidate, senator, member of the U.S. House of Representatives, secretary, deputy secretary, deputy assistant secretary, undersecretary, associate director, governor, director (CIA, FEMA), deputy director (CIA, OMB), commissioner (IRS, NRC, SSA, CRC, FDA, SEC), representative to the United Nations, ambassador, staff (White House, president, presidential campaign), chairman of a party caucus, chairman or staff of a presidential election campaign, and chairman or member of a presidential committee/council. Based on this definition, about 13 percent of our sample firms are politically connected.

2.2.1.2. Corporate Lobbying

Lobbying refers to the act of attempting to influence the decisions made by government officials. While some companies host in-house lobbyists, most companies hire an external lobbying firm. We obtain lobbying data from the lobbying reports database maintained by the Senate Office of Public Records. We assign a political connection lobby dummy (PC_Lobby = 1) for each firm-year observation with a non-zero lobby expenditure. About 15 percent of our sample firm-years are politically connected according to their lobbying activities.

2.2.1.3. Campaign Contributions

Our third measure of political connection is based on corporate campaign contributions. In the United States, firms can contribute to political campaigns indirectly by establishing and sponsoring political action committees (PACs). Our data on PAC contributions are collected from detailed committee and candidate summary contribution files from the Federal Election Commission.[4] We assign a political connection PAC dummy (PC_PAC = 1) for each firm-year observation with a registered PAC in November of that year. Approximately 8 percent of our sample firms are politically connected according to this definition.

We create an overall political connection variable, PC, which equals to 1 if a firm has any of the three aforementioned political connections in a given year and 0 if a firm is not politically connected in any fashion. Summary statistics in Table 1 show that 25 percent of the firm-year observations have at least one type of political tie, in close alignment with US corporate political

[4] We do not consider so-called Super PACs due to difficulties in data gathering and data reliability as these are prohibited from contributing directly to political candidates. An overview of Super PACs is available at Open Secrets https://www.opensecrets.org/pacs/superpacs.php

activism reported by Kim and Zhang (2014).[5] In our empirical analyses, we use the overall political connection measure, PC, as well as the three individual political connection measures, PC_Dir, PC_Lobby, and PC_PAC, as our primary independent variables in examining the impact of political connections on corporate innovation productivity.

2.2.2. Innovation Measures

While R&D expenditures serve as a measure of the input of innovation, recent innovation literature suggests that patent-based innovation output measures provide better indication of corporate innovation productivity. We use the KPSS patent database of patent and citation information, such as patent assignee names, the number of patents, the number of citations received by each patent, the patent application year, and the patent grant year, from 1926 to 2010.[6] We use two proxies that are widely employed in the innovation literature to measure innovation productivity. The first measure is the total number of patents filed by a firm in a given year. This patent application count measures the quantity of innovation; however, it may not be able to capture the quality of the innovation activities in a firm. As a result, as suggested by Trajtenberg (1990) and Hall et al. (2005), we employ a second innovation productivity measure, citations per patent, to distinguish breakthrough innovation from incremental technological discoveries. This citations per patent measure is defined as the average number of future citations received by each patent. These two innovation variables are created based on the patent application year instead of the patent grant year because the application year is closer to the time of actual innovation activities and therefore is more relevant (Griliches et al., 1987).

[5] Political connection definitions are sensitive as the more restricted definition employed by Chen, Parsley, and Yang (2015) shows the percentage of Compustat firms that lobby increases from 6.5% in 1998 to 11.8% in 2005.

[6] Another popularly used innovation data source is NBER patent data created by Hall et al. (2001). NBER data contains records of patents with application dates up to 2006. Since the political connection data starts in 1999, using KPSS patent data substantially increases our sample size. However, the NBER data yields untabulated results that are quantitatively and qualitatively similar.

Patent data are subject to two types of truncation problems. The first issue concerns patent counts because recording occurs upon a patent filing while the average lag between patent applications and patent grants is about two years., In the last few years of the sample (i.e., 2009 and 2010) where many patent applications are still under review, we observe only a small fraction of the filed patents that eventually will be granted. The other type of truncation bias regards citation counts. Patents keep receiving citations over a long period of time, but we only observe citations received up to 2010, which is the last year in the patent database. Following Hall et al. (2001, 2005), we correct for these truncation problems by using the application-grant empirical distribution and the citation-lag distribution respectively.

As is the convention in the innovation literature, we set the patent and citations per patent measures to zero for firms that have no patent and citation information available in the KPSS database. The distribution of patent counts and that of citations per patent are positively-skewed. To mitigate the effect, we use the natural logarithm of (innovation measures plus one) as the innovation measures in this study. Unless otherwise stated, regressions include innovation measures in year t + 1 as the dependent variables because the influences of political connections are unlikely to take effect on corporate innovation productivity immediately after the connections are established.[7]

2.3. Control Variables

Following the innovation literature, we control for firm and industry characteristics that affect a firm's innovation productivity. Specifically, we control for firm size (the natural logarithm of total sales), ROA (operating income before depreciation divided by total assets), leverage (book value of debt divided by total assets), CAPEX (capital expenditure divided by

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[7] As a robustness check, we use the innovation measures in year t+2 and t+3 as the dependent variables. The empirical results are qualitatively and quantitatively similar so for the sake of brevity we only report results using innovation measures in year_{t+1}.

total assets), Q (market to book ratio), R&D (Research and Development expenditure to total sales), PPE (Net property, plants and equipment divided by total assets), Firm Age (Natural logarithm of one plus the number of years the firm is listed on Compustat), market share based on sales, and institutional ownership. Summary statistics of variables used in this study are reported in Table 1. All continuous variables are winsorized at 1st and 99th percentiles by year to mitigate potential outlier issues. We provide detailed variable definitions in the Appendix.

<Table 1>

At first glance, political connections are positively and significantly associated with firm innovation productivity. The Pearson correlations reported in Table 2 show that all four measures of political connections, PC, PC_Dir, PC_Lobby, and PC_PAC are positively and significantly correlated with both of our future innovation productivity measures, $Ln(Patent)_{t+1}$ and $Ln(Cite)_{t+1}$.

<Table 2>

2.4. Specification

We investigate the relationship between political ties and corporate innovation productivity in a multivariate setting. To examine how corporate political connections affect firms' future innovation productivity, we employ the approach of Tian, and Wang (2014) by first estimating the following baseline OLS model:

$$Ln(Innovation)_{i,j,t+1} = \alpha + \beta(Political\ Connection)_{i,j,t} + \gamma Z_{i,j,t} + Year_t + Industry_j + \varepsilon_{i,j,t} \quad (1)$$

where *Innovation* is a patent-based measure of future corporate innovation productivity, and *Political Connection* represents one of the four PC dummy variables as discussed in the previous section. *i* represents firm, *j* represents industry (based on Fama-French 49 industry classification), and *t* represents year. $Z_{i,j,t}$ is a vector of control variables as discussed in the previous section. *Year* and *Industry* are dummy variables to capture year fixed effects, and industry fixed effects, respectively. We cluster standard errors at the firm level.

3. Results

The baseline OLS results are presented in Table 3. The specifications in Panel A use patent counts (quantity of innovation) as the dependent variable, while those in Panel B use citations per patent (quality of innovation) as the dependent variable. Each panel in the table has four columns, one for each political connection proxy. The coefficients on all four political connection measures are positive and significant at the 1% level in regressing the quantity of innovation. The coefficients are positive and significant at the 1% level for three of the four models explaining innovation quality, as the Panel B model 2 only provides significance at the 10% level. The baseline results in Table 3 consistently support Hypothesis 1 that politically connected firms are associated with higher corporate innovation productivity.

The coefficients on the control variables are generally consistent with the findings in prior research. Specifically, innovation productivity is higher in firms with larger size, lower ROA, lower leverage, higher capital expenditure, higher Tobin's Q, older age, higher market share, and higher institutional ownership. Innovation input, R&D expenditures, and CAPEX are positively associated with innovation output.

<Table 3 >

3.1. Endogeneity

While our OLS regression results support our hypothesis that politically connected firms are more innovative, endogeneity is a potential concern. As Taylor (1997) suggests, firms may simultaneously establish political connections and set innovation priorities. As a result, we employ a Heckman two-stage model to address the endogenous choices of corporate political connections. We first examine the determinants of different types of corporate political activism in the US.

