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Xunan Feng
Southwestern University of Finance and Economics

Anders C. Johansson
Stockholm School of Economics

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Xunan Feng
Southwestern University of Finance and Economics

Anders C. Johansson[1]
Stockholm School of Economics

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[1] Corresponding author, Stockholm School of Economics, P.O. Box 6501, SE-113 83 Stockholm, Sweden. Email: anders.johansson@hhs.se. Xunan Feng acknowledges financial support from National Natural Science Foundation of China (71672147). The authors thank participants at the 2017 Conference on Entrepreneurship, Innovation and Development in Beijing, organized by Stockholm China Economic Research Institute, Stockholm School of Economics and National School of Development, Peking University, for comments and suggestions. We especially want to thank Loren Brandt, Belton M. Fleisher, and Miaojie Yu for valuable comments.

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Abstract

We hypothesize that political uncertainty has an adverse effect on investments in activities related to innovation. Combining two hand-collected data sets on changes in local government officials and research and development (R&D) activity at the firm level in China, we examine how political turnover influences investments in R&D. We find that a change in local political leaders is associated with a significant decrease in R&D activity. This result is robust to various robustness tests. The decrease is larger when the new political leader is promoted from outside the city in question. Moreover, the decrease is significantly larger for privately controlled firms, firms operating in regions characterized by weak economic institutions, and firms within R&D-intensive industries. Our findings suggest that political uncertainty constitutes an important channel through which the local political process influences activities related to innovation.

JEL Classification: G18; G32; G38; O30; O31; O32
Keywords: Innovation; R&D expenditures; Political turnover; Political uncertainty; Local officials; China

1 Introduction

How politics influence firm behavior and economic outcomes is an issue that has captured the interest of researchers and been at the center of public debate for a long time. Political events such as a change in political leadership bring with them uncertainty, which in turn may have adverse effects on economic activity. While previous studies have highlighted how political uncertainty may affect overall macroeconomic activity and general corporate investment policies, there is still scant research on how political change and uncertainty associated with such change influence activities related to innovation at the firm level.

This study helps fill this void in the literature by examining how political uncertainty resulting from a change in local political leadership affects investments into R&D-related activity at the firm level in China. The effects of political uncertainty are important as political decisions have direct effects on firms' operations. China constitutes an especially interesting and relevant case for the analysis of local political uncertainty. In contrast to many other transition and developing countries, local officials have been shown to constitute a major factor behind regional economic growth in China. It has been argued that decentralization and fiscal incentives since the beginning of the economic reforms have resulted in the ability and incentive for local officials to promote growth in their respective region (e.g. Montinola et al., 1995; Lin and Liu, 2000; An et al., 2016). Jin et al. (2005) find that stronger fiscal incentives at the local level in China are associated with faster development of the private sector and reform of the state sector, developments that have likely functioned as drivers behind increased local economic growth. In addition, previous studies have argued that local officials have been promoted based on their performance, a process that has developed

a competitive environment in which local economic growth has been of primary importance (e.g. Chen et al., 2005; Li and Zhou, 2005; Maskin et al., 2000). Local governments and officials in China have a high level of autonomy in their decision making (Qian and Xu, 1993), suggesting that they constitute important factors when local firms conduct their business activities. As noted by An et al. (2016), while local officials may provide strong support to firms that operate in their regions, the time at which they leave their office may be characterized by a significant increase in political uncertainty.

In addition to the importance of local officials for local economic activity, the process through which government and party officials are selected differs significantly from that in democratic countries. In China, local leaders are selected by officials higher up the ladder in a process that is far from transparent. Moreover, the change of local leaders can take place at any time, a fact that further increases the potential for political uncertainty. Political turnover at the local level in China therefore provides a unique and suitable quasi-natural experiment framework for the study of how politics influence activities related to innovation.

A large literature on political or policy uncertainty and different forms of investments is based on the premise that firms hold off on their investments if they ascertain that future policies may have a detrimental effect on their business. Real options models have established this relationship by focusing on how capital irreversibility and uncertainty results in a positive option value of deferring investments (e.g. Bernanke, 1983; McDonald and Siegel, 1986). Studies that look at the political environment and aggregate investments have shown this to be the case. For example, Rodrik (1991) models policy uncertainty and its detrimental effects on investment,

focusing primarily on policy reforms and reversals in developing countries. There are also several studies on the aggregate level that support the negative relationship between political uncertainty and investments. Barro (1991) and Alesina and Perotti (1996) show that political instability is associated with cross-country differences in aggregate investment levels. Similarly, Pindyck and Solimano (1993) and Mauro (1995) find that political uncertainty is negatively associated with aggregate investments. However, and as noted by Julio and Yook (2012), analyzing the relationship between political uncertainty and aggregate investments is not without difficulties, as it can be questioned whether measures for political instability are exogenous to macroeconomic conditions and aggregate investment levels. Empirical studies at the firm level are mostly in favor of the conjecture that political uncertainty is detrimental to investments. Using cross-country data sets, Julio and Yook (2012) and Jens (2016) document significant declines in corporate investments that coincide with national elections. Focusing instead on economic policy, Baker et al. (2016) develop a new index for economic policy uncertainty and show that policy uncertainty is related to reduced investments at the firm level. Gulen and Ion (2016) use the same index to show that the aggregate level of uncertainty is negatively associated with corporate investments and that the relationship varies depending on the level of corporate investment irreversibility and dependency on government spending. In a study that relates to ours, An et al. (2016) find that political uncertainty in the form of changes of government officials in China is tied to decreases in overall corporate investment.

But do all types of corporate investments relate to political uncertainty in the same way? More importantly for this study, is political uncertainty detrimental to activities related to innovation, such as R&D expenditures? As noted by Atanassov et al. (2015),

R&D is an example of irreversible capital that is characterized by very costly adjustments. However, they also argue that the type of uncertainty is important. For example, Pindyck (1993) and Bar-Ilan and Strange (1996) have shown that project-specific factors such as the level of difficulty to complete a project or to estimate the duration of it induce firms to initiate R&D activities sooner rather than later. Bloom and Van Reenen (2002) also point out that firms may look favorably at taking on new R&D investments more quickly as they may result in new patents, which in effect means that at least part of the initial investment can be recovered. Atanassov et al. (2015) also point out that investments in R&D cannot be separated from strategic considerations. Along these lines, Weeds (2002) develops a real options model that includes competition in R&D, which shows that early investments may be more beneficial than the decision to the delay.

Empirical studies on the relationship between political uncertainty and innovation activities are not conclusive. Atanassov et al. (2015) focus on political uncertainty resulting from U.S. gubernatorial elections. They find that uncertainty over future policy is positively associated with firm-level R&D. They also show that this relationship is stronger in industries characterized by difficulties to innovate and a higher degree of political sensitivity, after hotly contested elections, for firms that are subject to higher growth options, and firms that face fiercer market competition. Compared to their study, there are at least two advantages of our empirical analysis. First, by proxying political uncertainty with political turnover, we can conduct a quasi-experimental analysis using exogenous shocks. Not only is there an uncertainty associated with incoming government officials, but the timing of political turnovers at the local level in China is known only to a select few higher up in the political chain.

In addition, local political leader turnover is often driven by considerations higher up in the political hierarchy rather than the general economic conditions. Thus, the potential issue of reverse causality is reduced. Second, as changes of government and party officials take place at different points in time across cities, we are better able to alleviate endogeneity concerns and confirm the relationship between political uncertainty and R&D investments.

In contrast to Atanassov et al. (2015), we find that political uncertainty is negatively associated with R&D expenditures. There is a significant decrease in R&D-related investments coinciding with a change in local political leadership. This result holds up when we combine changes in city Mayor and Secretary of the Chinese Communist Party (CCP). This result holds up when we test for Party Secretary changes only, as well as for several alternative measurements for R&D investments. We also collect data so that we can divide events into expected and unexpected political turnovers. By doing so, we can show that the decrease in R&D expenditures becomes more pronounced for firms experiencing an unexpected political turnover in their city. We also find that an outside official being promoted further decreases R&D expenditures, suggesting that an incoming political leader from out of town represents a higher degree of political uncertainty. We then analyze how ownership influences the relationship between political uncertainty and R&D expenditures. We show that the detrimental effect of political uncertainty on R&D-related activities is much stronger for privately controlled firms. We believe this result can be explained by the likelihood that new local political leaders have to continue supporting state-owned enterprises (SOEs) when they take up their new position immediately, leaving such firms much less vulnerable to political uncertainty.

