Can Social Trust Promote Corporate *R&D* Expenditure? Evidence from China

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Abstract

We examine the impact of social trust on corporate *R&D* expenditure. Using a large sample of 1811 Chinese firms during 2007-2018, we show that social trust significantly promotes corporate *R&D* expenditure. Firms located in higher social trust regions invest 6.16%(4.17%) more in *R&D1*(*R&D2*) than those located in lower social trust regions. This result is robust to a battery of robustness checks and endogeneity corrections using the instrumental variable approach, and is more pronounced for non-state owned enterprises (non-SOEs), small firms, firms with low cash flow, firms with weak corporate governance, and firms located in regions with lower marketization index. We further find that, social trust is positively associated with higher innovation output as measured by patents. Overall, we highlight the important role played by social trust in encouraging corporate *R&D* expenditure and enhancing innovation.

Keywords: Social trust; Corporate *R&D* expenditure; Corporate innovation; China

"The fundamental problem isn't lack of capital. It's lack of trust."

- Former US Labor Secretary Robert Reich (2008)

1. Introduction

It has long been recognized that innovation is the key driver for economic growth (Solow, 1957; Kogan et al., 2017). Research and development (*R&D*), as the essential input for innovation, is of vital importance in promoting innovation. However, it is also a widely held view that *R&D* activities are difficult to finance, which leads to the "underinvestment of *R&D*" phenomenon (Hall, 2002). In understanding the determinants of corporate *R&D* expenditure, the existing literature has identified a number of influential factors (see, for example, Aghion, Van Reenen, and Zingales, 2013; Baysinger, Kosnik, and Turk, 1991; Brown, Fazzari, and Petersen, 2009; Hirshleifer, Low, and Teoh, 2012). While such firm-specific characteristics and country-level formal institutions play important roles in shaping corporate decisions on *R&D* expenditure, we argue that social capital, and in particular, social trust, also plays a crucial role in affecting corporate *R&D* spending.

Social trust, which is a key element of culture and social capital, is defined as "the subjective probability that an individual assigns to the event of a potential counterparty performing an action that is beneficial or at least no harmful to that individual" (Gambetta, 1988). In a society of high trust, people tend to cooperate with each other and thus are more likely to produce efficient outcomes and superior performance (Gambetta, 2000). As a substitute to formal institutions, social trust has been shown to

be significantly related to both macro-level and micro-level outcomes. For example, at the macro-level, social trust promotes economic growth (Knack and Keefer, 1997; Zak and Knack, 2001) and financial development (Guiso, Sapienza, and Zingales, 2004), and encourages stock market participation (Guiso, Sapienza, and Zingales, 2008) and international trade (Guiso, Sapienza, and Zingales, 2009). At the micro-level, social trust improves financial reporting quality (Garrett, Hoitash, and Prawitt, 2014), increases corporate cash holdings (Dudley and Zhang, 2016), reduces stock price crash risk (Li, Wang, and Wang, 2017), and facilitates corporate leverage adjustments (Huang, Lu and Faff, 2020). However, it is less clear whether social trust has any impact on corporate *R&D* expenditure. We fill this gap in this paper and investigate the role played by social trust in shaping corporate decisions on *R&D* expenditure.

Social trust can potentially promote corporate *R&D* expenditure for several reasons. First, social trust facilitates financing availability for *R&D* spending by creating more efficient financial markets with lower costs of capital (Pevzner, Xie, and Xin, 2015; Hasan et al., 2017; Meng and Yin, 2019; Brockman et al., 2020). Second, social trust encourages corporate *R&D* expenditure as a result of reduced costs of monitoring (Knack and Keefer, 1997; Dudley and Zhang, 2016). Third, social trust fosters greater tolerance for short-term failure and encourages risk-taking by managers, which potentially leads to more investments in *R&D*. Finally, social trust mitigates information asymmetry, promotes collaboration, and facilitates timely actions and swift adjustments. This is important in the risky and unpredictable process of innovation and could potentially improve innovation outcomes, which, in turn, further encourages

innovation input, i.e. *R&D* expenditure. Based on these arguments, we propose that social trust is positively related with corporate *R&D* expenditure and firms located in higher social trust regions should spend more on *R&D*.

We test our hypothesis using a sample of Chinese listed firms. We argue that data on China are particularly helpful and suitable for our investigation. First, the formal institutions in China are still underdeveloped (Allen, Qian, and Qian, 2005). China's investor protection, enforcement of law, government regulations, and information environments are weak. As is well received in the existing literature, social trust serves as a substitute for formal institutions (Aghion et al., 2010; Dudley and Zhang, 2016; Guiso, Sapienza, and Zingales, 2004; Pevzner, Xie, and Xin, 2015). Thus, given the weak formal institutions in China, we expect that social trust plays a more significant role in shaping corporate policies and outcomes, which makes it easier for us to disentangle its substitution effect. Second, there is a large degree of heterogeneity in different regions of China in terms of ethnicity, religion, native dialect, and culture in general. China has 56 ethnic groups within 31 provinces. The level of social trust varies significantly across regions (Ang, Cheng, and Wu, 2015), which allows adequate variations for us to explore in our empirical analysis. Third, our single-country study on China offers a uniform formal institution context and thus could effectively isolate the effect of regional social trust on corporate *R&D* expenditure without any confounding effects which are likely to arise in cross-country studies, such as different legal and tax systems, financial market regulations, and corporate governance practices (Li, Wang, and Wang, 2017). Overall, China provides an ideal setting for our hypothesis

testing.

We measure provincial trustworthiness (*Trust)* by using an index taken from a survey from the Chinese Enterprise Survey System (CESS) in 2000. The index is a weighted average percentage of managers' indication of the trustworthiness of a province as ranked number one, number two, and so on. Therefore, each Chinese province will have a trustworthiness index as a proxy of its social capital. Next, we assign the provincial trustworthiness index to the firms located within the province. We examine the relationship between a firm's *R&D* expenditure and the firm's social capital from 2007 to 2018 in China. We scale a firm's *R&D* investment by either the firm's total asset (*R&D1*) or the firm's total operating income (*R&D2*), and use these two measures as our main dependent variable.

We find that social trust is significantly positively related to the firm's *R&D* expenditure, suggesting that the firm's social capital could promote the firm's *R&D* investment. For example, the firm would increase 11.76 million RMB in its *R&D* expenditure on average with one standard deviation increase in the measure of *Trust*. We further check the robustness of our main findings in several ways by addressing the potential endogeneity concerns. First, we apply the instrumental variable (IV) approach and perform the two-stage least squares regression (2SLS). We employ two sets of instrumental variables (IVs). The first IV measures the percentage of the population who donate blood in a province (*Blood*). The second set includes two IVs: the number of ethnic groups whose population exceeds 3% in a province (*Ethnicity*) and the sum of Chinese dialects and minority languages in a province (*Language*). The variable of

Blood measures the local people's compassion for the well-being of others in the province, which should have a positive relationship with *Trust*. For the second set of IVs, both *Ethnicity* and *Language* are identified as important determinants of trust in the existing literature (e.g. Guiso, Sapienza, and Zingale, 2006). For example, countries with more diversified ethnicity have lower social trust and people who speak different languages are hard to trust each other. Thus, both variables should negatively relate to *Trust*. The first-stage regression results confirm our expectation in both sets of IVs. We still observe a significantly positive relationship between a firm's R&D expenditure and *Trust* in both second-stage regressions. Furthermore, we perform a propensity score matching (PSM) approach by sorting all sample firms into two groups by the median value of *Trust*, where firms in a province with a value of *Trust* above the median are in the treatment group. Overall, our main findings remain significant in the PSM test.