3.1.1. First-Stage Regression

Determinants of corporate political activity are in the first stage of the Heckman two-stage procedure, we examine the determinants of corporate political connections using the following probit regression:

$$Pr(PC)_{i,j,t} = \alpha + \beta Instruments_{i,j,t} + \gamma Z_{i,j,t} + Year_t + Industry_j + \varepsilon_{i,j,t} \qquad (2)$$

where PC is one of the four political connection indicators (PC, PC_Dir, PC_Lobby, and PC_PAC). $Instruments_{i,j,t}$ represents additional selection model variables that are potential determinants of political connections. These instrumental variables (IVs) should only have impact on corporate innovation productivity through their effects on political connections. The vector $Z_{i,j,t}$ represents the set of control variables included in the second-stage regression. *Year* and *Industry* are dummy variables to capture year fixed effects, and industry fixed effects, respectively.

Specifically, we employ two IVs in the first stage probit model. The first IV is the percentage of politically connected firms in a given industry defined by 2-digit SIC. This industry political connection percentage variable is expected to be positively related to firm level political connections within the industry. However, there is no obvious reason to believe that industry political activeness has a direct impact on corporate innovation productivity through channels other than political connections. Tip O'Neill, 47th Speaker of the United States House of Representatives, 1977-1987, provides the motivation for the second IV with the quip, "All politics is local."[8] This IV is the distance between a firm's headquarters and the nearest political center of power (capital city or the largest city of the state where the firm is located), whichever is shorter.[9] The zip codes of corporate headquarters locations are identified in Compustat and the capital (largest) city's location is based on the coordinates of the state capital building (city hall).[10] We employ this proximity measure as a political geography variable to proxy for corporate access to political power. Additionally, Hill, Kelly, Lockhart, and Van Ness (2013) suggest that firms located closer to state capitals are more likely to spend money on lobbying activities. We posit that a firm's distance from political power should affect firms' political connection decisions, but should not have direct implications on innovation productivity.

Table 4 reports the probit regression results. We find that firm size, profitability, Tobin's Q, R&D expenditure, firm age, market share, and institutional ownership are significant factors that affect firms' political connection decisions. As far as instrument variables are concerned, firms operating in industries that are more politically connected are more likely to have political connections. In addition, we find that firms' distance from political power is an important determinant of corporate political connection decisions, consistent with Kim et al. (2012). Specifically, overall political connection (PC), political directorship (PC_Dir), and lobbying activities (PC_Lobby) are more common for firms that are located in geographic proximity to political power centers. In the specifications reported in Table 4, the area under the receiver operating characteristic (ROC) curve ranges from 0.78 to 0.92. This suggests that our probit

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[8] Speaker Thomas P. "Tip" O'Neill, Jr. (1912-1994). O'Neill promoted this line in 1935 for his first political campaign.

[9] This distance measure is computed following the methodology in Coval and Moskowitz (1999). Kim, Pantzalis, and Park (2012) also use this methodology to calculate political geography.

[10] We match each firm's headquarter zip code with the latitude and longitude data from http://federalgovernmentzipcodes.us/. We choose this federal government zip code database over U.S. Census Bureau's Gazetteer Place and Zip Code Database because of its better location coverage. Specifically, some firms' zip codes represent P.O. Box addresses, and such locations are oftentimes not covered by the Gazetteer database, which reduces our sample size. For robustness purpose, we use the location data from the Gazetteer database and find similar results.

model has acceptable discriminatory power. These first-stage regressions should produce meaningful results for application to the second-stage given the substantial model fit, pseudo R^2 range of .17-.39, and significance at the 1% level for all IV's.

<Table 4>

Interestingly, firms are more likely to use PACs when they are located farther away from political power. Previous studies also point out that lobbying expenditures differ from PAC spending (Milyo, Primo, and Groseclose (2000); Brasher and Lowery (2006); Ansolabehere, de Figueiredo, and Snyder (2003); Chen, Parsley, and Yang (2015)). PACs typically focus on campaigns which create or maintain favorable politicians while lobbying focuses on influencing existing political decision makers, and therefore it is possible that firms utilize political devices such as lobbying and PAC contributions differently, depending on their geographic distance to political power. In other words, it may be easier for firms that are near a political center of power to influence the short-term policies by lobbying the politicians currently in office, whereas firms that are located farther away from political power are less likely to have opportunities to interact with or have strong ties with current policy makers and as a result may choose to invest in PACs in the hope that the political donations will pay off from changes in the political landscape in the long run.

3.1.2. Second-Stage Regression

To address potential endogeneity concerns while examining the relation between political connections and innovation, we estimate the following second-stage regression:

$$Ln(Innovation)_{i,j,t+1} = \alpha + \beta(Political\ Connection)_{i,j,t} + \gamma Z_{i,j,t} + \theta Mills_{i,j,t} + Year_t + Industry_j + \varepsilon_{i,j,t}$$

where *Innovation* represents the innovation productivity measures for patent count or patent quality and *Political Connection* is one of the four proxies for political connections. The same set of control variables in the baseline regressions is included in $Z_{i,j,t}$. In all specifications, we control for year and industry fixed effects.[11] We construct inverse Mills ratios for each type of political connection from Equation (2) and incorporate them into the second-stage regressions to control for the endogenous choice of political connections. Again, *Year* and *Industry* are dummy variables to capture year fixed effects, and industry fixed effects, respectively.

<Table 5>

Table 5 reports the second-stage regression results. All political connection measures are positively and significantly associated with both innovation quantity and innovation quality. The inverse mills ratio, lambda, is significantly positive, suggesting that the unobserved variables that are associated with the choice of political connections potentially have a positive impact on firm innovation. Overall, both the baseline OLS regressions and Heckman two-step procedure support Hypothesis 1 that political connections are related to higher corporate innovation productivity, after controlling for a number of other determinants of corporate innovation and year/industry fixed effects, as well as the endogenous choice of political connections. We find greater support for the assertions of ORW than for BDD and Bellettini et al. (2013). Consistent with ORW and Taylor (1997), we document that political connections are associated with more innovation.

[11] In Model 1 of Table 4, the number of observations is slightly smaller than that in Model 2 and Model 3 because in our sample all the firms in the tobacco industry have at least one type of political connection (PC=1) in which case the probit model predicts perfect success and therefore firms in the tobacco industry are excluded from the regression. Similarly, in Model 4 of Table 4, the number of observations is slightly smaller than that in Model 2 and Model 3 because there are a few industries (candy&soda, fabricated products, and measuring and control equipment) that have no campaign contribution records (PC_PAC=0), in which case the probit model predicts perfect failure and as a result, firms in these industries are excluded from the probit regression. This in turn affects the number of observations in Model 1 and Model 4 of Table 5.

3.2. Subsample Analysis

We now investigate the differential impacts of political connections based on the business environment. We hypothesize that political connections help firms mitigate uncertainties, access capital, facilitate favorable policies, and aid in resource acquisition. Firms operating in high-tech environments where firms are more innovation driven, financially constrained environments where access to capital dictates innovation, and competitive environments where favorable policies are more valuable should benefit more from political connections (Hypothesis 2 – 4).

3.2.1. High-Tech Firms (H_2)

We assign a high-technology dummy (HiTech = 1) for each firm-year observation with an SIC code identified by Cliff and Denis (2004). From Table 1 we see that 29% of the full sample firm-years are defined as High-Tech. Innovation productivity is more crucial to explorative type of firms (high-tech firms) than to exploitive type of firms (non-high-tech firms). Therefore, we posit that the positive impact of political connections on innovation productivity documented above may be particularly valuable to high-tech firms than to non-high-tech firms. The results on the effects of political ties on high-tech firm innovation productivity are reported in Table 6 Panel A and Panel B. The political connection and HiTech interaction terms are positive and significant at the one percent level in all specifications, suggesting that political connections are especially important for high-tech firms, which supports Hypothesis 2.