In addition to personal and firm-specific characteristics such as government officials' origin and firm ownership, we also investigate the potential impact of local institutions. More specifically, we find that the effect of political uncertainty due to political turnover is driven by economic institutions at the local level. In regions characterized by weaker economic institutions, the negative relationship between political uncertainty and R&D-related activities at the firm level is significantly stronger. Finally, we examine if industry-specific characteristics are important. We provide evidence that R&D expenditures in firms that operate in industries characterized by higher R&D intensity are significantly more sensitive to political uncertainty.

This study makes several important contributions to the literature. First, the fact that the timing of local political turnover in China is difficult to foresee combined with the variation across cities means that we are better able to identify a causal effect between political uncertainty affects R&D-related activities. Second, we contribute to the literature on how political institutions affect real economic activities, especially in the context of China. Third, we help improve the understanding of influential drivers behind corporate innovation. There are numerous studies that link innovation to a wide range of factors.[2] However, except for a few studies including that of Atanassov et al.

[2] These factors include board and ownership structure (Baysinger et al., 1991); corporate strategy (Baysinger and Hoskisson, 1989, and Hoskisson and Hitt, 1988); firm age (García-Quevedoa et al., 2014); internal finance (Himmelberg and Petersen, 1994); external finance (Hall, 2003, and Brown et al., 2009); CEO-specific characteristics (Barker and Mueller, 2002, and Hirshleifer et al., 2012); top management and board composition (Kor, 2006); tax and government funding (Guellec and Van Pottelsberghe, 2003, and Falk 2006); shareholder protection and stock market financing (Brown et al., 2013); institutional

(2015), political factors have largely been ignored in this literature. Our findings thus have important implications for understanding a key factor that influences innovation at the firm level. Fifth, we add clarity to what drives R&D-related activity in China. To the best of our knowledge, we are the first to analyze the relationship between political uncertainty and firm-level R&D activity in China.

The remainder of this paper continues as follows. Section 2 develops the working hypotheses and empirical predictions. Section 3 introduces the three different data sets that are used in the empirical analysis and provides summary statistics for each of them. Section 4 first presents the results from our baseline estimations. We then present initial robustness tests that lend support to the initial results. The rest of the section then expands on the initial findings and provide answers to the remaining working hypotheses that focus on potential drivers behind the relationship between political uncertainty and innovation. Finally, Section 5 concludes the paper.

2 Hypothesis Development

The value of an investment is affected by uncertainty over future cash flows. As a result, the value of waiting to invest increases as uncertainty grows. There are a variety of potential sources of uncertainty that may affect the value of an investment, not the least political uncertainty. As noted by Bernanke (1983) and Julio and Yook (2012), the so-called bad news principle means that investments will be affected only if there is a likelihood of a bad outcome. For some political events, this may not be the case, which

ownership (Graves, 1988); the merger and acquisition market (Phillips and Zhdanov, 2013, and Bena and Li, 2014).

means that the event will not result in a significant impact on investment choices. In other cases, a change in political leadership may turn out to have a large impact on investments as firms become uncertain about future policies. We hypothesize that, in the case of China, the change of political leaders can be regarded as a typical case of the bad news principle. Julio and Yook (2012) note that outcomes in political elections are relevant to firm decisions as limited terms means that political leaders may be replaced by leaders with different policy preferences. The same reasoning should hold for local political leaders in China, suggesting that new leadership at the city level brings with it an uncertainty in future economic policy. In addition, previous studies have shown that political connections in China can bring with it important advantages such as preferential treatment and can thus, as a result, have a significant impact on firm value in China (e.g. Li et al., 2008; Su and Fung, 2013; Feng et al., 2014, 2016; Feng and Johansson, 2014). A change in a city's political leadership means that there is a risk that how firms are treated by the local government will change, thus adding to the political uncertainty for firms operating in that city. We therefore expect political turnover at the provincial level to be linked to a decline in innovation activity.

While the exact timing of political turnover at the city level is unknown to the public, observers can in some cases identify periods in which it is more or less likely for a turnover to occur. For example, if a political leader reaches the retirement age of 60, he or she is naturally less likely to remain in office for long. Moreover, if a local political leader is not near to retirement age, he or she is likely to sit for one or two terms (five or ten years, respectively). It is thus possible to ascertain whether a sitting political leader is more or less expected to remain in his or her position and for how long. Turnovers that do not follow these patterns, on the other hand, are likely perceived

as bringing with them an even higher level of political uncertainty. We therefore expect the impact political uncertainty has on innovation activity to be larger for firms experiencing an unexpected political turnover compared to if that political turnover was expected.

If the initial hypothesis that political turnover is linked to a change in R&D activity, it is also likely that where the incoming leader is coming from is important. If the newly appointed leader is promoted from within the city, it is likely that the level of political uncertainty is lower. Conversely, if the newly appointed political leader is promoted from the outside, we expect the level of political uncertainty to increase, which in turn will have a more severe effect on R&D activity.

Another factor that may influence the relationship between political uncertainty and firms' investment in innovation is ownership. We see several potential reasons for why political uncertainty may be perceived differently depending on whether a firm is privately or state owned in China. First, it is common knowledge that SOEs obtain preferential treatment in many ways, for example when it comes to access to finance (e.g. Brandt and Li, 2003; Feng and Johansson, 2015). It is likely that a change in political leadership at the local level will not have a dramatic effect on how SOEs operate. Second, it is likely that SOEs are less likely to be sensitive to temporary increases in political uncertainty due to facing policy burdens, soft budget constraints, and the "investment hunger" problem (e.g. Lin et al., 1998; Lin and Li, 2008; Lin and Tan, 1999; Xu and Zhang, 2008; Johansson and Feng, 2016). For example, Liu and Siu (2011) find that ownership is a primary institutional factor that influences corporate investment in China. Third, political connections are more important for private firms,

as SOEs are still receiving preferential treatment in various forms.[3] They therefore need to build new relationships with new local officials and this takes time. Before such a relationship exists, a logical choice for many private firms would be to decrease long-term investment and wait. We therefore conjecture that investments in innovation by privately controlled firms will be more sensitive to political uncertainty compared to similar investments made by SOEs.

Next, we conjecture that local economic institutions constitute a potential driver behind the relationship between political uncertainty and investments. It is generally acknowledged that firms operating in China are exposed to various institutional constraints, such as discriminatory practices by financial institutions, policy and tax distortions, and the risk of expropriation by the government (Fan et al., 2013, 2014; Liu and Siu, 2011; Feng and Johansson, 2014). As argued by Feng and Johansson (2014), it is likely that financial policies by Chinese firms are influenced by the quality of institutions in the region in which they operate. Subsequently, if a political turnover takes place in a region characterized by weak economic institutions, the political risk due to the change in political leadership may be amplified by these weak institutions. We therefore expect the negative effect of political uncertainty on investments in innovation to be dependent on the quality of local economic institutions.

Finally, it is likely that the sensitivity of investments in innovation to political uncertainty is dependent on the level of R&D intensity of the firm. We therefore

[3] For example, Johansson and Feng (2016) show that political connections constitute one way for privately controlled firms to obtain access to financing at a level closer to that of SOEs.

hypothesize that firms in industries characterized by high average R&D expenditures are more adversely affected by political uncertainty.

3 Data

3.1 R&D Expenditures

This study focuses on Chinese listed firms' investments into R&D-related activities during the period 2007-2015. Our sample starts in 2007 because the data we need for the empirical analysis is readily available from that year due to the implementation of new information disclosure regulations (i.e. Accounting Standards for Enterprises No.6 – Intangible Assets that was issued by the Ministry of Finance in 2006 and came into effect on 1 January 2007). We gather all data on R&D by hand, as information on R&D expenditures appears in different parts of annual reports in China. This information appears in three separate sections in Chinese annual reports: (i) items labelled "research and development expenses", "technology development", and others in the notes to the financial statements; (ii) items labelled "development expenditures" in the notes to the balance sheets (including opening amount, closing amount, current increase, current decrease, research or development stage, and so forth); (iii) information provided in the management discussion and analysis. We collect and combine all this information for each firm and year. Panel A in Table 1 presents summary statistics for R&D expenditures and the variables we use to examine determinants of R&D expenditures in the empirical analysis. Column 1 shows the total number of firm observations in each year. The total number of observations for the whole period is 12,714. Column 2 displays the average annual R&D expenditures

across all firms in Renminbi (RMB). Columns 3 to 5 then presents the average for the alternative measures we use for R&D expenditures: R&D/Sales, the ratio of R&D to total sales; R&D/Profits, the ratio of R&D to net profits; R&D/Assets, the ratio of R&D to total assets.