We further explore the cross-sectional variation in the effect of trust on corporate *R&D* spending and find that our main results are more pronounced for non-SOEs, small firms, firms with low cash flow, firms with weak corporate governance, and firms located in regions with lower marketization index. Finally, our main results are also significant in three robustness tests, i.e. by using the outputs of a firm's *R&D* expenditure, by using alternative proxies of social trust, and by using Tobit regression.

Our study contributes to the existing literature in the following ways. First, we contribute to the strand of literature which examines the impact of social trust. As an informal institution and a key element of social capital, social trust is found to be significantly associated with investment and economic growth (Knack and Keefer,

1997; Zak and Knack, 2001), financial development (Guiso, Sapienza, and Zingales, 2004), stock market participation (Guiso, Sapienza, and Zingales, 2008), international trade (Guiso, Sapienza, and Zingales, 2009), financial reporting quality (Garrett, Hoitash, and Prawitt, 2014), the provision of trade credit (Wu, Firth, and Rui, 2014), stock market reactions to corporate earnings announcements (Pevzner, Xie, and Xin, 2015), M&A activities (Ahern, Daminielli, and Fracassi, 2015), venture capital investment (Bottazzi, Da Rin, and Hellmann, 2016), corporate cash holdings (Dudley and Zhang, 2016), debt contracting (Hasan et al., 2017), stock price crash risk (Li, Wang, and Wang, 2017), bank risk-taking (Kanagaretnam, et al., 2019), and corporate leverage adjustments (Huang, Lu and Faff, 2020). We add to this line of studies by documenting the crucial role of social trust in encouraging corporate *R&D* expenditure and thus promoting corporate innovation.

Second, we also contribute to the literature which examines corporate innovation decisions in general and determinants of corporate *R&D* expenditure in particular. The existing evidence shows that, corporate *R&D* expenditure is associated with ownership structure (Baysinger, Kosnik, and Turk, 1991; Aghion, Van Reenen, and Zingales, 2013), board characteristics (Baysinger, Kosnik, and Turk, 1991; Balsmeier, Fleming, and Manso, 2017), CEO personal traits (Coles, Daniel and Naveen, 2006; Hirshleifer, Low, and Teoh, 2012), and firm-level financial conditions (Bhagat and Welch, 1995; Brown, Fazzari, and Petersen, 2009). We complement the existing evidence by identifying a previously overlooked factor, social trust, and exploring its impact on corporate *R&D* expenditure. We argue that, social trust can effectively promote

corporate *R&D* spending through facilitating financing availability, reducing monitoring costs, fostering tolerance for failure and encouraging risk-taking, and mitigating information asymmetry.

Third, we also add to the discussion on the persistent "underinvestment" phenomenon of corporate *R&D* (Hall, 2002). Since Schumpeter (1942), several studies have attempted to model and explain the "financing gap" for *R&D* (Nelson, 1959; Arrow, 1962). According to Hall (2002): "*The primary output of R&D investment is the knowledge of how to make new goods and services, and this knowledge is nonrival: use by one firm does not preclude its use by another. To the extent that knowledge cannot be kept secret, the returns to the investment in it cannot be appropriated by the firm undertaking the investment, and therefore such firms will be reluctant to invest, leading to the underprovision of R&D investment in the economy*." This issue could only be partially mitigated by venture capital, governmental seed capital and subsidy programs, and formal institutions such as intellectual property rights protection. Findings in our study provide an alternative explanation to the phenomenon of *R&D* underinvestment. We stress that, social trust, as an informal institution, is an important factor in determining corporate *R&D* expenditure, whose effect is over and above the effects of such firm-level factors and country-level formal institutions as documented in the existing literature.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature and develops the hypothesis. Section 3 describes the data, variable

construction and the regression model. Section 4 examines the impact of social trust on corporate *R&D* expenditure and addresses endogeneity concerns. Section 5 explores cross-sectional variations in the effect of social trust on corporate *R&D* expenditure. Section 6 provides further robustness checks and supplementary evidence on how social trust affects corporate innovation output – patent applications. Section 7 concludes.

2. Literature Review and Hypothesis Development

2.1 The Impact of Social Trust

It is well established that social trust plays an important role in affecting financial and economic transactions, managerial behaviour, and corporate policies and outcomes. Earlier studies find that social trust is positively related to economic development and growth (Fukuyama, 1995; Knack and Keefer, 1997; La Porta et al., 1997; Zak and Knack, 2001) and financial development (Guiso, Sapienza, and Zingales, 2004) at the country level. In more trusting countries, households are more willing to participate in capital markets (Guiso, Sapienza, and Zingales, 2008). Using data on bilateral trust between European countries, Guiso, Sapienza, and Zingales (2009) find that lower bilateral trust leads to less trade between two countries, less portfolio investment, and less direct investment. Social trust, as a key dimension of national culture, affects cross-border merger volume and synergy gains. Ahern, Daminelli, and Fracassi (2015) find that the volume of cross-border mergers is lower when countries are more culturally distant and greater cultural distance in trust leads to lower combined announcement

returns.

Social trust also significantly influences firm-level outcomes. The level of trust in a country affects investors' perception and utilization of information transmitted by firms through financial disclosure. As a result, investor reactions to earnings announcements are significantly higher in more trusting countries (Pevzner, Xie, and Xin, 2015). Trust among nations positively predicts venture capital firms' investment decisions, but it has a negative correlation with successful exits (Bottazzi, Da Rin, Hellmann, 2016). In countries with low levels of social trust, shareholders are more likely to pressure firms to disgorge cash. Thus, social trust has a positive effect on corporate cash holding (Dudley and Zhang, 2016). Based on employees' trust on management, Garrett, Hoitash, and Prawitt (2014) show that trust is associated with better accrual quality, lower likelihood of financial misstatements, and lower likelihood of internal control material weakness disclosures. Hasan et al. (2017) argue that debt holders perceive social capital as providing environmental pressure that constrains opportunistic firm behaviors in debt contracting. Accordingly, they find that firms headquartered in U.S. counties with higher levels of social capital incur lower bank loan spreads. Similarly, in an international setting, Meng and Yin (2019) show firms in countries with higher levels of social trust have lower bond yield spreads. Kanagaretnam et al. (2019) provide cross-country evidence on the relationship between social trust and risk-taking by banks. They report that banks in countries with higher social trust exhibit lower risk-taking and that these banks also experienced less financial trouble and fewer failures during the 2007–2009 financial crisis. In a most recent study,

Huang, Lu, and Faff (2020) find that social trust effectively reduces firms' financing costs and transaction costs, which leads to a faster speed with which firms adjust their leverage to the target level.

In particular, a strand of literature uses China as a setting to examine the impact of different levels of regional trust. Wu, Firth, and Rui (2014) argue that social trust helps private firms overcome institutional difficulties in financing their activities and find that private firms located in higher social trust regions use more trade credit from suppliers, extend more trade credit to customers, and collect receivables and pay payables more quickly. Ang, Cheng, and Wu (2015) analyze the case of foreign high-tech companies investing in China, where the risk of expropriation of their intellectual property is high. They find that firms prefer to invest in regions where local partners and employees are considered more trustworthy. Li, Wang and Wang (2017) examine the impact of social trust on stock price crash risk in China and find that firms headquartered in regions of high social trust tend to have smaller crash risk.

Collectively, the large volume of literature has well established the positive role of social trust in affecting economic growth and corporate activities and outcomes. Social trust, as a substitute of formal institutions, generates economic growth and prosperity at the macro-level. At the micro-level, it helps create firm value through bridging information gap, improving financial reporting quality, reducing stock price crash risk, and facilitating leverage adjustments. In this study, we add to the existing evidence of the positive role of social trust by documenting its effect in promoting corporate

innovation input, i.e. *R&D* expenditure.