<Table 6>

3.2.2. Financially constrained firms (H_3)

Due to the highly risky and uncertain nature of innovation, it is notoriously difficult for innovative firms to access capital to fund R&D projects (Hall and Lerner (2009); Arrow (1962); Hall (2010); Hedge and Mishra (2014)). Consequently, financial constraints present a serious challenge to technological innovations. On the other hand, empirical evidence suggests that politically connected firms have better access to capital compared to non-connected firms (Boubakri et al. (2012); Houston et al. (2014)). As a result, we expect more pronounced effects of political connections on innovation productivity among firms facing greater financial constraint. To empirically test this hypothesis, we interact political connection measures with the Kaplan and Zingales (1997) measure of financial constraint, KZ score. Since the KZ score is proportional to financial constraint, positive coefficients on the political connection and KZ interaction terms in Table 7 yield evidence to support Hypothesis 3 that the positive association between political connections and corporate innovation productivity is stronger for financially constrained firms.

<Table 7>

3.2.3. Competitive Industries (H_4)

Firms operating in concentrated industries typically face stiffer product market competition so the benefits from political connections may be more valuable for such firms. To test this proposition, we examine the interaction term between political connection measures and the Herfindahl-Hirschman Index (HHI) based on annual 2-digit SIC industry groups. We report results of political connection and industry competition interaction in Table 8. The coefficients on the interaction terms are negative and significant for six of the eight models, indicating that the positive impact of political connections on corporate innovation productivity becomes more pronounced as industry competition increases, consistent with Hypothesis 4.

<Table 8>

4. Mechanism

4.1. Channel

To mitigate concerns of a spurious finding, we present evidence of a specific channel by which political connections add value through facilitating innovation. Anecdotal evidence suggests that political connections bring favorable policies to connected firms and allow connected firms greater access to resources than non-connected firms. Due to the risk and information asymmetry inherent in the innovative process firms have difficulty obtaining external capital and hesitate to use internal capital for innovative activities. Therefore, financial assistance from a federal agency may be the means of funding very large, complex, and risky innovation.

Federal grant awards are the most direct method to finance firms' risky projects and mitigate potential firms' risk aversion. We empirically test this hypothesis using federal grant data from www.usaspending.gov. The USASpending website maintains records of four different types of federal financial assistance starting from 2000: federal contracts, federal grants, federal loans, and other financial assistance. We focus on federal grants because this channel is one of the most direct ways the federal agencies may be able to alter firms' ability to innovate. USASpending tracks recipients of federal grant awards which include government, non-profit organization, profit organization, higher education, and etc. We only focus on the "profit organization" category and merge these into our sample.

This matching procedure is a challenge because USASpending data lacks company identifiers such as gvkey or permno. Following Baker, Bloom and Davis (2015) we first standardize the recipient names in the USASpending data and the firm names in Compustat. Then we perform cleaning operations such as capitalizing all the letters, deleting excess spacing, and removing punctuation, abbreviation and generic words.[12] This matching procedure yields 591 firm-year observations with federal grant awards.[13]

We employ the federal grant award data to test the linkage between political connections and innovation. We create two proxies to measure the favorable resource allocation received by politically connected firms. The first one is Grant, a dummy variable that takes the value of one if a sample firm received federal grants in a given year and zero otherwise. We assign a grant dummy (Grant = 1) for each firm-year observation with net positive grant award dollars. The second measure is Ln(Grant), the natural logarithm of the total amount of federal grants received by a firm in a given year.[14] Both measures of grant activity are associated with greater innovation output at the one percent level. Table 9 shows future innovation productivity as the dependent variables and both the grant incidence (Grant) and size Ln(Grant) in the current year as the primary independent variables. Results indicate that federal grant awardees produce significantly more patents in the future and these patents receive substantially more future citations.[15]

<Table 9>

Now that we have established that government funding leads to higher corporate innovation activity, we next examine whether politically connected firms are more likely to

[12] For instance, the following abbreviations and generic words are deleted from firm names: " LLC", " LLP", " LTD", "THE", " INC", " COMPANY", " CORPORATION", " CORP", " CO", " GROUP", " ADR", " CL A", " CL B", " REDH", " HLDGS".

[13] We acknowledge that this approach may not yield perfect matching results, as there are some samples firms that could have potentially received government funding but are not labeled as grant recipients in our sample because their Compustat names do not match the names reported in USASpending database even after the cleaning process. However, we argue that the probability of firms not having the same names between the two databases should be entirely random, mitigating concerns of a data bias.

[14] In certain situations, the federal grant amount is negative. According to https://www.usaspending.gov/DownloadCenter/Documents/USAspending.govDownloadsDataDictionary.pdf, these negative values indicate a decrease in funding. Since our primary goal is to examine the effects of political connections on the likelihood of obtaining favorable policies and resources from the government, we do not consider decreases in funding and set negative grant amounts equal to zero.

[15] While we use patent count and citations per patent in year t+1 as the dependent variables in Table 9, we also examine the effects of receiving federal grants on innovation productivity in year t+2 and t+3 (untabulated) and we find consistent results.

receive grant awards from federal agencies. In Table 10 Panel A, we employ probit models where the dependent variable is a dummy variable that equals to one if a firm received federal grants in year t+1 and zero otherwise. The primary independent variables are the four proxies of political connections and control variables are the same as in the previous analyses. All four political connections increase the likelihood of receiving future federal grant awards and are all significant at the one percent level. In Table 10 Panel B, we show that political connections in the current year significantly increase the amount of federal grants received by firms in the subsequent year. These findings support Hypothesis 5 that politically connected firms extract favorable resource allocation through their connections to political power, which leads to better innovation output.

<Table 10>

4.2. Robustness

While individual political connection measures help demonstrate the positive impact of political connections on corporate innovation productivity, there is an endogeneity issue regarding multiple political connections in a firm. One may wonder if each of these different types of political connections has strong explanatory power by itself when the other types of connections are controlled for, as these political activism measures are positively correlated with each other. To answer this question, we include all three types of political connection measures, the presence of former politician directors, lobbying expenditures, and campaign contributions, in the same regressions to explain the quantity and quality of future innovation output. In Table 11 Panel A, we show that political connections due to lobbying and PACs produce greater innovation quantity and quality at the 1% significance level. Apparently, board members may be less influential as only the quantity is significant and only at the 5% level. These results suggest that each type of political connection adds to innovative output with lobbying expenditures producing the most prominent increase in innovation productivity, after controlling for other types of political connections, control variables, and year and industry fixed effects.

<Table 11>

Relatedly, we investigate whether increasing political power affects firm innovation. To measure the total political power, we create political number variables, PC1, PC2, and PC3, which equal the total number of political connections a firm has. PC1(2, 3) equals 1 if a firm has one (two, all three) of the three types of connections examined in this study. Results in Table 11 Panel B indicate that firms with higher combined political power, proxied by higher number of political connections, tend to be more innovative, which further supports our argument that political connections are associated with higher innovation productivity.

5. Conclusion

We demonstrate a strong positive relationship between corporate political connections and corporate innovation productivity. This study adds the innovation productivity channel to the literature illustrating that US political connections bolster corporate value. Political connections are associated with significantly higher corporate innovation productivity in terms of both innovation quantity and innovation quality as measured by patent awards and patent citations respectively. This result is robust after controlling for the endogenous choice of establishing political connections and the positive effects of political connections on firm innovation productivity are more pronounced for high-tech firms, for firms facing greater financial constraint, and for firms operating in competitive environments. Using federal grant data, we identify government grant funding as a potential channel through which political connections may affect innovation productivity. Specifically, we demonstrate that politically connected firms are more likely to receive federal grant awards, which in turn improves innovation productivity. While results are consistent with the conclusions of ORW, they do conflict with the findings of BDD as our results suggest that political connections benefit firms through greater innovation productivity as a result of more favorable resource allocation. Political connections may also improve corporate innovation productivity via other channels such as regulatory or non-grant resource allocation. However, these channels are beyond the scope of this paper but present important avenues for future research.