Panel B in Table 1 displays the distribution of R&D expenditures and the R&D variables we use in the empirical analysis across industries. We use the China Securities Regulation Commission classification for industries and find that 7,794 or over half of firm observations in our sample are within the manufacturing category. No other industries have more than 1,000 firm observations and a few industries such as Education, Leasing and commerce services, and Hotel and catering have less than 100 firm observations. As expected, the variation in average R&D expenditures for firms across industries is significant. For example, R&D/Sales vary from a low 0.001% for Hotel and catering up to 1.487% in the Information transmission, software and information technology services.

[TABLE 1 HERE]

3.2 Political Turnovers

We collect information on the change in the political positions at the city level from a variety of public sources, including newspapers and online search engines. In this study, we include both prefecture-level cities (*dijishi*) and direct-controlled municipalities (*zhixiashi*). It could be argued that the municipality Beijing, being the political center of China, constitutes a special case and that firms located there may be

affected differently by political turnovers compared to firms in other cities. In addition, it is possible that firms located in any of the four municipalities (Beijing, Chongqing, Shanghai and Tianjin) are affected differently by political turnovers as they are all controlled directly by the central government and not a provincial government. To take these issues into account, we first run estimations in which we include all cities and municipalities. We then run separate estimations in which we first drop firms located in Beijing and then firms located in any of the four municipalities from the sample. The results in these robustness tests remain qualitatively the same and we do not include these additional estimation results to conserve space. To quantify political turnover, we identify a change in Mayor or Party Secretary. Panel A in Table 2 shows the number of changes of city Mayors or Party Secretaries during 2007-2015. During this period, a total of 4,409 political turnovers took place at the city level. Comparing this to the data we have on listed firms throughout the sample period, we see that it amounted to 34.678% of total firm observations. We then identify in the city where the headquarter of each firm is located and match the respective firm to a change in political leadership.[4] In Panel B of Table 2, we link political turnovers to industries. The last column in Table 2 shows that the event of a political turnover is spread out relatively even across industries, with a few industries being relatively underrepresented (e.g. Education).

[TABLE 2 HERE]

[4] As a robustness check, we also identify the city in which a firm has its main operations. The results when doing so remain very similar to our original findings. We do not report these additional tests for the sake of brevity.

To examine how R&D expenditures compare between firms that experience a change in political leadership in their home city and firms that do not in a specific year, we divide the sample into two groups. The Turnover group refers to the sample which includes a firm observation if the Party Secretary or Mayor of the city where the firm's headquarter is located is changed in year *t*.[5] If this event does not occur in that year, the firm instead belongs to the non-turnover group. Table 3 show the average R&D expenditures in absolute value as well as the three R&D expenditure measures that we will use in the empirical analysis. To compare R&D expenditures in the two groups, we perform simple T-statistics for group differences. The results, presented in the last column of the table, show that firms in the group that faced a political turnover in their home city were characterized by significantly lower R&D expenditures on average. This simple test provides initial signs of political turnover being associated with a lower level of R&D activity.

[TABLE 3 HERE]

[5] We do not consider the specific time of the change in local political leadership here. In fact, if the change of Party Secretary or Mayor takes place during the second part of year *t*, R&D activities in year *t* may be less affected. Thus, the definition is this study bias against our findings. To check the effect this may have on our results, we redefine turnover as the change of Party Secretary or Mayor taking place during January to June in year *t* or during July to December of year t-1. When doing this, our results remain qualitatively the same. We do not report this alternative definition to save space.

3.3 Firm Data

We first collect data for all listed A-share firms on China's stock exchanges during the period in question and then delete observations for a number of firms to avoid potential firm-specific issues. First, we delete firms controlled by the central government, as it is likely that they are not affected by changes in local political leadership. Next, we delete firms with negative equity or earnings, firms within the finance industry, and firms with missing data for any of the control variables. We are left with a total of 12,714 firm observations throughout the sample period.

Table 4 displays summary statistics for the variables used in the empirical analysis. The first four rows present each of the alternative measures for R&D expenditures defined in Section 3.1. The remaining variables are the control variables used throughout the analysis and include: *Turnover*, a dummy variable which equals one if the Party Secretary or Mayor of the city where the firm's headquarter is located, changes in year t and zero otherwise; *Size*, defined as the natural logarithm of total assets of firm i at the beginning of year t; *Tobin's Q*, calculated as the ratio of the sum of the market value of equity and the book value of liabilities to the book value of assets at the beginning of year t. *Leverage*, measured as the ratio of total liabilities to total assets at the beginning of year t. *ROE*, measured as net profits divided by total equity at the beginning of the year t. *Cash*, measured as the ratio of cash and cash equivalents to total assets at the beginning of year t; *Largest Ownership*, defined as the percentage ownership by the largest shareholder; *Non-SOE*, a dummy variable which equals one if the firm is ultimately not controlled by one or several government bodies, or government-controlled firms, and zero otherwise.

[TABLE 4 HERE]

4 Political Uncertainty and R&D Activity

This section presents our empirical results related to political uncertainty and firm-level R&D activity. We first begin with a baseline multivariate regression and then complement that initial estimation with an alternative model specification with firm-fixed effects to partially control for endogeneity. After that, we run placebo tests in which we examine at alternative dates of political leadership changes at the city level as well as robustness tests based on alternative definitions of political turnover. Finally, we look at factors that may affect the relationship between political uncertainty and R&D expenditures, including whether the promoted political leader comes from the city where he or she is promoted, state ownership, local institutions, and R&D-intensive industry belonging.

4.1 Baseline Results

We start the empirical analysis by investigating how political uncertainty influences R&D activity. To do this, we use the following model specification to evaluate changes in R&D expenditures that are not fully explained by standard firm-specific explanatory variables:

$$I_{it} = \alpha + \beta_0 Turnover_{it} + \beta \mathbf{x}_{it} + \gamma \mathbf{z}_i + \varepsilon_{it}, \quad (1)$$

where i indexes firm, and t indexes year. Here, I_{it} is one of the measures of R&D expenditures for firm i in year t which is introduced in Section 3.1 and $Turnover_{it}$, the explanatory of interest, is the variable for political turnover explained in Section 3.3. In addition, $\mathbf{x}_{it}$ is a vector of the additional control variables introduced in Section 3.3, $\mathbf{z}_i$ is a vector of fixed effects (year, industry, and city effects). We cluster standard errors by firm throughout the paper (Petersen, 2009). Since the political turnover data are collected at the city level, we can also cluster the standard errors at the city level and control the firm fixed effect in the robustness test. When we do this, the results remain qualitatively the same throughout the study.

Table 5 reports the results of our baseline estimation. For the sake of brevity, we focus on two alternative specifications for R&D expenditures: *R&D/Sales(%)* and *R&D/Profits(%).* Throughout the paper, we multiply *R&D/Sales* and *R&D/Profits* by 100 before running the estimation. For example, if *R&D/Sales* = 0.02 then *R&D/Sales(%)* = 2. Here, R&D/Sales is defined as the ratio of R&D over total sales at year t. R&D/Profits is defined as the ratio of R&D over net profits at year t. Columns 1 and 2 thus report the results for *R&D/Sales(%)* and *R&D/Profits(%)* as the dependent variable, respectively. We find the R&D expenditures is negatively associated with political turnover for both measures of R&D expenditures. The decrease in conditional R&D expenditures is 0.025 for *R&D/Sales(%)* and 0.417 for *R&D/Profits(%).* This result indicates that local political turnover decreases 0.025 % of R&D/Sales and 0.417% of R&D/Profits, respectively. The coefficients for the political turnover variable are statistically significant at the 5% and 1% level, respectively. Because a firm's R&D expenditure may be zero, we also re-estimate the regressions using a probit model. When we do this, the main results remain qualitatively the same. For robustness, we

also delete the sample with zero R&D, after which the results remain unchanged. We do not report these tables for brevity. To sum up, political uncertainty is thus detrimental for investments in innovation at the firm level: firms experiencing an increase in political uncertainty because of a sudden change in local political leadership hold off on investments in innovation.

[TABLE 5 HERE]

4.2 Robustness Checks

While we include multiple control variables in the baseline estimation, unobservable firm-related factors may still pose a problem. We therefore use a firm-level fixed-effect model to alleviate potential endogeneity issues.[6] The results of these new estimations are presented in Table 6. While somewhat smaller, the coefficients for the political turnover variable are still negative and significant in both model specifications. For *R&D/Sales(%)*, the Turnover coefficient is significant at the 10% level, and for *R&D/Profits(%)*, it is significant at the 1% level. These results lend

[6] It should be noted that including firm-level fixed effects merely controls for static firm effects, not time-varying effects. So, while we address potential reverse causality issues using a firm-level fixed effect approach, it does not alleviate potential issues of changes that occur over time.

support to our initial finding that political uncertainty is negatively related to R&D expenditures.