2.2 Determinants of Corporate *R&D* Expenditure

Technological innovation based on *R&D* investment is indispensable to economic growth and productivity. A stream of literature has attempted to explore the determinants of corporate *R&D* expenditure, including various governance and firm-specific factors. Bhagat and Welch (1995) explore the determinants of corporate *R&D* in several developed countries and find that last year's debt ratio, two-year lagged stock return, and last year's tax payments are important factors in determining corporate *R&D* spending. Hall (2002) surveys a large number of earlier studies which try to explain the "underinvestment" phenomenon of corporate *R&D*. Evidence suggests that both anti-takeover provisions and managerial shareholdings are positively associated with *R&D* intensity. Brown, Fazzari, and Petersen (2009) estimate dynamic *R&D* models for high-tech US firms and find significant effects of cash flow and external equity for young, but not mature, firms. In comparing Japanese and US firms, Hundley, Jacobson, and Park (1996) find that Japanese firms have a greater propensity than US firms to sustain commitment to *R&D* in the face of fluctuating profits and liquidity. They show that profitability declines lead to increased *R&D* intensity in Japan while the *R&D* intensity of US firms fluctuates directly with two-year lagged profitability and liquidity variables.

In examining the impact of ownership structure on *R&D* expenditure, Baysinger, Kosnik, and Turk (1991) find that a concentration of equity among institutional investors positively affects corporate *R&D* spending in US firms. However, Lee and

O'Neill (2003) compare ownership structures and *R&D* investments in Japanese and US firms and conclude that the impact of ownership concentration on *R&D* investments differs across countries. A more recent study confirms the significant impact of institutional investors. Aghion, Van Reenen, and Zingales (2013) document that institutional ownership has a significantly positive association with corporate *R&D* investments.

Evidence on whether board characteristics affect *R&D* expenditure is mixed. Earlier studies find that a high insider representation on a board positively affects corporate *R&D* spending (Baysinger, Kosnik, and Turk, 1991). However, several more recent studies suggest that board characteristics are not related to *R&D* investments. For example, Balsmeier, Fleming, and Manso (2017) show that a transition to an independent board appears unrelated to the level of firms' *R&D* investments. Jia (2017) finds no significant difference in their *R&D* investment intensity between firms with directors having extended tenure and those without. Huang and Lu (2020) show that board industry experience diversity does not have any significant impact on corporate *R&D* investments.

Several CEO traits are shown to be significantly associated with corporate *R&D* investments. Daellenbach, McCarthy, and Schoenecker (1999) find that CEOs with technical work experience are associated with higher *R&D* spending. Coles, Daniel and Naveen (2006) find that lower delta values and higher vega values are associated with increased spending on *R&D*. CEOs who are overconfident tend to spend more on *R&D*

(Hirshleifer, Low, and Teoh, 2012).

While a large number of studies focus on firm-level determinants of corporate *R&D* expenditure, several recent studies have examined macro-level factors that are influential. Atanassov et al. (2019) show that firms spend more on *R&D* during gubernatorial election years while Xu (2020) finds that firms spend less on *R&D* as economic policies become more uncertain. We add to this strand of literature by exploring the impact of an informal institution, namely, social trust, whose effect is over and above the firm-level variables, on corporate *R&D* expenditure.

2.3 The Potential Link between Social Trust and Corporate *R&D* Expenditure

The potential link between social trust and corporate *R&D* expenditure emerges from at least four plausible sources.[2] First, a higher social trust level is associated with better financing availability. As noted in Hall (2002), there is a persistent phenomenon of underinvestment in *R&D*. Small and new innovative firms experience especially high costs of capital, which hinders their *R&D* spending. However, social trust encourages more active participation in capital markets (Guiso, Sapienza, and Zingales, 2008), making it easier for firms to access funding when they need to issue either debt or equity to finance *R&D* investments. Existing evidence shows that, a higher level of social trust is associated with more efficient equity markets (Pevzner, Xie, and Xin, 2015), lower bank loan spreads (Hasan et al., 2017) and lower costs of debt (Meng and Yin, 2019; Brockman et al., 2020). To the extent that social trust reduces firms' costs of capital and

[2] We note that these four sources are not mutually exclusive and, indeed, are necessarily interrelated.

facilitates financing availability, we expect a positive impact of social trust on corporate *R&D* expenditure.

Second, social trust mitigates agency costs and monitoring costs (Knack and Keefer, 1997; Dudley and Zhang, 2016). With higher trust, shareholders spend less to protect themselves from being expropriated by managers. Written contracts are less likely to be needed, and they do not have to specify every possible contingency (Knack and Keefer, 1997). Thus, money, time, and efforts can be more effectively devoted to doing better business, including investing in *R&D*, rather than being wasted in negotiating and monitoring. For example, Dudley and Zhang (2016) show that in high trust countries, managers are subject to less stringent monitoring and are thus allowed to hold more cash; in low trust countries, managers are pressured by shareholders to disgorge cash. Thus, we expect that social trust encourages corporate *R&D* expenditure as a result of reduced costs of monitoring.

Third, *R&D* investments are usually risky, challenging, and unpredictable, which involve a large degree of uncertainty. With a higher level of trust, shareholders are less likely to attribute unsuccessful outcomes to managerial opportunism and penalize managers. Thus, managers don't have to worry too much about their short-term, temporary failures, and can concentrate on long-term, value-enhancing strategies. As shown in Manso (2011), the optimal innovation-motivating incentive scheme should exhibit substantial tolerance (or even reward) for early failure and reward for long-term success. To the extent that social trust fosters greater tolerance for short-term failure

and encourages risk-taking by awarding long-term success, we expect that a higher level of trust will lead to more *R&D* spending.

Fourth, social trust improves information production and information sharing, which results in less information asymmetry, promotes collaboration, and facilitates timely actions and swift adjustments. For instance, trust improves financial reporting quality, enhances earnings transparency, and facilitates timely recognition of bad news (Garrett, Hoitash, and Prawitt, 2014; Nanda and Wysocki, 2013). Risky and uncertain strategic decisions, such as *R&D* investments, crucially require decision-makers to adjust swiftly by incorporating performance feedback. To the extent that trust improves information quality and allows speedy adjustments when needed, we expect that it can significantly encourage corporate *R&D* expenditure.

Based on the preceding discussions, we propose our hypothesis as follows:

Hypothesis: *Firms located in higher social trust regions spend more on corporate R&D.*

3. Data, Variables and Methodology

3.1 Data Collection

All data are obtained from the China Stock Market & Accounting Research (CSMAR) database. The sample period covers 2007-2018. The main dependent variable is a firm's *R&D expenditure*, which is defined as a firm's *R&D expenditure* scaled by either the

firm's total asset (*R&D1*) or the firm's total operating income (*R&D2*)[3]. We also collect control variables, such as a firm's financial information (e.g., ROA, firm size, firm financial leverage, and cash flow), ownership information (e.g., state ownership, institutional ownership and top shareholders' shareholding ratio), and corporate governance (e.g., the listed age, the board size, independent director ratio and CEO Duality). The Appendix table defines all control variables in detail. However, our sample excludes firms such as financial services firms, special treatment (S.T.) firms, and firm-year observations without sufficient data to construct the regressions. We winzorized all time-series variables at the 1st and 99th percentile values to exclude outliers. The final sample consists of 1811 firms and 13,062 firm-year observations.

3.2 Measuring Social Trust

We measure social trust in three ways following the previous literature. Our main explanatory variable of social trust (*Trust*) is the province-level enterprise trustworthiness, taken from a survey conducted by the Chinese Enterprise Survey System (CESS) in 2000. The purpose of the survey is to examine companies' perceived provincial trustworthiness located in the thirty-one Chinese provinces. About 15,000 managers of companies across 31 provinces received the questionnaires. These managers were required to answer the main questions as "*According to your experience, which five provinces have the most trustworthy enterprises? Please list them in order.*" The CESS received more than 5,000 valid responses with the response rate over 33%.