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Appendix. Variable Definition

Variable	Definition	Data Source
Innovation measures		
Ln(Patent)	Natural log of the total number of patents applied for by a firm in a given year, corrected for truncation bias.	KPSS
Ln(Cite)	Natural log of the average number of citations per patent of a firm in a given year, corrected for truncation bias.	KPSS
Political connection measures		
PC	An indicator equal to 1 if one or more of PC_Dir or PC_Lobby or PC_PAC equals 1, zero otherwise.	
PC_Dir	An indicator that takes the value of one if the firm has at least one former politician on board, zero otherwise.	EDGAR
PC_Lobby	An indicator that takes the value of one if the firm has non-zero lobby expenses, zero otherwise.	Senate Office of Public Records
PC_PAC	An indicator that takes the value of one if the firm has non-zero campaign contributions, zero otherwise.	Committee and candidate summary contribution files from the Federal Election Commission
PC1	An indicator that takes the value of one if the firm has only one type of political connection.	
PC2	An indicator that takes the value of one if the firm has two types of political connections.	
PC3	An indicator that takes the value of one if the firm has all three types of political connections.	
Other variables		
Size	Log of sales; log(sale)	Compustat
ROA	Operating income before depreciation to total assets ratio; oibdp/at	Compustat
Lev	Total debt divided by total assets; (dlc+dltt)/at	Compustat
CAPX	Capital expenditure to total assets ratio; capx/at	Compustat
Q	Market to book ratio; (at-ceq+csho*prcc_f-txdb)/at	Compustat
R&D	Research and Development expenditure to total sales ratio; xrd/sale	Compustat

PPE	Net property, plants and equipment to assets ratio; ppent/at	Compustat
Age	Natural logarithm of one plus the number of years the firm is listed on Compustat	Compustat
MKT Share	Firm sales divided by total sales in the same industry based on four-digit SIC	Compustat
IO	Total percentage of a firm's equity held by institutional investors	Thomson Financial 13f institutional holdings database
HiTech	An indicator variable that equals 1 if the firm belongs to the high-tech industry and 0 otherwise. High-tech industries are defined in Cliff and Denis (2004).	Compustat
KZ	−1.002×cash flow ((ib+dp)/ppent) plus 0.283×Q((at+prcc_f×csho−ceq−txdb)/at) plus3.139×leverage((dltt+dlc)/(dltt+dlc+seq)) minus 39.368×dividends ((dvc+dvp)/ppent) minus 1.315×cash holdings (che/ppent), where ppent is lagged, as defined in Kaplan and Zingales (1997)	Compustat
HHI	Herfindahl index of a firm's industry in a given year constructed based on sales at two-digit SIC industries.	Compustat
IndPC IndPC_Dir IndPC_Lobby IndPC_PAC	The percentage of politically (through directors, lobbying, or campaign contribution) connected firms in the same two-digit SIC industry.	
Distance	Natural log of the distance (in kilometers) from the firm headquarters to either the largest city or the capital of the headquarters state, whichever is shorter.	www.federalgovernmentzipcodes.us/
Grant	An indicator variable that equals 1 if the firm received federal grant in a given year and 0 otherwise.	www.usaspending.gov
Ln(Grant)	Natural log of the positive amount of federal grant received by a firm in a given year.	www.usaspending.gov

TABLE 1: Summary Statistics

This table reports descriptive statistics on variables used in this study. Detailed variable descriptions and sources of data are included in the Appendix.

	Mean	Median	1st Percentile	99th Percentile	STD	N
Ln(Patent)t+1	0.45	0.00	0.00	4.80	1.02	44,381
Ln(Cite)t+1	0.92	0.00	0.00	6.42	1.95	44,381
PCt	0.25	0.00	0.00	1.00	0.43	44,381
PC_Dirt	0.13	0.00	0.00	1.00	0.34	44,381
PC_Lobbyt	0.15	0.00	0.00	1.00	0.35	44,381
PC_PACt	0.08	0.00	0.00	1.00	0.27	44,381
Sizet	5.39	5.39	-0.35	10.33	2.23	44,381
ROAt	0.05	0.09	-0.83	0.40	0.21	44,381
Levt	0.21	0.16	0.00	0.92	0.21	44,381
CAPXt	0.05	0.03	0.00	0.30	0.06	44,381
Qt	2.06	1.39	0.58	10.14	2.14	44,381
R&Dt	0.05	0.00	0.00	0.55	0.11	44,381
PPEt	0.23	0.15	0.00	0.89	0.23	44,381
Aget	2.65	2.56	1.10	4.06	0.74	44,381
MKT Sharet	0.01	0.00	0.00	0.15	0.03	44,381
IOt	0.46	0.46	0.00	1.00	0.31	44,381
HiTecht	0.29	0.00	0.00	1.00	0.45	44,381
HHIt	0.06	0.04	0.01	0.28	0.05	44,381
KZt	-13.40	-1.60	-295.47	9.00	44.27	44,381
IndPCt	0.24	0.22	0.06	0.61	0.13	44,381
IndPC_Dirt	0.13	0.12	0.00	0.40	0.08	44,381
IndPC_Lobbyt	0.14	0.13	0.00	0.40	0.09	44,381
IndPC_PACt	0.08	0.05	0.00	0.34	0.08	44,381
Distancet	3.38	3.61	-0.51	6.19	1.83	44,381
Grantt	0.01	0.00	0.00	1.00	0.11	39,678
Ln(Grant)t	0.12	0.00	0.00	10.82	1.21	39,678

TABLE 2: Correlation Table

This table reports the Pearson correlations between political connection measures and innovation measures. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels respectively.

	PCt	PC_Dirt	PC_Lobbyt	PC_PACt	Ln(Patent)t+1	Ln(Cite)t+1
PCt	1.00					
PC_Dirt	0.68***	1.00				
PC_Lobbyt	0.72***	0.23***	1.00			
PC_PACt	0.52***	0.23***	0.47***	1.00		
Ln(Patent)t+1	0.17***	0.12***	0.21***	0.18***	1.00	
Ln(Cite)t+1	0.10***	0.06***	0.13***	0.10***	0.80***	1.00

TABLE 3: Baseline Estimation

This table reports the OLS regression results of future corporate innovation productivity on political connection measures. Panel A and B report regression results with the number of patent and the number of citations per patent as dependent variables, respectively. Detailed variable definitions can be found in the Appendix. Year and industry (Fama-French 49 industry classification) fixed effects are included in all regressions. All standard errors are clustered at the firm level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A

	(1)	(2)	(3)	(4)
	Ln(Patent)t+1	Ln(Patent)t+1	Ln(Patent)t+1	Ln(Patent)t+1
PCt	0.164***			
	(0.02)			
PC_Dirt		0.122***		
		(0.03)		
PC_Lobbyt			0.314***	
			(0.04)	
PC_PACt				0.338***
				(0.06)
Sizet	0.167***	0.175***	0.161***	0.165***
	(0.01)	(0.01)	(0.01)	(0.01)
ROAt	0.004	-0.023	0.018	0.005
	(0.05)	(0.05)	(0.05)	(0.05)
Levt	-0.215***	-0.217***	-0.211***	-0.212***
	(0.04)	(0.04)	(0.04)	(0.04)
CAPXt	0.448***	0.460***	0.447***	0.461***
	(0.13)	(0.13)	(0.13)	(0.13)
Qt	0.051***	0.052***	0.050***	0.051***
	(0.00)	(0.00)	(0.00)	(0.00)
R&Dt	1.288***	1.277***	1.298***	1.275***
	(0.13)	(0.13)	(0.13)	(0.13)
PPEt	-0.056	-0.053	-0.052	-0.076
	(0.06)	(0.06)	(0.06)	(0.06)
Aget	0.040**	0.047***	0.037**	0.034**
	(0.02)	(0.02)	(0.02)	(0.02)
MKT Sharet	1.213*	1.287*	1.158*	0.948
	(0.70)	(0.70)	(0.70)	(0.69)
IOt	0.053	0.057	0.058	0.068*
	(0.04)	(0.04)	(0.04)	(0.04)
Constant	-0.972***	-1.014***	-0.948***	-0.889***
	(0.17)	(0.17)	(0.17)	(0.17)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44381	44381	44381	44381
Adj. R-Squared	0.34	0.34	0.35	0.34

TABLE 3 (Continued)