[TABLE 6 HERE]

Next, we consider the possibility that there is nothing unusual about the years of political turnovers or that there exists some type of time trend in the data that we do not cover fully when using the year fixed effects. Using a procedure similar to that of Julio and Yook (2012), we assume that the political turnover instead takes place in one of the four years surrounding the year of an actual political turnover, i.e. in [-2,2]. We then design four simulated dummy variables for each of these years. If the political turnover variable we used in the previous section indeed does not capture what we have assumed it does, we can expect the simulated political turnover variables to be significant in our new estimations.

The results from these placebo tests are presented in Table 7. The regression models we use are the same as in Equation (1). However, to conserve space, we only report the coefficient for the simulated political turnover variable. As shown in the table, the simulated political turnover variable is very small and insignificant in all four placebo tests. These results indicate that the variation in R&D expenditure indeed is tied to the actual time of political turnovers in the city in question and not some form of underlying trend in the data.

[TABLE 7 HERE]

Another potential issue is the political turnover variable itself. So far, we have simply used changes in both Mayor and Party Secretary at city level throughout the sample period. However, it could be argued that this is not the best measure of political uncertainty at the local level, as the positions differ in importance. In China's political system, the leader of the Party has more influence than the administrative counterpart at the same level (Zhong, 2003). At the city level, this corresponds to the Party Secretary having more power than the Mayor. This means that a change of a city-level Party Secretary is potentially more challenging to local firms compared to a change in the Mayor in that same city. We test if this institutional feature in the political system influences our baseline results by ignoring the changes to city Mayors and instead defining the political turnover variable as a dummy variable which equals 1 if there is a change in the position of city Party Secretary in a specific year and zero otherwise. Table 8 presents the results of the new estimations using the alternative political turnover variable. Focusing on the key explanatory variable, the coefficient for political turnover is still negative and significant, this time at the 1% level for both R&D/Sales*(%)* and R&D/Profits*(%)*. We can therefore conclude that the initial relationship that we identified between political uncertainty and R&D expenditures was not only driven by the inclusion of changes of city Mayors in the key explanatory variable.

[TABLE 8 HERE]

Besides the measure for political uncertainty, another potential issue is how we measure R&D activity. We therefore carry out robustness tests in which we use two alternative measures for firm-level R&D expenditure: *R&D/Assets(%)* and

Log(R&D+1), respectively. We then run the baseline regression with each of these two as dependent variables. The results of these regressions are displayed in Table 9. The coefficient for the explanatory variable of interest, Political Turnover, remains negative and significant for the two alternative measures of R&D activity. These results support the baseline results, suggesting that the initial results were not driven by the choice of R&D activity measure.

[TABLE 9 HERE]

So far, we have based our analysis on the assumption that the timing of political turnovers at the local level typically is known only to a select few higher up in the political chain. However, it could be argued that certain types of political turnover may be expected. For example, Party Secretaries and Mayors often retire at the age of 60. Firms could anticipate this type of natural turnover and change their R&D investments accordingly. While this phenomenon on the Chinese political turnover process is interesting, we believe that it biases against our findings due to the following reasons. First, if certain political turnovers can be expected, firms would most likely end up reducing their R&D investments ahead of the change. Second, even if firms can anticipate when political leaders will step down, it is difficult for them to anticipate who will assume power. Our focus is on how political uncertainty affects innovation, which means that incoming political leaders are more important. To be certain that expected turnovers do not affect our results, we run new tests in which we include the age and tenure of local political leaders in the regressions. The results remain qualitatively the same and we therefore leave them out for brevity.

To fully examine the potential impact of expected political turnovers, we also run an empirical analysis. We first divide the sample into two groups of firms characterized by having their operations in a city with expected turnover or non-expected turnover, respectively. Here, expected turnover refers to the Party Secretary or Mayor retiring at the age of 60 or remaining in the same position for five or ten years (one or two consecutive terms).[7] Unexpected political turnovers thus include the remaining observations. In the political turnover sample, expected political turnover make up 31.57% of the total observations. Table 10 presents the regression results for expected and unexpected turnover and R&D investments. The coefficients for unexpected turnover are negatively significant at the 1 percent level. The coefficients for expected turnover, on the other hand, are much weaker. Moreover, unreported *F*-statistics show that the coefficient of expected turnover is significantly smaller than that of unexpected turnover. We can therefore conclude that unexpected changes in local political leadership are negatively associated with investment in innovation-related activities.

[TABLE 10 HERE]

4.3 Factors Influencing the Relationship between Political Uncertainty and Innovation

Having established that political uncertainty is negatively and significantly associated with R&D activity, we now turn to potential drivers behind this relationship.

[7] Political leaders in China are elected for a term of five years with a limit of two consecutive years.

First, we take a closer look at where the newly appointed leader comes from. As mentioned earlier, if the newly appointed political leader is promoted from the outside, we expect the effect that political uncertainty has on R&D activity is more severe. To test this hypothesis, we run the same regression again, this time adding an interaction variable for political turnover and a dummy variable that is equal to 1 if the appointed leader comes from another jurisdiction and zero otherwise.

The new results are presented in Table 11. Looking first at the main explanatory variable, political turnover, we see that it is still negative and significant, albeit only at a 10% level in the estimation for *R&D/Profits(%)*. Focusing instead on the interaction variable, it turns out to be negative and significant for both measures of R&D activity. For *R&D/Sales(%)*, the coefficient for *Turnover*Other Jurisdiction* is significant at the 5% level, and for *R&D/Profits(%)*, it is significant at the 1% level. These results support the hypothesis that an incoming political leader from outside the city in which a firm operates constitute a higher level of political uncertainty compared to if the political leader was promoted within the city's political ranks.

[TABLE 11 HERE]

Firm ownership is likely to have a significant influence on the relationship between political uncertainty and R&D activity. Our hypothesis in Section 2 suggests that firms controlled by one or several state entities are likely to be less affected by a political turnover. To test this, we first classify all firms in the sample into SOEs and non-SOEs. We then run new regressions in which we include an interaction variable between political turnover and a dummy variable that is equal to 1 if the firm is not

controlled by the state and 0 otherwise. The results of the new regressions are displayed in Table 12. This time, the coefficient for political turnover, while still negative, is no longer significant in the estimation for *R&D/Sales(%)*. In the estimation for *R&D/Profits(%)*, it is still negative and significant at the 5% level. Turning instead to the interaction variable, it turns out that ownership is an important driver behind the effect of turnover. The interaction variable is negative and significant at the 1% level in both cases. This suggests that privately controlled firms are much more affected by the political uncertainty stemming from a change in local political leadership compared to their state-controlled counterparts.

[TABLE 12 HERE]

Next, we examine the potential role of local institutions. Recollecting the discussion in Section 2, our work hypothesis is that local institutions can act as a driver of the effect political uncertainty has on innovation. To analyze this, we add the interaction variable for political turnover and local institutions to the baseline regression model. We use the National Economic Research Institute (NERI) Index of Marketization as a proxy for local institutions (Wang et al., 2007). It measures provincial progress towards a market economy relative to the progress in other provinces. The NERI index, which is based on 23 indicators of institutional arrangement, has been used extensively in studies within economics, finance, and business (e.g. Du et al., 2008; Chen et al., 2009; Li et al., 2011; Feng et al., 2014; Feng and Johansson, 2017). We divide the sample into two groups, one with firms located in regions characterized by a higher NERI index and one with firms located in regions

with a lower index. We then create a dummy which equals 1 if the firm belongs to the group with weaker market institutions and 0 otherwise.

Table 13 presents the results of the new estimations. The coefficient for political turnover remains negative and significant, even though the significance level is somewhat lower in the regressions for both measures of R&D activity. More importantly, the interaction variable for turnover and the dummy variable for low quality of market institutions is negative for both R&D measures. Moreover, the coefficient for the interaction variable is significant at the 1% level in both regressions, which indicates that institutions should be taken into consideration when analyzing the relationship between political turnover and R&D expenditures. To examine the robustness of these results, we also use property rights protection as an alternative proxy for local institutions. We use a World Bank (2006) survey that focuses on China's larger cities to divide the sample into two groups based on whether their headquarters are in cities with relatively lower levels of property protection. Similar to Feng et al. (2014), we also use provincial GDP per capita as a rough proxy for institutions.[8] Our results remain qualitatively the same using all three measures for local institutions. To sum up, local institutions drive the negative effect political uncertainty has on innovation activity for firms at the city level in China.