[3] We multiply the variable of both R&D1 and R&D2 by 1000 when running regressions to avoid too small coefficient estimates.

The ranking method for each province is straightforward, i.e. 5-point for a number-one ranking, 4-point for a number-two ranking, and so on. Each provincial trust score is then calculated as the weighted average of the rankings. The weights are the percentages of managers who ranked a province as number one, number two, and so on. (Li et al., 2017). For example, 16.6% of managers ranked Beijing as number one place, following by 11.3% in number two, 8.3% in number three, 5.5% in number four, and 4.9% in number five. Consequently, Beijing earns a trust score of 169% (16.6% × 5 + 11.3% × 4 + 8.3% × 3 + 5.5% × 2 + 4.9% × 1). Our measurement of *Trust* has been widely used in the existing literature (Zhang and Ke, 2002; Wu et al., 2014; Ang et al., 2015; and Li et al., 2017).

We check the robustness of our main results by replacing the main social trust measure by two alternative measures. The first alternative social trust measure (*Trust2*) is taken from the same survey as for *Trust* but with a different calculation method. *Trust2* is defined as the percentage of the survey participants who ranked a province the highest score for trustworthiness. This approach focuses on the percentage of managers who believe a specific province is the most trustworthy in China.

The second alternative measure of social trust (*Trust3*) [4] is an index of trustworthiness for each Chinese province. The index is produced by the China Reformation Foundation National (Guomin) Economic Research Institute (CRFN). The CRFN conducts a survey every two years, with more than 4,000 respondents in 29

[4] Dong et al. (2018) use the trust index to examine the listing firm's corporate misconduct in China.

provinces. The survey ranks the general business environment across different provinces, autonomous regions, and municipalities. We calculate the mean score of each province from the survey as the social trust index measure.

3.3 Model

We use Equation (1) to examine the relationship between social trust and a firm's *R&D* expenditure.

$$R\&D\_expenditure_{i,t} = \beta_0 + \beta_1 Trust_{i,t} + \sum_k \beta_k Controls_{k,i,t} + \varepsilon_{i,t} \quad (1)$$

The dependent variable, $R\&D\_expenditure_{i,t}$, is firm *i*'s *R&D* expenditure at year *t*, which is defined as a firm's *R&D* expenditure scaled by either the firm's total asset or the firm's total operating income. The primary explanatory variable, *Trust*, which has been defined above, is a province-level trust index in year *t* where the firm *i* locates. $Controls_{k,i,t}$ is a set of control variables which are introduced above and defined in the Appendix. We conduct a two-way fixed effects model to estimate model (1) to control for sample heterogeneity caused by industry and year. We estimate the regressions based on the standard errors corrected for a firm and year clustering to mitigate potential problems from cross-sectional and time-series dependence in the data (Petersen, 2009).

3.4 Descriptive Statistics

Table 1 shows descriptive statistics for both variables and industry distributions. Panel A shows descriptive statistics for each variable. The mean value of *R&D1* is 0.0088 while the mean value of *R&D2* is 0.0142 for the sample firms. This indicates that an

average sample firm spends 191 million RMB during the testing period. The average *Trust* ratio is 0.7444 with a standard deviation of 0.6783, where the range of *Trust* is from 0.027 to 2.189. The result suggests that the trustworthiness of each province in China varies from one to another and some provinces may have relatively low trustworthiness from corporate managers' perspectives. Moreover, Panel A also shows statistical information for all control variables. For example, the average firm size is 22.442, which is about 21700 million RMB. Sample firms reach a 3.77% growth of ROA on average, with the minimum ratio of -11.9% and the maximum ratio of 16.31% during the sample period. The average leverage ratio of sample firms is 0.5012. The ratio of cash flow to total assets is 0.0467 on average. The listing ages for our sample firms are from 1.37 years to 25.27 years. The largest shareholders hold about 36.3% shares on average, which indicates the shareholding for the Chinese firms is relatively concentrated. About 16.4% of firms have a dual position of CEO and chairman. The average board size is 9 and 37% of the directors are independent.

Panel B of Table 1 shows the sample distribution across all industries in the China stock markets. About 16.82% of sample firms are in the industry of machinery, equipment, and instrument, equivalent to 2,197 firm observations. The timber and furniture industry has the smallest number of firm observation in our sample, which is 81.

[Insert Table 1 here]

Table 2 shows the correlation coefficients among all variables. The upper-right

reports the Spearman correlation coefficients while the lower-left reports the Pearson correlation coefficients. The variable of *R&D*1 has a strong and positive correlation with the variable of *R&D2*. Moreover, the variable of *Trust* is positively correlated to both *R&D1* and *R&D2*. We will formally test whether there is a significantly positive relationship between the provincial level of *Trust* and a firm's *R&D* expenditure in the following sections.

[Insert Table 2 here]

4. Social Trust and Corporate *R&D* Expenditure

4.1 Baseline Regression Results

Table 3 reports our baseline regression results. Columns (1) and (2) report the relationship between the variable of *Trust* and a firm's *R&D1* while the columns (3) and (4) report results by replacing the *R&D1* by *R&D2*. Moreover, columns (1) and (3) report single variate regression results, but columns (2) and (4) report multi-variate regression results with the full set of control variables.

First, across all four columns, we find consistent evidence that there is a significantly positive relationship between a firm's *R&D* and *Trust,* with and without controlling for a firm's other characteristics. The result indicates that the local provincial trustworthiness promotes the firm's *R&D* expenditure. Economically, our results suggest that one standard deviation increase in the measure of *Trust* would result in a 6.16% (4.17%) increase in a firm's *R&D1* (*R&D2*), which is equivalent to 11.76

million RMB.

Second, both columns (2) and (4) show some consistent results between some control variables and *R&D1* and *R&D2*. For example, the result shows a significantly negative relationship between a firm's age and its *R&D* expenditure. The result suggests that young firms spend more on *R&D* than matured firms, which is consistent with existing findings in the literature (García-Quevedo et al., 2014; Rafiq et al., 2016; Gan & Xu, 2019). Both Chen et al. (2016) and Wang and Söderbom (2018) find that Chinese firms with a high level of cash flow spend more on their *R&D* activities than firms with a low level of cash flow. This has been evident in both columns (2) and (4) of Table 3, where the coefficients of CF are 8.8388 (column 2) and 4.7187 (column 4) respectively and highly significant. Diversified shareholders and board of directors would influence a firm's *R&D* investment. Table 3 also shows a significantly negative relationship between a firm's *R&D* expenditure and the proportion of shares held by the largest shareholder and a significantly positive relationship between a firm's *R&D* expenditure and board size. Both results suggest a diversified shareholding and a larger board of director would promote a firm's *R&D* expenditure, consistent with Hoskisson et al. (1993), Kor (2006), and Dalziel et al. (2011).

Third, columns (2) and (4) of Table 3 also have some findings that are worth noting. On the one hand, column (2) shows that a firm's *R&D* expenditure is significantly negatively related to firm size but positively related to its profitability as measured by ROA. Existing empirical results suggest that profitable firms spend more money on

their *R&D* investment because of high affordability in China (Howell, 2016; and Xie et al., 2020), which corroborate our results. On the other hand, results in the column (4) also suggest that firms with a low leverage ratio invest more on their *R&D* expenditures. This result supports Gao et al. (2019), Kang et al. (2018), and Hu et al.(2020) that a high leverage ratio reduces a firm's *R&D* expenditures in China.

Overall, our baseline results support the main research hypothesis that firms located in higher social trust regions spend more on corporate *R&D*.