Panel B

	(1) Ln(Cite)t+1	(2) Ln(Cite)t+1	(3) Ln(Cite)t+1	(4) Ln(Cite)t+1
PCt	0.207***			
	(0.04)			
PC_Dirt		0.083*		
		(0.05)		
PC_Lobbyt			0.392***	
			(0.05)	
PC_PACt				0.377***
				(0.07)
Sizet	0.190***	0.203***	0.182***	0.189***
	(0.01)	(0.01)	(0.01)	(0.01)
ROAt	0.071	0.026	0.087	0.065
	(0.09)	(0.09)	(0.09)	(0.09)
Levt	-0.352***	-0.355***	-0.347***	-0.350***
	(0.07)	(0.07)	(0.07)	(0.07)
CAPXt	0.693***	0.703***	0.693***	0.709***
	(0.23)	(0.23)	(0.23)	(0.23)
Qt	0.091***	0.093***	0.090***	0.092***
	(0.01)	(0.01)	(0.01)	(0.01)
R&Dt	2.485***	2.471***	2.497***	2.469***
	(0.23)	(0.23)	(0.23)	(0.23)
PPEt	-0.152	-0.151	-0.147	-0.175*
	(0.09)	(0.09)	(0.09)	(0.09)
Aget	-0.004	0.007	-0.007	-0.009
	(0.02)	(0.02)	(0.02)	(0.03)
MKT Sharet	1.836**	2.030**	1.771**	1.576*
	(0.83)	(0.83)	(0.82)	(0.83)
IOt	0.453***	0.457***	0.459***	0.470***
	(0.06)	(0.06)	(0.06)	(0.06)
Constant	-0.963***	-1.035***	-0.935***	-0.882***
	(0.20)	(0.20)	(0.21)	(0.21)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44381	44381	44381	44381
Adj. R-Squared	0.27	0.27	0.28	0.28

TABLE 4: First-Stage Probit Model: Determinants of Political Connections

This table reports the first stage Probit regression results of instrumental variables (IV) and firm characteristics on corporate political connection decisions. The IVs used in each regression are the distance between a firm's headquarter and the closest major city in a given state and the percentage of each type of political connection in an industry. Detailed variable definitions can be found in the Appendix. Year and industry (Fama-French 49 industry classification) fixed effects are included in all regressions. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1) PCt	(2) PC_Dirt	(3) PC_Lobbyt	(4) PC_PACt
Sizet	0.280***	0.199***	0.284***	0.428***
	(0.01)	(0.01)	(0.01)	(0.01)
ROAt	-0.984***	-0.669***	-0.962***	-0.491***
	(0.05)	(0.06)	(0.06)	(0.12)
Levt	-0.067*	0.016	-0.084*	0.200***
	(0.04)	(0.04)	(0.05)	(0.06)
CAPXt	0.489***	0.033	0.704***	0.451
	(0.18)	(0.21)	(0.22)	(0.31)
Qt	0.041***	0.026***	0.047***	0.038***
	(0.00)	(0.00)	(0.00)	(0.01)
R&Dt	-0.180	0.064	-0.230*	0.276
	(0.11)	(0.13)	(0.13)	(0.30)
PPEt	-0.077	-0.135**	-0.138**	0.575***
	(0.06)	(0.07)	(0.07)	(0.09)
Aget	0.211***	0.140***	0.163***	0.304***
	(0.01)	(0.01)	(0.01)	(0.02)
MKT Sharet	4.845***	4.093***	2.110***	1.537***
	(0.38)	(0.37)	(0.37)	(0.43)
IOt	0.164***	0.062*	0.235***	0.256***
	(0.03)	(0.04)	(0.04)	(0.05)
IVs				
Distancet	-0.020***	-0.023***	-0.022***	0.032***
	(0.00)	(0.00)	(0.00)	(0.01)
IndPCt	3.029***			
	(0.11)			
IndPC_Dirt		3.711***		
		(0.14)		
IndPC_Lobbyt			3.246***	
			(0.16)	
IndPC_PACt				3.296***
				(0.22)
Constant	-4.019***	-3.539***	-3.968***	-6.574***
	(0.17)	(0.18)	(0.17)	(0.30)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44326	44381	44381	43068
Pseudo R-Squared	0.23	0.17	0.24	0.39
Area under ROC Curve	0.81	0.78	0.83	0.92

TABLE 5: Second-Stage Regressions: Political Connections and Corporate Innovation

This table reports the second stage regression results of future corporate innovation productivity on political connection measures, with the Inverse Mills Ratio (IMR) calculated in the first stage included in each regression. Panel A and B report regression results with the number of patent and the number of citations per patent as dependent variables, respectively. Detailed variable definitions can be found in the Appendix. Year and industry (Fama-French 49 industry classification) fixed effects are included in all regressions. All standard errors are clustered at the firm level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A

	(1)	(2)	(3)	(4)
	Ln(Patent)t+1	Ln(Patent)t+1	Ln(Patent)t+1	Ln(Patent)t+1
PCt	0.182***			
	(0.02)			
PC_Dirt		0.138***		
		(0.03)		
PC_Lobbyt			0.327***	
			(0.04)	
PC_PACt				0.336***
				(0.06)
Sizet	0.272***	0.220***	0.298***	0.398***
	(0.02)	(0.01)	(0.02)	(0.04)
ROAt	-0.364***	-0.176***	-0.448***	-0.217***
	(0.06)	(0.05)	(0.07)	(0.06)
Levt	-0.220***	-0.209***	-0.237***	-0.076
	(0.04)	(0.04)	(0.04)	(0.05)
CAPXt	0.534***	0.414***	0.666***	0.580***
	(0.13)	(0.13)	(0.13)	(0.13)
Qt	0.066***	0.058***	0.072***	0.071***
	(0.00)	(0.00)	(0.00)	(0.01)
R&Dt	1.245***	1.295***	1.221***	1.464***
	(0.13)	(0.13)	(0.13)	(0.13)
PPEt	-0.048	-0.068	-0.091	0.305***
	(0.06)	(0.06)	(0.06)	(0.08)
Aget	0.117***	0.077***	0.117***	0.203***
	(0.02)	(0.02)	(0.02)	(0.03)
MKT Sharet	1.996***	1.950***	1.558**	1.120
	(0.69)	(0.70)	(0.68)	(0.68)
IOt	0.140***	0.077*	0.187***	0.202***
	(0.04)	(0.04)	(0.04)	(0.04)
IMR	0.495***	0.267***	0.581***	0.636***
	(0.05)	(0.05)	(0.06)	(0.09)
Constant	-2.622***	-1.900***	-3.030***	-4.795***
	(0.27)	(0.25)	(0.31)	(0.59)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44326	44381	44381	43068
Adj. R-Squared	0.35	0.34	0.35	0.35

TABLE 5 (Continued)

Panel B

	(1) Ln(Cite)t+1	(2) Ln(Cite)t+1	(3) Ln(Cite)t+1	(4) Ln(Cite)t+1
PCt	0.229***			
	(0.04)			
PC_Dirt		0.101**		
		(0.05)		
PC_Lobbyt			0.406***	
			(0.05)	
PC_PACt				0.377***
				(0.07)
Sizet	0.314***	0.251***	0.322***	0.404***
	(0.02)	(0.02)	(0.02)	(0.04)
ROAt	-0.365***	-0.142	-0.389***	-0.129
	(0.10)	(0.10)	(0.11)	(0.10)
Levt	-0.357***	-0.346***	-0.374***	-0.216***
	(0.07)	(0.07)	(0.07)	(0.08)
CAPXt	0.800***	0.652***	0.916***	0.826***
	(0.24)	(0.23)	(0.24)	(0.24)
Qt	0.110***	0.099***	0.113***	0.111***
	(0.01)	(0.01)	(0.01)	(0.01)
R&Dt	2.436***	2.491***	2.419***	2.639***
	(0.23)	(0.23)	(0.23)	(0.24)
PPEt	-0.144	-0.166*	-0.187**	0.180
	(0.09)	(0.09)	(0.09)	(0.11)
Aget	0.088***	0.041	0.074***	0.154***
	(0.03)	(0.03)	(0.03)	(0.04)
MKT Sharet	2.748***	2.758***	2.179***	1.780**
	(0.83)	(0.85)	(0.82)	(0.83)
IOt	0.555***	0.479***	0.591***	0.572***
	(0.06)	(0.06)	(0.06)	(0.07)
IMR	0.587***	0.293***	0.593***	0.592***
	(0.07)	(0.07)	(0.09)	(0.11)
Constant	-2.920***	-2.008***	-3.060***	-4.531***
	(0.33)	(0.33)	(0.39)	(0.71)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44326	44381	44381	43068
Adj. R-Squared	0.28	0.27	0.28	0.27

TABLE 6: Are Political Connections More Important to High-Tech Firms?