[TABLE 13 HERE]

[8] Treisman (2000) shows that economic development has a causal effect on corruption, suggesting a link between GDP per capita and institutional quality.

Finally, we examine the role of R&D intensity. Earlier, we conjectured that R&D intensive firms may be more adversely affected by political uncertainty, as political risk may turn out to have a significantly larger impact on future revenues from current investments in innovation-related activity. To analyze this, we divide the firm sample into two groups based on R&D intensity in the industry in which they operate. Here, R&D intensity is defined as the ratio of total R&D over total sales in the industry.[9] We then create a dummy variable which equals 1 if the firm operates in an industry that is characterized by a higher level of R&D activity and 0 otherwise. Like the analysis in the previous sections, we extend the baseline regression by including an interaction variable for political turnover and industry R&D intensity.

Table 14 displays the results for the new estimations. Political turnover is negative and significant, again with somewhat lower significance levels compared to the baseline regression results in Section 4.1. The interaction variable for political turnover and R&D intensity is negative and significant. The coefficient for both measures of R&D expenditures is significant at the 1% level, suggesting that the effect that R&D intensity has on the relationship between political turnover and R&D expenditures is nontrivial. We can thus conclude that innovation-related activities in high R&D firms are more adversely affected by increased political uncertainty.

[TABLE 14 HERE]

[9] For robustness, we also run regressions in which we use the 2016 patent intensive industry catalogue to classify industries' R&D intensive industry (http://www.gov.cn/xinwen/2016-10/28/content_5125650.htm). The results remain qualitatively the same and are left out for brevity.

5 Conclusion

This study investigates the relationship between political uncertainty and innovation among Chinese firms. We document that firms' R&D expenditures tend to be lower during years of change in political leadership in the cities where the firms' headquarters are located. This result is robust to various definitions for the key dependent and explanatory variables. Additional placebo tests confirm that it is the timing of political turnover that is associated with a reduction in R&D expenditures. These findings contrast those of a recent study on U.S. firms, which suggests a positive rather than negative relationship between political uncertainty and R&D activity. Our results are instead in line with studies on general corporate investments and political uncertainty, which have shown that firms tend to be more cautious by holding back on investments during periods of increases in political uncertainty.

We also analyze potential drivers behind the relationship between political uncertainty and innovation activity. We find that whether the political leader is promoted within or from the outside, state or private ownership type, local economic institutions, and R&D intensity all influence how much political uncertainty affect R&D activity among Chinese firms.

Our findings support the primary hypothesis that we put forward, namely that politics matter for firms' decision to invest in innovation. Moreover, our study adds to the literature on uncertainty and R&D activity by lending empirical evidence on how politics at the local level in an authoritarian regime affect firms' will to invest in innovation-related activities. Previous studies on this topic have primarily focused on

the U.S. The political system in China differs significantly from that of the U.S., suggesting that there is a need to improve the understanding of how political risk influences Chinese firms.

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Table 1. R&D Activity

This table displays R&D activity during 2007-2015. *R&D* is the average RMB amount of R&D investment, *R&D/Sales* is the average ratio of R&D over total sales, *R&D/Profits* is the average ratio of R&D over net profits, and *R&D/Assets* is the average ratio of R&D over total assets.

Panel A: By Year

This panel presents the distribution of R&D by year during 2007-2015.

Year	Number	R&D(RMB)	R&D/Sales	R&D/Profits	R&D/Assets
2007	884	1128986.59	0.062%	1.285%	0.035%
2008	991	1418913.04	0.092%	2.293%	0.053%
2009	972	2083480.83	0.143%	2.600%	0.072%
2010	1113	2252519.08	0.183%	2.771%	0.088%
2011	1472	3473237.61	0.317%	4.263%	0.133%
2012	1722	4224090.01	0.350%	5.005%	0.145%
2013	1826	4795666.68	0.364%	5.254%	0.150%
2014	1819	5850016.61	0.399%	5.725%	0.159%
2015	1915	6456592.68	0.413%	6.261%	0.165%
Total	12714	4018034.87	0.294%	4.395%	0.124%

Table 1. R&D Activity
Panel B: By Industry
This panel presents the distribution of R&D classified by industry during 2007-2015. Industry is identified using China Securities Regulatory Commission's (CSRC) classification.

CSRC Industry	N	R&D	R&D/Sales	R&D/ Profits	R&D/ Assets
Agriculture, forestry, livestock farming, fishery	201	2974129.37	0.207%	3.255%	0.095%
Mining	368	1572211.40	0.115%	1.347%	0.026%
Manufacturing	7794	5182923.16	0.341%	5.431%	0.150%
Utilities	399	314633.42	0.011%	0.227%	0.003%
Construction	330	475287.03	0.068%	1.266%	0.022%
Wholesale and retail	935	1131719.66	0.021%	1.358%	0.018%
Transportation	446	82137.56	0.011%	0.179%	0.005%
Hotel and Catering industry	71	10111.27	0.001%	0.008%	0.001%
Information transmission, software and information technology service	556	11573825.30	1.487%	14.848%	0.553%
Real estate	880	838816.91	0.049%	0.514%	0.008%
Leasing and commerce service	157	376274.13	0.012%	0.611%	0.011%
Scientific research and technology service	62	29527.31	0.008%	0.096%	0.003%
Water conservancy, environment and public facilities management	142	2331768.99	0.201%	1.376%	0.056%
Education	6	2985707.83	0.256%	4.789%	0.170%
Hygienism and social work	30	1475806.80	0.075%	0.615%	0.066%
Culture, sports and entertainment	168	444846.00	0.032%	1.556%	0.021%
Miscellaneous	169	2563198.93	0.205%	7.304%	0.089%
Total	12714	4018034.87	0.294%	4.395%	0.124%

Table 2. Local Political Turnover

This table displays the sample distribution of local political turnover during 2007-2015. Local political turnover occurs if the Party Secretary or Mayor of the city where firm *i*'s headquarter is located is changed in year *t*.

Panel A: By Year

This panel presents the distribution of local political turnover by year during 2007-2015.

Year	Total Sample	Local Political Turnover	
	Number	Number	As percentage of Total Sample
2007	884	347	39.253
2008	991	333	33.602
2009	972	233	23.971
2010	1113	329	29.560
2011	1472	681	46.264
2012	1722	653	37.921
2013	1826	694	38.007
2014	1819	388	21.330
2015	1915	751	39.217
Total	12714	4409	34.678

Table 2. Local Political Turnover

Panel B: By Industry

This panel presents the distribution of firms tied to a local political turnover during 2007-2015, classified by CSRC industry.

CSRC Industry	Total sample Number	Local Political Turnover	
		Number	As Percentage of Total Sample
Agriculture, forestry, livestock farming, fishery	201	62	30.846
Mining	368	133	36.141
Manufacturing	7794	2776	35.617
Utilities	399	128	32.080
Construction	330	105	31.818
Wholesale and retail	935	338	36.150
Transportation	446	160	35.874
Hotel and Catering industry	71	18	25.352
Information transmission, software and information technology service	556	161	28.957
Real estate	880	282	32.045
Leasing and commerce service	157	58	36.943
Scientific research and technology service	62	19	30.645
Water conservancy, environment and public facilities management	142	48	33.803
Education	6	1	16.667
Hygienism and social work	30	8	26.667
Culture, sports and entertainment	168	56	33.333
Miscellaneous	169	56	33.136
Total	12714	4409	34.678

Table 3. R&D Activity

This table presents the univariate test of R&D activity for the local political turnover sample and the non-turnover sample. The turnover sample refers to the sample with firm observations linked to a change of Party Secretary or Mayor in the city where the firm *i*'s headquarter is located in year *t*. Correspondingly, the non-turnover sample is defined as this not being the case. The sample size for the turnover and non-turnover sample are 4409 and 8305, respectively. *R&D* is the average RMB amount of R&D investment, *R&D/Sales* is the average ratio of R&D over total sales, *R&D/Profits* is the average ratio of R&D over net profits, and *R&D/Assets* is the average ratio of R&D over total assets. The final column provides T-tests for the comparison of the mean value of R&D activity for firms located in a city with a local political leader turnover in year *t*. ***, **, and * denote significance at the 1%, 5% and 10% level, respectively.