[Insert Table 3 here]

4.2 Addressing Endogeneity Concerns

One of the biggest challenges to the empirical corporate finance research is the endogeneity issues, such as the unobserved or hidden variables, measurement error bias, and self-selection errors that may cause selection bias. To alleviate the potential endogeneity problems in our analysis, we perform two different approaches in this section, which are the instrumental variable approach and the propensity score matching (PSM) method.

4.2.1 The Instrumental Variable Approach

In this section, we address the potential endogeneity problems in our baseline results by using two 2SLS regressions. The 2SLS regression requires at least one instrumental variable that is exogenous and highly correlated with the main independent variables of *Trust*. We employ two sets of instrumental variables: voluntary blood donations (*Blood*),

and *Ethnicity* and *Language*.

First, we use a variable of *Blood* as the instrumental variable, which measures the percentage of the population who donate blood in a province. We collect the data of *Blood* from the Chinese Society of Blood Transfusion. Wu et al. (2014) argue that the blood donation is not due to donors' wealthy and healthy position. Moreover, blood donations are not requested by either the law or the effectiveness of legal enforcement. A high percentage of blood donations in a province reflects that the more people have compassion for the well-being of others in the province. Therefore, blood donations are a good indicator of social trust, which measures people's civic-mindedness. Column (1) of Table 4 reports the first stage regression result, where the coefficient of *Blood* is 0.0079 and statistically significant at the 1% level. The result suggests a significantly positive relationship between social trust and blood donations in a province and indicates the instrument variable is working well. Both columns (2) and (3) of Table 4 report the results from the second stage regressions by using either *R&D1* or *R&D2* as dependent variables respectively. Results show that both coefficients of *Trust* are positive and significant at the 1% level. This indicates that our main results in Table 3 are valid after controlling for the endogeneity issue.

[Insert Table 4 here]

Second, we employ another set of instrumental variables to further check the robustness of our main results. The IVs are the number of ethnic groups whose population exceeds 3% in a province (*Ethnicity*) and the sum of Chinese dialects and

minority languages in a province (*Language*). On the one hand, Glaeser et al. (2000) find that trustworthiness declines with the increased number of ethnicity in a region, which has been confirmed by Coffe and Geys (2006), and Herreros and Criado (2009). On the other hand, Vårheim (2014) states that the greatest problem for trust is the language barrier. If two parties speak different languages, they are very difficult to trust each other. Consequently, we would expect a negative relationship between *Trust* and both variables of *Ethnicity* and *Language*. Column (1) of Table 5 reports the first stage regression result, where the coefficients of both variables of *Ethnicity* and *Language* are -0.2911 and -0.0292, respectively, and statistically significant at the 1% level. Results meet our predictions. Again, in the second stage, for both *R&D1* and *R&D2*, results show that both coefficients of *Trust* are positive and significant at the 1% level. Overall, our baseline regression results are robust in Table 5.

[Insert Table 5 here]

4.2.2 The Propensity Score Matching Approach (PSM)

The literature indicates that the PSM approach can result in the same distribution of covariance in the treatment and control groups (Rosenbaum & Rubin, 1983). Zhao (2004) argues that one of the most significant advantages for the PSM approach is to eliminate the dimensionality limitations if multiple characteristics need to be matched. Therefore, we further alleviate the potential endogeneity problems by using the PSM approach in this section. We sort all sample firms into two groups by the median value of *Trust*. Firms located in a province with a value of *Trust* above the median are in the

treatment group. Next, we do the nearest neighbour 1:1 matching using variables, including *R&D1, R&D2, Size, ROA, Lev, Age, CF, Share. Dual, Ind,* and *Board*, to construct the control group. Panel A in Table 6 shows descriptive statistics on the firm's characteristics between the treatment group and the control group. According to the results of Panel A, we eliminate the observable differences between the two groups. Finally, we re-estimate the baseline regression by using the matched sample and Panel B of Table 6 reports the results. Results in Panel B suggest that the effect of *Trust* on a firm's *R&D* expenditure measured by either *R&D1* or *R&D2* remains significantly positive, as all *Trust* coefficients are positive and statistically significant at the 1% level across four columns regardless of controlling for a firm's characteristics. Our main results still hold in the PSM test.

[Insert Table 6 here]

5. Cross-sectional Variations in the Effect of Social Trust on Corporate *R&D* Expenditure

5.1 SOEs Versus Non-SOEs

The literature suggests that the ownership structure has a significant influence on a firm's *R&D* expenditure (Chin et al., 2009; Wang et al., 2017). For example, non-SOEs in China have a greater incentive to invest in innovation activities than SOEs because of the pressure of gaining a market share in China (Wang et al., 2015). However, SOEs have substantial advantages in obtaining *R&D* resources in China. First, SOEs have a priority in receiving *R&D* resources because of their strong political connections to the local and central government (Wang et al., 2017). Their resources include receiving

public subsidies and tax credits and accessing government financing and distribution channels (Boeing et al., 2016; Wang et al., 2015). Second, SOEs also have an advantage in receiving superior human capital because SOEs are naturally linked with most Chinese universities and research institutes. Both George et al. (2002) and Eom and Lee (2010) argue that Chinese SOEs could gain access to complementary capabilities through university-industry collaboration, which could boost innovation performance and increase economic returns for their *R&D* investment. Compared to SOEs, non-SOEs should more rely on social trust to gain the resources to invest in *R&D* expenditure. Therefore, we would expect that social trust should have more pronounced influence on non-SOEs' *R&D* expenditure as they do not have such advantages in allocating *R&D* resources compared to SOEs in China.

To empirically test this, we create a dummy variable of *SOE*, which equals one if a firm is *SOE*, 0 otherwise. We re-estimate our baseline regression by adding an interaction term between *Trust* and *SOE* and the dummy variable of SOE. Columns (1) and (2) of Table 7 report the regression results for *R&D1* and *R&D2* as the dependent variable, respectively. The coefficients of *Trust* remain positive and significant in both columns, which are 1.9181 and 2.4422 respectively. More importantly, both columns observe significantly negative coefficients of the interaction terms, which are -1.6985 and -2.3330. Our results indicate that social trust has a stronger effect on a firm's *R&D* expenditure for non-SOEs than SOEs, which meets our expectation.

[Insert Table 7 here]

5.2 The Role of Marketization

The economic development in China is magnificently asymmetric. Fan et al. (2011) present a marketization index to measure the economic development of each province in China. On the one hand, existing empirical results find that provinces with a high level of marketization index have better economic growth than those with a low marketization index. Consequently, firms located in provinces with a high marketization index have more resources, including monetary capital and human capital, to invest in their R&D activities (Pan et al., 2013). On the other hand, Xin and Xin (2017) find a significantly negative relationship between social trust and the marketization index in China. Therefore, we expect that social trust would play a more important role in a firm's *R&D* expenditure where the firm located in low marketization regions.

We empirically examine the effect of the marketization level on the relationship between *Trust* and the firm's *R&D* expenditure in Table 8. We measure a provincial marketization level by using a marketization index from Fan et al. (2011). We create a dummy variable of MAR, which equals one if a firm is located in a province with a marketization index above the median value, 0 otherwise. Furthermore, we create an interaction term between *Trust* and MAR and add both the interaction term and the variable of MAR to our baseline regression. Columns (1) and (2) of Table 8 report the regression results for *R&D1* and *R&D2* as the dependent variable, respectively. Results show that the coefficient of *Trust* in column (1) is 1.9725 and significant at the 1% level

and the coefficient of *Trust* in column (2) is 1.8169 and significant at the 10% level. More importantly, the coefficients of the interaction terms in both columns are negative, which are -2.4631 with significance at the 1% level in column (1) and -2.5758 with significance at the 5% level in column (2). Overall, results in Table 8 indicate that social trust plays a more important role in promoting a firm's *R&D* expenditure for firms located in low marketable regions than those in high marketable regions.