This table reports the main regression results interacted with the HiTech variable. Panel A and B report regression results with the number of patent and the number of citations per patent as dependent variables, respectively. Detailed variable definitions can be found in the Appendix. Year and industry (Fama-French 49 industry classification) fixed effects are included in all regressions. All standard errors are clustered at the firm level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A

	(1) Ln(Patent)t+1	(2) Ln(Patent)t+1	(3) Ln(Patent)t+1	(4) Ln(Patent)t+1
PCt	0.029			
	(0.03)			
PCt*HiTecht	0.490***			
	(0.07)			
PC_Dirt		0.009		
		(0.04)		
PC_Dirt*HiTecht		0.444***		
		(0.09)		
PC_Lobbyt			0.171***	
			(0.04)	
PC_Lobbyt*HiTecht			0.493***	
			(0.09)	
PC_PACt				0.159***
				(0.06)
PC_PACt*HiTecht				1.039***
				(0.17)
HiTecht	0.133**	0.200***	0.160***	0.166***
	(0.06)	(0.06)	(0.06)	(0.06)
Sizet	0.165***	0.174***	0.158***	0.156***
	(0.01)	(0.01)	(0.01)	(0.01)
ROAt	-0.015	-0.037	0.002	-0.012
	(0.05)	(0.05)	(0.04)	(0.05)
Levt	-0.211***	-0.214***	-0.206***	-0.199***
	(0.04)	(0.04)	(0.04)	(0.04)
CAPXt	0.396***	0.406***	0.402***	0.411***
	(0.13)	(0.13)	(0.13)	(0.13)
Qt	0.050***	0.051***	0.049***	0.049***
	(0.00)	(0.00)	(0.00)	(0.00)
R&Dt	1.313***	1.257***	1.312***	1.288***
	(0.13)	(0.13)	(0.13)	(0.13)
PPEt	-0.063	-0.049	-0.064	-0.084
	(0.06)	(0.06)	(0.06)	(0.06)
Aget	0.044***	0.049***	0.041**	0.034**
	(0.02)	(0.02)	(0.02)	(0.02)
MKT Sharet	1.646**	1.488**	1.513**	1.357**
	(0.69)	(0.69)	(0.69)	(0.69)
IOt	0.065*	0.067*	0.067*	0.103***
	(0.04)	(0.04)	(0.04)	(0.04)
Constant	-0.956***	-1.009***	-0.927***	-0.870***

	(0.17)	(0.17)	(0.17)	(0.17)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44381	44381	44381	44381
Adj. R-Squared	0.35	0.34	0.35	0.36

TABLE 6 (Continued)

Panel B

	(1) Ln(Cite)t+1	(2) Ln(Cite)t+1	(3) Ln(Cite)t+1	(4) Ln(Cite)t+1
PCt	0.083*			
	(0.04)			
PCt*HiTecht	0.450***			
	(0.09)			
PC_Dirt		-0.014		
		(0.05)		
PC_Dirt*HiTecht		0.378***		
		(0.12)		
PC_Lobbyt			0.278***	
			(0.06)	
PC_Lobbyt*HiTecht			0.389***	
			(0.11)	
PC_PACt				0.232***
				(0.08)
PC_PACt*HiTecht				0.834***
				(0.17)
HiTecht	0.186**	0.253***	0.220**	0.226**
	(0.09)	(0.09)	(0.09)	(0.09)
Sizet	0.187***	0.202***	0.180***	0.181***
	(0.01)	(0.01)	(0.01)	(0.01)
ROAt	0.052	0.013	0.073	0.050
	(0.09)	(0.09)	(0.09)	(0.09)
Levt	-0.347***	-0.351***	-0.341***	-0.337***
	(0.07)	(0.07)	(0.07)	(0.07)
CAPXt	0.636***	0.645***	0.644***	0.655***
	(0.23)	(0.23)	(0.23)	(0.23)
Qt	0.091***	0.092***	0.089***	0.090***
	(0.01)	(0.01)	(0.01)	(0.01)
R&Dt	2.497***	2.438***	2.491***	2.462***
	(0.23)	(0.23)	(0.23)	(0.23)
PPEt	-0.160*	-0.148	-0.158*	-0.182*
	(0.09)	(0.09)	(0.09)	(0.09)
Aget	0.001	0.010	-0.004	-0.008
	(0.02)	(0.02)	(0.02)	(0.03)
MKT Sharet	2.232***	2.199***	2.048**	1.902**
	(0.83)	(0.83)	(0.82)	(0.83)
IOt	0.465***	0.466***	0.467***	0.499***
	(0.06)	(0.06)	(0.06)	(0.06)
Constant	-0.949***	-1.031***	-0.918***	-0.867***
	(0.21)	(0.21)	(0.21)	(0.21)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44381	44381	44381	44381
Adj. R-Squared	0.28	0.27	0.28	0.28

TABLE 7: Are Political Connections More Important to Financially Constrained Firms?

This table reports the main regression results interacted with the KZ index. Panel A and B report regression results with the number of patent and the number of citations per patent as dependent variables, respectively. Detailed variable definitions can be found in the Appendix. Year and industry (Fama-French 49 industry classification) fixed effects are included in all regressions. All standard errors are clustered at the firm level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A

	(1) Ln(Patent)t+1	(2) Ln(Patent)t+1	(3) Ln(Patent)t+1	(4) Ln(Patent)t+1
PCt	0.176***			
	(0.03)			
PCt*KZt	0.001***			
	(0.00)			
PC_Dirt		0.134***		
		(0.04)		
PC_Dirt*KZt		0.001***		
		(0.00)		
PC_Lobbyt			0.327***	
			(0.04)	
PC_Lobbyt*KZt			0.001**	
			(0.00)	
PC_PACt				0.362***
				(0.06)
PC_PACt*KZt				0.004***
				(0.00)
KZt	-0.000***	-0.000**	-0.000**	-0.000*
	(0.00)	(0.00)	(0.00)	(0.00)
Sizet	0.168***	0.176***	0.162***	0.166***
	(0.01)	(0.01)	(0.01)	(0.01)
ROAt	0.004	-0.025	0.017	-0.001
	(0.05)	(0.05)	(0.05)	(0.05)
Levt	-0.212***	-0.214***	-0.210***	-0.211***
	(0.04)	(0.04)	(0.04)	(0.04)
CAPXt	0.457***	0.470***	0.455***	0.474***
	(0.13)	(0.13)	(0.13)	(0.13)
Qt	0.050***	0.051***	0.049***	0.050***
	(0.00)	(0.00)	(0.00)	(0.00)
R&Dt	1.300***	1.287***	1.308***	1.283***
	(0.13)	(0.13)	(0.13)	(0.13)
PPEt	-0.051	-0.047	-0.047	-0.075
	(0.06)	(0.06)	(0.06)	(0.06)
Aget	0.040**	0.047***	0.037**	0.034**
	(0.02)	(0.02)	(0.02)	(0.02)
MKT Sharet	1.180*	1.259*	1.139	0.913
	(0.69)	(0.70)	(0.70)	(0.69)
IOt	0.052	0.056	0.057	0.065*
	(0.04)	(0.04)	(0.04)	(0.04)
Constant	-0.976***	-1.020***	-0.953***	-0.892***

	(0.17)	(0.17)	(0.17)	(0.17)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44381	44381	44381	44381
Adj. R-Squared	0.34	0.34	0.35	0.34

TABLE 7 (Continued)