	Turnover Sample	Non-turnover Sample	T-value
R&D	3,515,061.20	4,285,056.06	2.91***
R&D/Sales	0.250%	0.318%	3.05***
R&D/Profits	3.859%	4.680%	2.83***
R&D/Assets	0.109%	0.132%	2.72***

Table 4. Summary Statistics

This table presents the summary statistics for the sample. Definitions of variables are found in Appendix A. All continuous variables are winsorized at the top and bottom 1%.

	Number	Mean	STD	Median	Min	Max
R&D/Sales	12714	0.294%	1.194%	0	0	8.679%
R&D/Profits	12714	4.395%	18.181%	0	0	131.880%
R&D/Assets	12714	0.124%	0.461%	0	0	3.024%
Ln(1+ R&D)	12714	2.370	5.732	0	0	18.700
Turnover	12714	0.347	0.476	0	0	1
Size	12714	21.649	1.133	21.515	19.272	24.878
Tobin's Q	12714	2.509	1.641	2.000	0.897	10.234
Leverage	12714	42.960%	21.205%	43.074%	3.965%	89.180%
ROE	12714	8.701%	6.878%	7.334%	0.331%	39.961%
Cash	12714	19.035%	16.057%	14.021%	0	75.005%
Largest ownership	12714	33.754%	14.416%	31.570%	9.090%	73.820%
Non-SOE	12714	0.619	0.486	1	0	1

Table 5. Political Turnover and R&D Activity

This table presents ordinary least square regression results for local political leader turnover and R&D activity. The dependent variables are defined as *R&D/Sales(%)* and *R&D/Profits(%)* in column (1) and (2), respectively. *R&D/Sales* is the ratio of R&D over total sales at year *t. R&D/Profits* is the ratio of R&D over net profits at year *t*. We multiply *R&D/Sales* and *R&D/Profits* by 100 to obtain the measures used in the regression, *R&D/Sales(%)* and *R&D/Profits(%). Turnover* is a dummy variable which equals one if the Party Secretary or Mayor of the city where the firm *i*'s headquarter is located is changed in year *t* and zero otherwise. *Size* is defined as the natural logarithm of total assets of firm *i* at the beginning of year *t. Tobin's Q* is defined as the ratio of sum of the market value of equity and the book value of liabilities over the book value of assets at the beginning of year *t*. *Leverage* is defined as the ratio of total liabilities to total assets at the beginning of year *t*. *ROE* is defined as net profits divided by total equity at the beginning of the year *t*. *Cash* is defined as the ratio of cash and cash equivalents to total assets at the beginning of year *t*. *Largest ownership* is defined as the percentage ownership by the largest owner. *Non-SOE* is a dummy variable which equals one if the firm is not ultimately controlled by governments entities and zero otherwise. Year, Industry and city dummies are included but not reported and *t*-statistics are computed using heteroskedasticity-robust standard errors clustered by firm. All continuous variables are winsorized at the top and bottom 1%.***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	R&D/Sales(%)	*R&D/Profits(%)*
	(1)	(2)
Turnover	-0.025**	-0.417***
	(-2.17)	(-3.24)
Size	0.069***	0.803***
	(5.68)	(4.19)
Tobin's Q	0.107***	0.832***
	(12.38)	(6.14)
Leverage	-0.335***	-4.240***
	(-5.13)	(-4.13)
ROE	1.136	30.202
	(0.87)	(0.61)
Cash	0.274***	3.123**
	(3.46)	(2.50)
Largest ownership	-0.436***	-7.488***
	(-5.83)	(-6.36)
Non-SOE	0.038	0.375
	(1.52)	(0.96)
Intercept	-1.254***	-11.741***
	(-4.54)	(-2.70)
Year fixed effect	Yes	Yes
Industry fixed effect	Yes	Yes
City fixed effect	Yes	Yes
Adjusted R^2	0.124	0.068
Observations	12714	12714

Table 6. Firm-fixed Effect Model

This table presents the firm-fixed effect regression for political leader turnover and R&D activity. The dependent variables are defined as *R&D/Sales(%)* and *R&D/Profits(%)* in column (1) and (2), respectively. *R&D/Sales* is the ratio of R&D over total sales at year *t*. *R&D/Profits* is the ratio of R&D over net profits at year *t*. We multiply *R&D/Sales* and *R&D/Profits* by 100 to obtain the measures used in the regression, *R&D/Sales(%)* and *R&D/Profits(%)*. *Turnover* is a dummy variable which equals one if the Party Secretary or Mayor of the city where the firm *i*'s headquarter is located, is changed in year *t* and zero otherwise. *Size* is defined as the natural logarithm of total assets of firm *i* at the beginning of year *t*. *Tobin's Q* is defined as the ratio of sum of the market value of equity and the book value of liabilities to the book value of assets at the beginning of year *t*. *Leverage* is defined as the ratio of total liabilities to total assets at the beginning of year *t*. *ROE* is defined as net profits divided by total equity at the beginning of the year *t*. *Cash* is defined as the ratio of cash and cash equivalents to total assets at the beginning of year *t*. *Largest ownership* is defined as the percentage ownership by the largest owner. *Non-SOE* is a dummy variable which equals one if the firm is not ultimately controlled by government entities and zero otherwise. Year and firm effects are included but not reported and *t*-statistics are computed using heteroskedasticity-robust standard errors clustered by firm. All continuous variables are winsorized at the top and bottom 1%.***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	R&D/Sales(%)	*R&D/Profits(%)*
	(1)	(2)
Turnover	-0.013*	-0.145***
	(-1.77)	(-2.29)
Size	0.057***	0.258**
	(3.67)	(2.96)
Tobin's Q	0.043***	0.244*
	(6.40)	(1.90)
Leverage	-0.287***	-0.918*
	(-4.45)	(-1.78)
ROE	0.444	18.256
	(0.72)	(0.93)
Cash	0.009	0.317**
	(1.14)	(2.27)
Non-SOE	0.249***	1.669**
	(4.51)	(2.19)
Intercept	-1.069***	-3.678
	(-2.88)	(-0.60)
Year fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
Adjusted R^2	0.427	0.365
Observations	12590	12590

Table 7. Placebo Tests

This table presents placebo test results for political leader turnover and R&D activity. We assume that the local leader turnover occurs in the four years around the actual turnover [-2, 2] and create four simulated dummy variables (TURNOVER-2, TURNOVER-1, TURNOVER1, and TURNOVER2) in panels A to D for each year. To conserve space, we do not report the coefficients for the control variables. In the regressions standard errors are clustered by firm to compute statistical significance (Petersen, 2009). All continuous variables are winsorized at the top and bottom 1%. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	R&D/Sales(%)	*R&D/Profits(%)*
	(1)	(2)
Panel A. Turnover-2		
Turnover-2	0.006	-0.018
	(0.43)	(-0.62)
Panel B. Turnover-1		
Turnover-1	-0.002	0.021
	(-0.71)	(0.57)
Panel C. Turnover+1		
Turnover+1	0.013	0.004
	(0.69)	(0.35)
Panel D. Turnover+2		
Turnover+2	0.002	0.007
	(0.38)	(0.84)

Table 8. Alternative Definition of Political Turnover

This table presents pooled OLS regression results using *Party Secretary* as an alternative measure for political turnover. The dependent variables are defined as *R&D/Sales(%)* and *R&D/Profits(%)* in column (1) and (2), respectively. *R&D/Sales* is the ratio of R&D over total sales at year *t. R&D/Profits* is the ratio of R&D over net profits at year *t*. We multiply *R&D/Sales* and *R&D/Profits* by 100 to obtain the measures used in the regression, *R&D/Sales(%)* and *R&D/Profits(%). Party Secretary Turnover* is a dummy variable which equals one if the Party Secretary of the city where the firm *i*'s headquarter is located is changed in year *t* and zero otherwise. *Size* is defined as the natural logarithm of total assets of firm *i* at the beginning of year *t. Tobin's Q* is defined as the ratio of sum of the market value of equity and the book value of liabilities over the book value of assets at the beginning of year *t*. *Leverage* is defined as the ratio of total liabilities to total assets at the beginning of year *t*. *ROE* is defined as net profits divided by total equity at the beginning of the year *t*. *Cash* is defined as the ratio of cash and cash equivalents to total assets at the beginning of year *t*. *Largest ownership* is defined as the percentage ownership by the largest owner. *Non-SOE* is a dummy variable which equals one if the firm is not ultimately controlled by government entities, and zero otherwise. Year, Industry and city dummies are included but not reported and *t*-statistics are computed using heteroskedasticity-robust standard errors clustered by firm. All continuous variables are winsorized at the top and bottom 1%.***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	R&D/Sales(%)	*R&D/Profits(%)*
	(1)	(2)
Party Secretary Turnover	-0.013***	-0.224***
	(-4.56)	(-3.60)
Size	0.069***	0.803***
	(5.69)	(4.19)
Tobin's Q	0.107***	0.831***
	(12.39)	(6.13)
Leverage	-0.335***	-4.229***
	(-5.15)	(-4.12)
ROE	1.138	30.178
	(0.88)	(0.60)
Cash	0.274***	3.108**
	(3.45)	(2.49)
Largest ownership	-0.437***	-7.492***
	(-5.84)	(-6.36)
Non-SOE	0.038	0.375
	(1.52)	(0.96)
Intercept	-1.268***	-11.848***
	(-4.59)	(-2.73)
Year fixed effect	Yes	Yes
Industry fixed effect	Yes	Yes
City fixed effect	Yes	Yes
Adjusted R^2	0.128	0.068
Observations	12714	12714