[Insert Table 8 here]

5.3 The Role of Corporate Governance

Previous studies indicate that corporate governance has a significant impact on a firm's investment decisions because of the separation of ownership and control in the firm (Jensen & Meckling, 1976; O'Connor & Rafferty, 2012). The literature presents two arguments about the impact of corporate governance on a firm's *R&D* expenditure. On the one hand, the concentrated ownership reduces the agency costs associated with innovation due to effective monitoring of management strategies, which has been called a principal-agent framework (Baysinger et al., 1991; Mork et al., 2005; Lee, 2005). Firms with high concentrated ownership should have strong internal control, which represents strong corporate governance to the firm. Under this theoretical framework, a firm's corporate governance should be positively related to its *R&D* expenditure. As social trust could soft the agency problems between a firm's shareholders and managers, we would expect the effect of social trust on a firm's *R&D* expenditure should be more pronounced to firms with weak corporate governance. On the other hand, Francis and

Smith (1995) and Markman et al. (2001) argue that a diversified ownership structure mitigates the problem of agency costs and information asymmetry in innovative investment, and thus promotes a firm's *R&D* expenditure. However, the firm with more diversified ownership structure should have a weaker internal control system (i.e. weak corporate governance) than firms with concentrated ownership structures. If this is the case, social trust should benefit more to the firm with strong corporate governance. Consequently, we would expect a significantly positive relationship between a firm's corporate governance and its *R&D* expenditure.

In this section, we empirically examine the impact of a firm's corporate governance on the relationship between social trust and the firm's *R&D* expenditure. We employ two dummy variables to measure the firm's corporate governance: the level of internal control (IC) and whether a firm's ultimate owner's voting rights equal cash flow rights (*SEPF*). Table 9 reports the regression results. Panel A of Table 9 directly measures a firm's corporate governance by using a dummy variable of IC. We collect the level of corporate IC from the website of the Shenzhen Dibo Internal Control Database, which constructs the Dibo internal control index for listed firms in China. The dummy variable equals one if a firm's internal control index is above the median value and 0 otherwise. A high level of IC index indicates strong corporate governance for the firm. Moreover, we create an interaction term between *Trust* and IC and add both the interaction term and the variable of IC to our baseline regression. Columns (1) and (2) of Table 9 report the regression results for *R&D1* and *R&D2* as the dependent variable, respectively. Results in panel A meet our expectation that social trust has a stronger effect on a firm's

R&D expenditure if the firm has weak corporate governance. We observe negative interaction terms with significance at the 5% level in both models, which are -0.6846 and -1.1213 respectively.

To further confirm the results in panel A, we employ an alternative measure of corporate governance, which measures whether or not a firm's ultimate owner's voting rights equal cash flow rights (*SEPF*). If a firm's ultimate owner's voting rights equal to cash flow rights, this indicates that the firm has strong corporate governance. We create a dummy variable which equals one if a firm's ultimate owner's voting rights equal cash flow rights, 0 otherwise. The dummy variable of one indicates that a firm has strong corporate governance than firms with a zero dummy variables. Again, we use an interaction term between *Trust* and *SEPF* and add both the interaction term and variable of *SEPF* to our baseline regression. Columns (1) and (2) of Table 9 report the regression results. Both interaction terms in panel B are negative and statistically significant at the 5% level, which is -0.7251 and -1.1359 respectively. The result confirms the findings in panel A of Table 9, indicating social trust promotes a firm's *R&D* expenditure when the firm has weak corporate governance.

Overall, the results in Table 9 suggest that the significantly positive relationship between *Trust* and a firm's *R&D* expenditure is more pronounced for firms with weak corporate governance. Our results support the principal-agent framework.

[Insert Table 9 here]

5.4 The Role of Financial Characteristics

In this section, we examine how the heterogeneity of corporate financial characteristics affects our main findings. First, Guo et al. (2016) find that big firms are more likely to receive government *R&D* subsidies and thus invest more in their *R&D* expenditure. More importantly, Maskus et al. (2012) find that European firms with the high value of tangible assets are easier to get external financial support to their *R&D* investment. Compared to the big firms, small firms may need to rely on social trust to get financial support for their *R&D* expenditure. Therefore, we expect that social trust would be more beneficial to small firm's *R&D* expenditure than big firms. We measure a firm's size by using its total assets. Panel A of Table 10 examines the effect of firm size on our main findings. We create an interaction term between *Trust* and *Size* and add both the interaction term and variable of *Size* to our baseline regression. Both columns (1) and (2) show that the coefficients of the interaction terms are significantly negative, which are -1.2489 and -1.4846 respectively. Results confirm that our main findings are more significant to small firms than big firms.

Second, we employ a proxy to measure a firm's financial characteristics, i.e. the firm's free cash flow (*CF*). Panel B of Table 10 reports the regression results. Since *R&D* expenditure requires a firm's cash to invest, firms with more free cash flow could afford more *R&D* expenditure than other firms (Szewczyk et al., 1996; Driver & Guedes, 2012). Consequently, firms with low free cash flow may rely more on social trust to finance their *R&D* expenditure. We use an interaction term between *Trust* and *CF* and add both the interaction term and variable of *CF* to our baseline regression. Columns (1) and (2) show that the coefficients of the interaction terms are -0.4468

(significant at the 10% level) and -1.3379 (significant at the 1% level), respectively. Results confirm our expectation.

[Insert Table 10 here]

6. Robustness Tests

In this section, we perform three robustness tests for our baseline regression. Table 11 reports these results. Panel A examines the effect of social trust on a firm's corporate innovation outputs; Panel B employs various measures of social trust to re-examine our main results, and Panel C performs an alternative model specification.

Panel A examines the impact of *Trust* on the output of a firm's *R&D* expenditure. We measure the output of the firm's *R&D* expenditure by either the natural logarithm of the total number of patent applications from the firm in year *t* (*Patent1*) or the natural logarithm of the sum of the number of patents, utility model and design applications from the firm in year *t* (*Patent2*). By following Chen and Zhang (2019), we collect both data from the China National Intellectual Property Administration (CNIPA). Compare to the patent applications, the patents of the utility model and design can be straightforwardly granted and published to the applicants after preliminary examination. Therefore, the utility model and design patents embody less technological components than invention patents (Xie & Zhang, 2015). To examine the impact of *Trust* on the output of a firm's *R&D* expenditure, we re-run the baseline regression by replacing a firm's *R&D* expenditure by either *Patent1* or *Patent2* in Panel A of Table 11. Both models report positive coefficients of *Trust* which are significant at the 1% level.

Results of Panel A suggest that firms located in a province with a high level of social trust generate more outputs from their *R&D* expenditure.

Panel B of Table 11 reports results by replacing our main *Trust* variable by either *Trust2* or *Trust3*, which are defined in Section 3.2. Once again, columns (1) and (3) report single variate regression results, whereas columns (2) and (4) report multi-variate regression results with the full set of control variables. Overall, all columns show a significantly positive relationship between a firm's R&D expenditure and our trust measures regardless of controlling for other corporate characteristics.

Panel C performs a model specification test by using a Tobit regression. In sum, the positive relationship between *Trust* and a firm's *R&D* expenditure measured by *R&D1* and *R&D2* remain significant. Our results are robust for a model specification test.

[Insert Table 11 here]

7. Conclusion

In this paper, we examine the impact of social trust on a firm's *R&D* expenditure from 2007 to 2018 in China. We measure social trust by using province-level enterprise trustworthiness, taken from a survey conducted by the Chinese Enterprise Survey System (CESS). Empirically, we find a significantly positive relationship between social trust and the firm's *R&D* expenditure. Our results are also economically significant: one standard deviation increase in the measure of *Trust* would result in a 11.76 million RMB increase in a firm's *R&D* expenditure. To alleviate the potential

endogeneity problems, we employ the instrumental variable approach and the PSM test. Our main findings survive in both endogeneity tests. Furthermore, we find that our main results are more robust for non-SOEs, firms in low marketable regions, firms with weak corporate governance, small size and low cash flows. Finally, we perform three robustness tests. We find that our main findings are robust by using the outputs of a firm's *R&D* expenditure and alternative proxies of social trust, and remain significant by using a Tobit regression.