Panel B

	(1) Ln(Cite)t+1	(2) Ln(Cite)t+1	(3) Ln(Cite)t+1	(4) Ln(Cite)t+1
PCt	0.221***			
	(0.04)			
PCt*KZt	0.001**			
	(0.00)			
PC_Dirt		0.094*		
		(0.05)		
PC_Dirt*KZt		0.001		
		(0.00)		
PC_Lobbyt			0.405***	
			(0.05)	
PC_Lobbyt*KZt			0.001	
			(0.00)	
PC_PACt				0.410***
				(0.07)
PC_PACt*KZt				0.005***
				(0.00)
KZt	-0.000	-0.000	-0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Sizet	0.190***	0.203***	0.183***	0.191***
	(0.01)	(0.01)	(0.01)	(0.01)
ROAt	0.072	0.024	0.087	0.058
	(0.09)	(0.09)	(0.09)	(0.09)
Levt	-0.349***	-0.352***	-0.347***	-0.348***
	(0.07)	(0.07)	(0.07)	(0.07)
CAPXt	0.702***	0.712***	0.700***	0.723***
	(0.23)	(0.23)	(0.23)	(0.23)
Qt	0.090***	0.092***	0.089***	0.091***
	(0.01)	(0.01)	(0.01)	(0.01)
R&Dt	2.497***	2.481***	2.507***	2.477***
	(0.23)	(0.23)	(0.23)	(0.23)
PPEt	-0.148	-0.144	-0.143	-0.177*
	(0.09)	(0.09)	(0.09)	(0.09)
Aget	-0.004	0.007	-0.007	-0.009
	(0.02)	(0.02)	(0.02)	(0.03)
MKT Sharet	1.800**	2.004**	1.752**	1.532*
	(0.83)	(0.83)	(0.82)	(0.83)
IOt	0.452***	0.456***	0.458***	0.467***
	(0.06)	(0.06)	(0.06)	(0.06)
Constant	-0.967***	-1.041***	-0.939***	-0.883***
	(0.20)	(0.20)	(0.21)	(0.21)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44381	44381	44381	44381
Adj. R-Squared	0.27	0.27	0.28	0.28

TABLE 8: Are Political Connections More Important to Firms in Competitive Industries?

This table reports the main regression results interacted with the industry Herfindahl-Hirschman Index (HHI). Panel A and B report regression results with the number of patent and the number of citations per patent as dependent variables, respectively. Detailed variable definitions can be found in the Appendix. Year and industry (Fama-French 49 industry classification) fixed effects are included in all regressions. All standard errors are clustered at the firm level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A

	(1) Ln(Patent)t+1	(2) Ln(Patent)t+1	(3) Ln(Patent)t+1	(4) Ln(Patent)t+1
PCt	0.279***			
	(0.04)			
PCt*HHIt	-2.048***			
	(0.38)			
PC_Dirt		0.239***		
		(0.05)		
PC_Dirt*HHIt		-1.990***		
		(0.46)		
PC_Lobbyt			0.440***	
			(0.05)	
PC_Lobbyt*HHIt			-2.332***	
			(0.56)	
PC_PACt				0.468***
				(0.08)
PC_PACt*HHIt				-2.304***
				(0.83)
HHIt	0.093	-0.138	-0.098	-0.183
	(0.19)	(0.20)	(0.18)	(0.19)
Sizet	0.164***	0.173***	0.158***	0.162***
	(0.01)	(0.01)	(0.01)	(0.01)
ROAt	0.012	-0.017	0.023	0.010
	(0.05)	(0.05)	(0.05)	(0.05)
Levt	-0.216***	-0.216***	-0.212***	-0.213***
	(0.04)	(0.04)	(0.04)	(0.04)
CAPXt	0.434***	0.444***	0.430***	0.452***
	(0.13)	(0.13)	(0.13)	(0.13)
Qt	0.050***	0.052***	0.049***	0.050***
	(0.00)	(0.00)	(0.00)	(0.00)
R&Dt	1.293***	1.277***	1.306***	1.278***
	(0.13)	(0.13)	(0.13)	(0.13)
PPEt	-0.049	-0.045	-0.044	-0.067
	(0.06)	(0.06)	(0.06)	(0.06)
Aget	0.040**	0.046***	0.038**	0.032*
	(0.02)	(0.02)	(0.02)	(0.02)
MKT Sharet	1.897***	1.763**	1.755**	1.455**
	(0.73)	(0.72)	(0.73)	(0.72)
IOt	0.060	0.062	0.063	0.073*
	(0.04)	(0.04)	(0.04)	(0.04)
Constant	-0.902***	-0.938***	-0.849***	-0.842***

	(0.17)	(0.18)	(0.16)	(0.17)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44381	44381	44381	44381
Adj. R-Squared	0.34	0.34	0.35	0.34

TABLE 8 (Continued)

Panel B

	(1) Ln(Cite)t+1	(2) Ln(Cite)t+1	(3) Ln(Cite)t+1	(4) Ln(Cite)t+1
PCt	0.290***			
	(0.06)			
PCt*HHIt	-1.471**			
	(0.63)			
PC_Dirt		0.201***		
		(0.07)		
PC_Dirt*HHIt		-1.996***		
		(0.68)		
PC_Lobbyt			0.437***	
			(0.07)	
PC_Lobbyt*HHIt			-0.818	
			(0.96)	
PC_PACt				0.460***
				(0.10)
PC_PACt*HHIt				-1.445
				(1.26)
HHIt	0.214	0.092	0.009	0.019
	(0.33)	(0.33)	(0.31)	(0.32)
Sizet	0.187***	0.200***	0.181***	0.187***
	(0.01)	(0.01)	(0.01)	(0.01)
ROAt	0.075	0.030	0.089	0.067
	(0.09)	(0.09)	(0.09)	(0.09)
Levt	-0.353***	-0.356***	-0.348***	-0.351***
	(0.07)	(0.07)	(0.07)	(0.07)
CAPXt	0.684***	0.688***	0.687***	0.703***
	(0.23)	(0.23)	(0.23)	(0.23)
Qt	0.091***	0.093***	0.090***	0.091***
	(0.01)	(0.01)	(0.01)	(0.01)
R&Dt	2.489***	2.470***	2.500***	2.470***
	(0.23)	(0.23)	(0.23)	(0.23)
PPEt	-0.148	-0.144	-0.145	-0.170*
	(0.09)	(0.09)	(0.09)	(0.09)
Aget	-0.004	0.006	-0.007	-0.010
	(0.02)	(0.02)	(0.02)	(0.03)
MKT Sharet	2.275***	2.427***	1.965**	1.846**
	(0.84)	(0.84)	(0.84)	(0.85)
IOt	0.457***	0.461***	0.461***	0.473***
	(0.06)	(0.06)	(0.06)	(0.06)
Constant	-0.948***	-1.014***	-0.910***	-0.884***
	(0.22)	(0.23)	(0.22)	(0.22)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44381	44381	44381	44381
Adj. R-Squared	0.27	0.27	0.28	0.28

TABLE 9: The Effects of Federal Grants on Corporate Innovation Productivity

This table reports the regression results of future corporate innovation productivity on federal grant awards, with the number of patents as the dependent variable in Model (1) and (3) and the number of citations per patent as the dependent variable in Model (2) and (4). Detailed variable definitions can be found in the Appendix. Year and industry (Fama-French 49 industry classification) fixed effects are included in all regressions. All standard errors are clustered at the firm level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1) Ln(Patent)t+1	(2) Ln(Cite)t+1	(3) Ln(Patent)t+1	(4) Ln(Cite)t+1
Grantt	1.091***	1.205***		
	(0.13)	(0.14)		
Ln(Grant)t			0.084***	0.092***
			(0.01)	(0.01)
Sizet	0.176***	0.203***	0.177***	0.204***
	(0.01)	(0.01)	(0.01)	(0.01)
ROAt	-0.057	-0.016	-0.060	-0.019
	(0.05)	(0.09)	(0.05)	(0.09)
Levt	-0.203***	-0.332***	-0.205***	-0.334***
	(0.04)	(0.07)	(0.04)	(0.07)
CAPXt	0.367***	0.574**	0.368***	0.575**
	(0.14)	(0.25)	(0.14)	(0.25)
Qt	0.070***	0.108***	0.071***	0.108***
	(0.01)	(0.01)	(0.01)	(0.01)
R&Dt	1.117***	2.301***	1.132***	2.319***
	(0.13)	(0.24)	(0.13)	(0.24)
PPEt	-0.050	-0.142	-0.049	-0.141
	(0.06)	(0.10)	(0.06)	(0.10)
Aget	0.043**	0.001	0.043**	0.002
	(0.02)	(0.03)	(0.02)	(0.03)
MKT Sharet	1.107*	1.796**	1.148*	1.843**
	(0.66)	(0.81)	(0.66)	(0.82)
IOt	0.040	0.432***	0.038	0.430***
	(0.04)	(0.06)	(0.04)	(0.06)
Constant	-0.978***	-0.977***	-0.985***	-0.986***
	(0.17)	(0.22)	(0.18)	(0.22)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	39678	39678	39678	39678
Adj. R-Squared	0.35	0.27	0.35	0.27