Table 9. Alternative Definition of R&D Activity

This table presents pooled OLS regression results using alternative definitions of R&D activity. The dependent variables are defined as *R&D/Assets (%)* and *Log(R&D+1)* in column (1) and (2), respectively. *R&D/Assets* is the ratio of R&D over total assets at year *t.* We multiply *R&D/Assets* by 100 to obtain the measures used in the regression, *R&D/Assets (%). Log(R&D+1)* is the natural logarithm of one plus the RMB amount of R&D for firm *i* at year *t. Party Secretary Turnover* is a dummy variable which equals one if the Party Secretary of the city where the firm *i*'s headquarter is located is changed in year *t* and zero otherwise. *Size* is defined as the natural logarithm of total assets of firm *i* at the beginning of year *t. Tobin's Q* is defined as the ratio of sum of the market value of equity and the book value of liabilities over the book value of assets at the beginning of year *t*. *Leverage* is defined as the ratio of total liabilities to total assets at the beginning of year *t*. *ROE* is defined as net profits divided by total equity at the beginning of the year *t*. *Cash* is defined as the ratio of cash and cash equivalents to total assets at the beginning of year *t*. *Largest ownership* is defined as the percentage ownership by the largest owner. *Non-SOE* is a dummy variable which equals one if the firm is not ultimately controlled by government entities, and zero otherwise. Year, Industry and city dummies are included but not reported and *t*-statistics are computed using heteroskedasticity-robust standard errors clustered by firm. All continuous variables are winsorized at the top and bottom 1%.***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	R&D/Assets(%)	*Log(R&D+1)*
	(1)	(2)
Turnover	-0.007***	-0.092**
	(-2.84)	(-2.39)
Size	0.025***	0.756***
	(5.30)	(12.89)
Tobin's Q	0.039***	0.395***
	(11.65)	(9.53)
Leverage	-0.053**	-0.416
	(-2.11)	(-1.33)
ROE	-0.348***	-3.966***
	(-5.44)	(-4.98)
Cash	0.074**	1.078***
	(2.42)	(2.82)
Largest ownership	-0.179***	-2.498***
	(-6.18)	(-6.93)
Non-SOE	0.006	0.345***
	(0.67)	(2.90)
Intercept	-0.437***	-13.900***
	(-4.09)	(-10.45)
Year fixed effect	Yes	Yes
Industry fixed effect	Yes	Yes
City fixed effect	Yes	Yes
Adjusted R^2	0.120	0.118
Observations	12714	12714

Table 10. Unexpected Political Turnover and R&D Activity

This table presents OLS regression results for unexpected political leader turnover and R&D activity. The alternative dependent variables are defined as *R&D/Sales(%)* and *R&D/Profits(%)* in column (1) and (2), respectively. *R&D/Sales* is the ratio of R&D over total sales at year *t. R&D/Profits* is the ratio of R&D over net profits at year *t*. We multiply *R&D/Sales* and *R&D/Profits* by 100 to obtain the measures used in the regression, *R&D/Sales(%)* and *R&D/Profits(%). Unexpected Turnover* is a dummy variable which equals one if the Party Secretary or Mayor of the city where the firm *i*'s headquarter is located is changed unexpectedly in year *t* and zero otherwise. Here, expected turnover refers to when the Party Secretary or Mayor retires at 60 or remains in the same position for five or ten years (one or two consecutive terms). *Unexpected Turnover* thus includes all other observations of political turnover. *Size* is defined as the natural logarithm of total assets of firm *i* at the beginning of year *t. Tobin's Q* is defined as the ratio of sum of the market value of equity and the book value of liabilities over the book value of assets at the beginning of year *t*. *Leverage* is defined as the ratio of total liabilities to total assets at the beginning of year *t*. *ROE* is defined as net profits divided by total equity at the beginning of the year *t*. *Cash* is defined as the ratio of cash and cash equivalents to total assets at the beginning of year *t*. *Largest ownership* is defined as the percentage ownership by the largest owner. *Non-SOE* is a dummy variable which equals one if the firm is not ultimately controlled by government entities and zero otherwise. Year, Industry and city dummies are included but not reported and *t*-statistics are computed using heteroskedasticity-robust standard errors clustered by firm. All continuous variables are winsorized at the top and bottom 1%.***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	R&D/Sales(%)	*R&D/Profits(%)*
	(1)	(2)
Unexpected Turnover	-0.031***	-0.439***
	(-2.89)	(-5.07)
Expected Turnover	-0.007*	-0.052*
	(-1.68)	(-1.94)
Size	0.062***	0.784***
	(5.61)	(4.35)
Tobin's Q	0.113***	0.827***
	(10.46)	(6.52)
Leverage	-0.327***	-4.108***
	(-4.75)	(-2.97)
ROE	1.124	24.385
	(0.59)	(0.82)
Cash	0.251***	3.472***
	(3.67)	(2.90)
Largest ownership	-0.410***	-6.260***
	(-5.26)	(-5.15)
Non-SOE	0.032	0.329
	(1.43)	(0.84)
Intercept	-1.083***	-13.206***
	(-5.73)	(-3.81)
Year fixed effect	Yes	Yes
Industry fixed effect	Yes	Yes

City fixed effect	Yes	Yes
Adjusted R^2	0.127	0.073
Observations	12714	12714

Table 11. Local Promotion

This table presents OLS regression results for political turnover, R&D, and whether or not the local political leader is promoted from the same city. The dependent variables are defined as *R&D/Sales(%)* and *R&D/Profits(%)* in column (1) and (2), respectively. *R&D/Sales* is the ratio of R&D over total sales at year *t. R&D/Profits* is the ratio of R&D over net profits at year *t*. We multiply *R&D/Sales* and *R&D/Profits* by 100 to obtain the measures used in the regression, *R&D/Sales(%)* and *R&D/Profits(%). Turnover* is a dummy variable which equals one if the Party Secretary or Mayor of the city where the firm *i*'s headquarter is located is changed in year *t* and zero otherwise. *Other jurisdiction* is a dummy variable which equals one if the newly appointed Party Secretary or Mayor is promoted from outside the city where the firm *i*'s headquarter is located in year *t* and zero otherwise. *Turnover*Other jurisdiction* is the interaction term of *Turnover* and *Other jurisdiction. Size* is defined as the natural logarithm of total assets of firm *i* at the beginning of year *t. Tobin's Q* is defined as the ratio of sum of the market value of equity and the book value of liabilities over the book value of assets at the beginning of year *t*. *Leverage* is defined as the ratio of total liabilities to total assets at the beginning of year *t*. *ROE* is defined as net profits divided by total equity at the beginning of the year *t*. *Cash* is defined as the ratio of cash and cash equivalents to total assets at the beginning of year *t*. *Largest ownership* is defined as the percentage ownership by the largest owner. *Non-SOE* is a dummy variable which equals one if the firm is not ultimately controlled by government entities and zero otherwise. Year, Industry and city dummies are included but not reported and *t*-statistics are computed using heteroskedasticity-robust standard errors clustered by firm. All continuous variables are winsorized at the top and bottom 1%.***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	R&D/Sales(%)	*R&D/Profits(%)*
	(1)	(2)
Turnover	-0.012***	-0.306*
	(-2.93)	(-1.81)
*Turnover * Other jurisdiction*	-0.017**	-0.124***
	(-2.18)	(-5.67)
Size	0.064***	0.765***
	(5.21)	(4.03)
Tobin's Q	0.113***	0.819***
	(10.65)	(5.76)
Leverage	-0.316***	4.064***
	(-3.04)	(4.11)
ROE	1.015	27.693
	(0.49)	(0.92)
Cash	0.252***	3.087***
	(3.16)	(2.82)
Largest ownership	-0.418***	-7.186***
	(-5.39)	(-4.08)
Non-SOE	0.031	0.335
	(1.02)	(1.23)
Intercept	-1.215***	-10.571***
	(-4.37)	(-3.96)
Year fixed effect	Yes	Yes