Overall, our results confirm the importance of social trust as a key element of social capital in promoting a firm's *R&D* expenditure. Our results have some significant policy implications to both governments and firms. On the one hand, Chinese local government should understand the role of social capital in affecting a firm's *R&D* expenditure and even the local economic growth. Therefore, the local government may need to build up reliable social trustworthiness. On the other hand, our results show how corporate characteristics reshape the impact of social trust on *R&D* expenditure and thus help firms learn how to use social capital to effectively finance their *R&D* expenditure.

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Table 1: Descriptive statistics

Table1 presents the summary statistics and sample selection. Panel A summarizes the descriptive statistics of all variables. Panel B is the industry distribution for sample firms. All variables are defined in the Appendix.

Panel A Summary Statistics

Variable	N	Mean	SD	Min	25th	Median	75th	Max
R&D1	13062	0.0088	0.0143	0.0000	0.0000	0.0116	0.0375	0.0736
R&D2	13062	0.0142	0.0234	0.0000	0.0000	0.0107	0.0576	0.1224
Trust	13062	0.7444	0.6783	0.0270	0.1410	0.3210	1.172	2.1890
Size	13062	22.442	1.3324	20.0016	21.4938	22.2821	23.2686	25.7979
ROA	13062	0.0377	0.0496	-0.1190	0.0123	0.0329	0.0627	0.1631
Lev	13062	0.5012	0.1967	0.1098	0.3524	0.5074	0.6537	0.8760
Age	13062	2.4669	0.7154	0.3167	2.2946	2.7091	2.9424	3.2297
CF	13062	0.0467	0.0715	-0.1310	0.0055	0.0461	0.0902	0.2166
Share	13062	0.3631	0.1582	0.0029	0.2378	0.3436	0.4771	0.8941
Dual	13062	0.1640	0.3703	0.0000	0.0000	0.0000	0.0000	1.0000
Ind	13062	0.3692	0.0554	0.0909	0.3333	0.3333	0.4000	0.8000
Board	13062	2.1860	0.2036	1.0986	2.0794	2.1972	2.1972	2.8904

Panel B Sample Selection and Distribution

Industry	Observations	Percentage (%)
A: Farming. Forestry. Animal Husbandry & Fishery	224	1.71%
B: Mining and Quarrying	482	3.69%
C0: Food and Beverage	648	4.96%
C1: Textile. Clothing. Fur	411	3.15%
C2: Timber, Furniture Industry	81	0.62%
C3: Papermaking. Printing	228	1.75%
C4: Petroleum. Chemical. Rubber. Plastic	1,182	9.05%
C5: Electronic	432	3.31%
C6: Metal. Non-metal	1,111	8.51%
C7: Machinery. Equipment. Instrument	2,197	16.82%
C8: Medicine. Biologic Products	869	6.65%
C9: Other manufacturing	73	0.56%
D: Production & Supply of Power. Gas & Water	597	4.57%
E: Construction	291	2.23%
F: Transportation. Storage	609	4.66%
G: Information Technology Industry	738	5.65%
H: Wholesale and Retail Trades	925	7.08%
J: Real Estate	851	6.52%
K: Social Services	496	3.80%
L: Transmitting. Culture Industry	213	1.63%
M: Integrated	404	3.09%
A-share firms used for analysis over the period 2007–2018	13,062	100%

Table 2: Pearson and Spearman Correlation Analysis

Table 2 reports the correlation coefficients between all variables. The upper-right reports the Spearman correlation coefficients while the lower-left reports the Pearson correlation coefficients. ***. **. and * represent significance levels of 1%, 5%, and 10%, respectively. Variables are Winsorized at the 1% level.

	R&D1	*R&D2*	*Trust*	*Size*	*ROA*	*Lev*	*Age*	*CF*	*Share*	*Dual*	*Ind*	*Board*
R&D1		0.928***	0.067***	0.066***	0.086***	-0.175***	0.003	0.028***	0.008	0.105***	0.044***	-0.086***
R&D2	0.843***		0.060***	0.077***	0.055***	-0.183***	0.024***	0.004	-0.015*	0.117***	0.050***	-0.090***
Trust	0.072***	0.064***		0.080***	0.115***	-0.048***	-0.026***	0.023**	0.088***	0.041***	0.001	-0.013
Size	-0.027***	-0.025***	0.110***		-0.024***	0.387***	0.173***	0.027***	0.242***	-0.098***	0.081***	0.198***
ROA	0.126***	0.053***	0.088***	0.004		-0.435***	-0.198***	0.410***	0.146***	0.070***	-0.029***	-0.012
Lev	-0.170***	-0.195***	-0.053***	0.386***	-0.406***		0.150***	-0.196***	0.024***	-0.083***	0.026***	0.104***
Age	-0.161***	-0.153***	-0.084***	0.133***	-0.229***	0.225***		-0.111***	-0.206***	-0.092***	0.006	-0.043***
CF	0.053***	0.000	0.015*	0.022**	0.403***	-0.199***	-0.098***		0.100***	0.002	-0.034***	0.065***
Share	-0.028***	-0.062***	0.087***	0.264***	0.148***	0.022**	-0.214***	0.096***		-0.079***	0.025***	0.014
Dual	0.103***	0.120***	0.032***	-0.091***	0.056***	-0.082***	-0.157***	-0.002	-0.078***		0.059***	-0.141***
Ind	0.028***	0.034***	0.015*	0.104***	-0.019**	0.027***	-0.032***	-0.039***	0.044***	0.063***		-0.385***
Board	-0.072***	-0.078***	0.000	0.217***	-0.006	0.106***	0.019**	0.065***	0.020**	-0.131***	-0.400***	

Table 3: The Relationship between Firms' *R&D* Expenditure and Social Trust

Table 3 presents the relationship between a firm's *R&D* expenditure and the social trust level in the province where the firm locates. The dependent variable is the firm's *R&D* expenditure which is defined as the firm's *R&D* expenditure scaled by either the firm's total assets (*R&D1*) or the firm's total operating income (*R&D2*). All control variables are defined in the Appendix. We control for industry fixed effect and year fixed effect and adopt the robust standard errors clustered at the firm level in the regression. Robust t-statistics are reported in parentheses. ***. **. and * represent significance levels of 1%, 5%, and 10%, respectively.

	R&D1		*R&D2*	
	(1)	(2)	(3)	(4)
Trust	1.1506***	0.7995***	1.3509***	0.8722***
	(7.8671)	(5.4090)	(5.4633)	(3.4882)
Size		-0.2244**		0.2069
		(-2.3307)		(1.3172)
ROA		22.9086***		-6.2725
		(8.6825)		(-1.3577)
Lev		-0.9249		-10.4103***
		(-1.4378)		(-9.5169)
Age		-2.1825***		-4.0831***
		(-12.7236)		(-14.5108)
CF		8.8388***		4.7187**
		(5.6099)		(1.9725)
Share		-1.4604**		-6.7662***
		(-2.2143)		(-6.2117)
Dual		0.2492		1.3067***
		(0.8482)		(2.6954)
Ind		-1.4931		-3.5001
		(-0.7752)		(-1.1248)
Board		1.3958**		2.0359**
		(2.4560)		(2.1911)
Intercept	-4.4485***	3.0544	-7.6457***	1.7605
	(-7.8502)	(1.4142)	(-6.6452)	(0.5213)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Adjust R^2	0.3836	0.4109	0.4018	0.4260
N	13062	13062	13062	13062

Table 4 Endogeneity Test I: 2SLS using Blood Donation as IV

Table 4 shows the 2SLS regression results. The instrumental variable, *Blood*, measures the percentage of the population who donates their blood in a province. All other variables are defined in the Appendix. We control for industry fixed effects and year fixed effects and adopt robust standard errors clustered at the firm level in the regression. Robust t-statistics in parentheses. ***. **. and * represent significance levels of 1%, 5%, and 10%, respectively.