TABLE 10: The Effects of Political Connections on the Federal Grant Awards

This table reports the regression results of future federal grant awards on political connection measures. Panel A and B report regression results with a dummy variable of whether a firm received any federal grant award at time t+1 and the amount of federal grant received by a firm at t+1 as dependent variables, respectively. Detailed variable definitions can be found in the Appendix. Year and industry (Fama-French 49 industry classification) fixed effects are included in all regressions. All standard errors are clustered at the firm level and are reported in parentheses below the coefficient estimates. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A

	(1) Grantt+1	(2) Grantt+1	(3) Grantt+1	(4) Grantt+1
PCt	0.393***			
	(0.07)			
PC_Dirt		0.230***		
		(0.08)		
PC_Lobbyt			0.476***	
			(0.08)	
PC_PACt				0.355***
				(0.12)
Sizet	0.153***	0.179***	0.150***	0.167***
	(0.03)	(0.03)	(0.03)	(0.03)
ROAt	-0.753***	-0.834***	-0.752***	-0.811***
	(0.19)	(0.19)	(0.19)	(0.19)
Levt	-0.671***	-0.677***	-0.662***	-0.667***
	(0.22)	(0.22)	(0.21)	(0.22)
CAPXt	0.241	0.333	0.188	0.318
	(0.68)	(0.66)	(0.68)	(0.66)
Qt	0.026***	0.029***	0.025**	0.027***
	(0.01)	(0.01)	(0.01)	(0.01)
R&Dt	1.375***	1.321***	1.396***	1.336***
	(0.41)	(0.41)	(0.40)	(0.41)
PPEt	0.335	0.350	0.339	0.308
	(0.25)	(0.25)	(0.24)	(0.25)
Aget	0.056	0.063	0.052	0.055
	(0.05)	(0.05)	(0.05)	(0.06)
MKT Sharet	5.214***	5.230***	5.234***	5.022***
	(1.44)	(1.45)	(1.39)	(1.44)
IOt	-0.007	0.001	0.008	0.015
	(0.15)	(0.14)	(0.14)	(0.14)
Constant	-3.289***	-3.387***	-3.171***	-3.194***
	(0.33)	(0.33)	(0.32)	(0.33)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	38982	38982	38982	38982
Pseudo R-Squared	0.24	0.24	0.25	0.24

TABLE 10 (Continued)

Panel B

	(1) Ln(Grant)t+1	(2) Ln(Grant)t+1	(3) Ln(Grant)t+1	(4) Ln(Grant)t+1
PCt	0.202***			
	(0.04)			
PC_Dirt		0.193***		
		(0.06)		
PC_Lobbyt			0.373***	
			(0.07)	
PC_PACt				0.402***
				(0.12)
Sizet	0.071***	0.079***	0.065***	0.069***
	(0.01)	(0.01)	(0.01)	(0.01)
ROAt	-0.308***	-0.336***	-0.295***	-0.310***
	(0.08)	(0.08)	(0.08)	(0.08)
Levt	-0.157**	-0.159**	-0.153**	-0.154**
	(0.07)	(0.07)	(0.07)	(0.07)
CAPXt	0.161	0.180	0.160	0.177
	(0.19)	(0.19)	(0.19)	(0.19)
Qt	0.011**	0.012***	0.009**	0.011**
	(0.00)	(0.00)	(0.00)	(0.00)
R&Dt	0.680***	0.666***	0.691***	0.663***
	(0.21)	(0.21)	(0.21)	(0.21)
PPEt	0.088	0.092	0.093	0.064
	(0.09)	(0.09)	(0.09)	(0.09)
Aget	0.047*	0.054**	0.044*	0.040*
	(0.02)	(0.02)	(0.02)	(0.02)
MKT Sharet	2.892**	2.922**	2.839**	2.589**
	(1.28)	(1.27)	(1.25)	(1.28)
IOt	-0.138**	-0.133**	-0.132**	-0.120**
	(0.06)	(0.06)	(0.06)	(0.06)
Constant	-0.735***	-0.776***	-0.710***	-0.640***
	(0.17)	(0.17)	(0.17)	(0.16)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
No. of Obs.	44381	44381	44381	44381
Adj. R-Squared	0.06	0.06	0.06	0.06

TABLE 11: Robustness Check

This table reports robustness check results of the effect of political connection measures on future corporate innovation productivity. Panel A includes all three different types of political connections in the same regressions, with the number of patents and the number of citations per patents as the dependent variables in Model (1) and (2), respectively. Panel B reports the impact of the number of political connections on future corporate innovation productivity, with the number of patents and the number of citations per patents as the dependent variables in Model (1) and (2), respectively. Detailed variable definitions can be found in the Appendix. Year and industry (Fama-French 49 industry classification) fixed effects are included in all regressions. All standard errors are clustered at the firm level and are reported in parentheses below the coefficient estimates.***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Does the Type of Political Connections Matter?

	(1)	(2)
	Ln(Patent)t+1	Ln(Cite)t+1
PC_Dirt	0.079**	0.031
	(0.03)	(0.05)
PC_Lobbyt	0.249***	0.331***
	(0.04)	(0.05)
PC_PACt	0.212***	0.219***
	(0.06)	(0.07)
Sizet	0.152***	0.175***
	(0.01)	(0.01)
ROAt	0.046	0.110
	(0.05)	(0.09)
Levt	-0.208***	-0.345***
	(0.04)	(0.07)
CAPXt	0.461***	0.703***
	(0.13)	(0.23)
Qt	0.049***	0.089***
	(0.00)	(0.01)
R&Dt	1.292***	2.492***
	(0.13)	(0.23)
PPEt	-0.064	-0.161*
	(0.06)	(0.09)
Aget	0.027	-0.016
	(0.02)	(0.03)
MKT Sharet	0.787	1.454*
	(0.69)	(0.82)
IOt	0.067*	0.467***
	(0.04)	(0.06)
Constant	-0.850***	-0.844***
	(0.17)	(0.21)
Year FE	Yes	Yes
Industry FE	Yes	Yes
No. of Obs.	44381	44381
Adj. R-Squared	0.35	0.28

TABLE 11 (Continued)

Panel B: Does the Number of Political Connections Matter?

	(1) Ln(Patent)t+1	(2) Ln(Cite)t+1
PC1	0.069***	0.105***
	(0.02)	(0.04)
PC2	0.337***	0.437***
	(0.06)	(0.08)
PC3	0.763***	0.696***
	(0.11)	(0.12)
Sizet	0.153***	0.176***
	(0.01)	(0.01)
ROAt	0.038	0.103
	(0.05)	(0.09)
Levt	-0.207***	-0.345***
	(0.04)	(0.07)
CAPXt	0.490***	0.731***
	(0.13)	(0.23)
Qt	0.049***	0.090***
	(0.00)	(0.01)
R&Dt	1.278***	2.477***
	(0.13)	(0.23)
PPEt	-0.065	-0.162*
	(0.06)	(0.09)
Aget	0.028*	-0.016
	(0.02)	(0.02)
MKT Sharet	0.566	1.261
	(0.69)	(0.83)
IOt	0.079**	0.477***
	(0.04)	(0.06)
Constant	-0.826***	-0.830***
	(0.17)	(0.21)
Year FE	Yes	Yes
Industry FE	Yes	Yes
No. of Obs.	44381	44381
Adj. R-Squared	0.35	0.28