Industry fixed effect	Yes	Yes
City fixed effect	Yes	Yes
Adjusted R^2	0.121	0.074
Observations	12714	12714

Table 12. SOEs vs Non-SOEs

This table presents OLS regression results for political turnover, R&D activity and type of firm ownership. The dependent variables are defined as *R&D/Sales(%)* and *R&D/Profits(%)* in column (1) and (2), respectively. *R&D/Sales* is the ratio of R&D over total sales at year *t. R&D/Profits* is the ratio of R&D over net profits at year *t*. We multiply *R&D/Sales* and *R&D/Profits* by 100 to obtain the measures used in the regression, *R&D/Sales(%)* and *R&D/Profits(%). Turnover* is a dummy variable which equals one if the Party Secretary or Mayor of the city where the firm *i*'s headquarter is located, is changed in year *t* and zero otherwise. *Turnover*Non-SOE* is the interaction term of *Turnover* and *Non-SOE. Size* is defined as the natural logarithm of total assets of firm *i* at the beginning of year *t. Tobin's Q* is defined as the ratio of sum of the market value of equity and the book value of liabilities over the book value of assets at the beginning of year *t*. *Leverage* is defined as the ratio of total liabilities to total assets at the beginning of year *t*. *ROE* is defined as the ratio of net profits divided by total equity at the beginning of the year *t*. *Cash* is defined as the ratio of cash and cash equivalents to total assets at the beginning of year *t*. *Largest ownership* is defined as the percentage ownership by the largest owner. *Non-SOE* is a dummy variable which equals one if the firm is not ultimately controlled by government entities and zero otherwise. Year, Industry and city dummies are included but not reported and *t*-statistics are computed using heteroskedasticity-robust standard errors clustered by firm. All continuous variables are winsorized at the top and bottom 1%.***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	R&D/Sales	*R&D/Profits*
	(1)	(2)
Turnover	-0.002	-0.282**
	(-1.06)	(-2.52)
*Turnover * Non-SOE*	-0.043***	-0.215***
	(-6.07)	(-4.32)
Size	0.069***	0.803***
	(5.67)	(4.19)
Tobin's Q	0.106***	0.831***
	(12.37)	(6.14)
Leverage	-0.335***	4.240***
	(-5.13)	(4.13)
ROE	-1.136***	30.202
	(-6.87)	(0.61)
Cash	0.275***	3.129**
	(3.48)	(2.51)
Largest ownership	-0.437***	-7.490***
	(-5.84)	(-6.36)
Non-SOE	0.052*	0.302
	(1.82)	(0.67)
Intercept	-1.263***	-11.789***
	(-4.57)	(-2.71)
Year fixed effect	Yes	Yes
Industry fixed effect	Yes	Yes
City fixed effect	Yes	Yes

Adjusted R^2	0.128	0.068
Observations	12714	12714

Table 13. Local Institutions

This table presents OLS regression results for political leader turnover, R&D activity, and local institutions. The dependent variables are defined as *R&D/Sales(%)* and *R&D/Profits(%)* in column (1) and (2), respectively. *R&D/Sales* is the ratio of R&D over total sales at year *t*. *R&D/Profits* is the ratio of R&D over net profits at year *t*. We multiply *R&D/Sales* and *R&D/Profits* by 100 to obtain the measures used in the regression, *R&D/Sales(%)* and *R&D/Profits(%)*. *Turnover* is a dummy variable which equals one if the Party Secretary or Mayor of the city where the firm *i*'s headquarter is located, is changed in year *t* and zero otherwise. *Low-Marketization* is a dummy variable which equals one if the average NERI index is below the sample median value and zero otherwise. Here, a lower NERI index value indicates weaker institutions at the provincial level. *Turnover*Low-Marketization* is the interaction term of *Turnover* and *Low-Marketization*. *Size* is defined as the natural logarithm of total assets of firm *i* at the beginning of year *t*. *Tobin's Q* is defined as the ratio of sum of the market value of equity and the book value of liabilities over the book value of assets at the beginning of year *t*. *Leverage* is defined as the ratio of total liabilities to total assets at the beginning of year *t*. *ROE* is defined as net profits divided by total equity at the beginning of the year *t*. *Cash* is defined as the ratio of cash and cash equivalents to total assets at the beginning of year *t*. *Largest ownership* is defined as the percentage ownership by the largest owner. *Non-SOE* is a dummy variable which equals one if the firm is not ultimately controlled by government entities and zero otherwise. Year, Industry and city dummies are included but not reported and *t*-statistics are computed using heteroskedasticity-robust standard errors clustered by firm. All continuous variables are winsorized at the top and bottom 1%.***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	R&D/Sales	*R&D/Profits*
	(1)	(2)
Turnover	-0.017*	-0.238**
	(-1.75)	(-2.17)
*Turnover * Low-Marketization*	-0.011***	-0.107***
	(-3.22)	(-5.13)
Size	0.069***	0.803***
	(5.68)	(4.19)
Tobin's Q	0.106***	0.832***
	(12.37)	(6.14)
Leverage	-0.335***	4.239***
	(-5.14)	(4.13)
ROE	1.135	30.198
	(0.87)	(0.61)
Cash	0.275***	3.126**
	(3.47)	(2.51)
Largest ownership	-0.436***	-7.487***
	(-5.83)	(-6.36)
Non-SOE	0.038	0.376
	(1.52)	(0.97)
Intercept	-1.254***	-11.747***
	(-4.54)	(-2.70)
Year fixed effect	Yes	Yes

Industry fixed effect	Yes	Yes
City fixed effect	Yes	Yes
Adjusted R^2	0.128	0.068
Observations	12714	12714

Table 14. Industry R&D Intensity

This table presents OLS regression results for political turnover, R&D activity, and industry R&D intensity. The dependent variables are defined as *R&D/Sales(%)* and *R&D/Profits(%)* in column (1) and (2), respectively. *R&D/Sales* is the ratio of R&D over total sales at year *t*. *R&D/Profits* is the ratio of R&D over net profits at year *t*. We multiply *R&D/Sales* and *R&D/Profits* by 100 to obtain the measures used in the regression, *R&D/Sales(%)* and *R&D/Profits(%)*. *Turnover* is a dummy variable which equals one if the Party Secretary or Mayor of the city where the firm *i*'s headquarter is located, is changed in year *t* and zero otherwise. *R&D intensive industry* is a dummy variable which equals one if the firm is operating in an R&D intensive industry and zero otherwise. *Turnover*R&D intensive industry* is the interaction term of *Turnover* and *R&D intensive industry*. *Size* is defined as the natural logarithm of total assets of firm *i* at the beginning of year *t*. *Tobin's Q* is defined as the ratio of sum of the market value of equity and the book value of liabilities over the book value of assets at the beginning of year *t*. *Leverage* is defined as the ratio of total liabilities to total assets at the beginning of year *t*. *ROE* is defined as net profits divided by total equity at the beginning of the year *t*. *Cash* is defined as the ratio of cash and cash equivalents to total assets at the beginning of year *t*. *Largest ownership* is defined as the percentage ownership by the largest owner. *Non-SOE* is a dummy variable which equals one if the firm is not ultimately controlled by government entities and zero otherwise. Year, Industry and city dummies are included but not reported and *t*-statistics are computed using heteroskedasticity-robust standard errors clustered by firm. All continuous variables are winsorized at the top and bottom 1%.***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	R&D/Sales	*R&D/Profits*
	(1)	(2)
Turnover	-0.021*	-0.181**
	(-1.82)	(-2.24)
*Turnover * R&D Intensive industry*	-0.018***	-0.136***
	(-3.01)	(-6.53)
Size	0.063***	0.827***
	(5.21)	(4.51)
Tobin's Q	0.108***	0.831***
	(10.34)	(4.65)
Leverage	-0.316***	4.123***
	(-5.25)	(3.26)
ROE	1.215	25.469
	(0.48)	(0.92)
Cash	0.262***	3.291**
	(3.53)	(2.15)
Largest ownership	-0.427***	-6.875***
	(-5.31)	(-4.87)
Non-SOE	0.039	0.353
	(1.07)	(0.60)
Intercept	-1.465***	-13.756***
	(-7.76)	(-3.98)
Year fixed effect	Yes	Yes
Industry fixed effect	Yes	Yes
City fixed effect	Yes	Yes

Adjusted R^2	0.125	0.067
Observations	12714	12714