	Trust	*R&D1*	*R&D2*
	(1)	(2)	(3)
Blood	0.0079***		
	(146.0731)		
Trust		0.7376***	1.1587***
		(4.0008)	(3.7067)
Size	-0.0101***	-0.2194**	0.1839
	(-3.4802)	(-2.2672)	(1.1643)
ROA	0.4914***	22.9225***	-6.3370
	(6.8915)	(8.6976)	(-1.3731)
Lev	0.0019	-0.9470	-10.3079***
	(0.1023)	(-1.4733)	(-9.4170)
Age	-0.0082*	-2.1868***	-4.0632***
	(-1.7522)	(-12.7468)	(-14.4809)
CF	0.1616***	8.8439***	4.6949**
	(3.5422)	(5.6229)	(1.9655)
Share	-0.1351***	-1.4465**	-6.8309***
	(-6.8913)	(-2.1971)	(-6.2812)
Dual	0.0127	0.2513	1.2967***
	(1.5812)	(0.8572)	(2.6803)
Ind	-0.3141***	-1.5073	-3.4345
	(-5.4710)	(-0.7830)	(-1.1051)
Board	-0.0916***	1.3947**	2.0407**
	(-5.6534)	(2.4579)	(2.1997)
Intercept	-0.0042	2.9969	2.0265
	(-0.0624)	(1.3890)	(0.5996)
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
Adjust R^2	0.7696	0.4109	0.4260
Wald value	617.49***	7839.94***	8284.80***
N	13062	13062	13062

Table 5 Endogeneity Test II: 2SLS using Ethnicity and Language as IVs

Table 5 shows the 2SLS regression results. We use two variables of *Ethnicity* and *Language* as instrumental variables. All other variables are defined in the Appendix. We control for industry fixed effects and year fixed effects and adopt robust standard errors clustered at the firm level in the regression. Robust t-statistics in parentheses. ***. **. and * represent significance levels of 1%, 5%, and 10%, respectively.

	Trust	*R&D1*	*R&D2*
	(1)	(1)	(2)
Ethnicity	-0.2911***		
	(-54.3969)		
Language	-0.0292***		
	(-25.5764)		
Trust		1.4941***	2.1349***
		(5.1588)	(4.8012)
Size	0.0519***	-0.2802***	0.1054
	(10.6552)	(-2.8646)	(0.6588)
ROA	0.0262	22.7523***	-6.5567
	(0.2210)	(8.6341)	(-1.4197)
Lev	-0.2803***	-0.6766	-9.9590***
	(-8.6758)	(-1.0429)	(-9.0683)
Age	-0.0174**	-2.1343***	-3.9955***
	(-2.1734)	(-12.4302)	(-14.2172)
CF	-0.0045	8.7813***	4.6142*
	(-0.0572)	(5.5801)	(1.9304)
Share	0.1393***	-1.6171**	-7.0510***
	(4.0793)	(-2.4406)	(-6.4701)
Dual	0.0388***	0.2251	1.2629***
	(2.9988)	(0.7670)	(2.6061)
Ind	0.3488***	-1.3343	-3.2113
	(3.5874)	(-0.6936)	(-1.0326)
Board	0.0958***	1.4074**	2.0571**
	(3.4467)	(2.4794)	(2.2155)
Intercept	-0.0835	3.6994*	2.9332
	(-0.7443)	(1.7024)	(0.8639)
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
Adjust R^2	0.3378	0.4099	0.4248
N	13062	13062	13062

Table 6 Endogeneity Test III: Propensity Score Matching Approach (PSM)

Table 6 presents a propensity-score-matched sample result. We divided all sample firms into two groups by using the median value of Social Trust. Panel A compares firm characteristics between the treated group and the control group. Panel B presents the estimation results based on 1:1 matched sample. The dependent variable is the firm's *R&D* expenditure which is defined as the firm's *R&D* expenditure scaled by either the firm's total assets (*R&D*1) or the firm's total operating income (*R&D*2). All control variables are defined in the Appendix. We control for industry fixed effect and year fixed effect and adopt the robust standard errors clustered at the firm level in the regression. Robust t-statistics in parentheses. ***. **. and * represent significance levels of 1%, 5%, and 10%, respectively.

Panel A The Difference between the treated group and the control group

		Post matching	
Variable	Treatment sample	Control sample	t-statistic
R&D1	0.0098	0.0083	5.11***
R&D2	0.0152	0.0138	2.92***
Size	22.4180	22.439	-0.80
ROA	0.0393	0.0392	0.05
Lev	0.4966	0.5003	-0.92
Age	2.4661	2.4603	0.39
CF	0.0475	0.0467	0.51
Share	0.3618	0.3642	-0.74
Dual	0.1659	0.1697	-0.49
Ind	0.3678	0.3680	-0.14
Board	2.1845	2.1875	-0.74

Panel B: Estimation based on the propensity-score-matched sample

		R&D1		*R&D2*
	(1)	(2)	(3)	(4)
DTrust	1.4789***	1.4903***	1.3737***	1.3685***
	(6.3674)	(6.5810)	(3.7125)	(3.7813)
Intercept	-4.7744***	0.7834	-8.5978***	-0.6811
	(-6.0978)	(0.2996)	(-5.5105)	(-0.1680)
Control Variables	No	Yes	No	Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Adjust R^2	0.3934	0.4232	0.4159	0.4413
N	9522	9522	9522	9522

Table 7: The Effect of State Ownership on the Relationship between Social Trust and Firms' *R&D* expenditure

Table 7 presents the results on how state ownership affects the relationship between social trust and firms' *R&D* expenditure. We only report the coefficients on the variable of *Trust*, the interventional variable, and an interaction variable between the *Trust* and the interventional variable. All control variables are defined in the Appendix. We control for industry fixed effect and year fixed effect and adopt the robust standard errors clustered at the firm level in the regression. Robust t-statistics in parentheses. ***. **. and * represent significance levels of 1%, 5%, and 10%, respectively.

	R&D1	*R&D2*
	(1)	(2)
Trust	1.9181***	2.4422***
	(6.8856)	(4.9236)
Trust **SOE*	-1.6985***	-2.3330***
	(-5.2024)	(-4.0904)
SOE	1.4152***	0.8616*
	(4.5532)	(1.6613)
Intercept	1.9084	-1.6390
	(0.8293)	(-0.4553)
Control Variables	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Adjust R^2	0.4123	0.4272
N	13062	13062

Table 8: The Effect of Marketization on the Relationship between Social Trust and Firms' *R&D* Expenditure

Table 8 presents the results on how a provincial marketization level affects the relationship between social trust and firms' *R&D* expenditure. We only report the coefficients on the variable of *Trust*, the interventional variable, and an interaction variable between the *Trust* and the interventional variable. All control variables are defined in the Appendix. We control for industry fixed effect and year fixed effect and adopt the robust standard errors clustered at the firm level in the regression. Robust t-statistics in parentheses. ***. **. and * represent significance levels of 1%, 5%, and 10%, respectively.

	R&D1	*R&D2*
	(1)	(2)
Trust	1.9725***	1.8169*
	(3.0296)	(1.7542)
*Trust *MAR*	-2.4631***	-2.5758**
	(-3.5418)	(-2.2892)
MAR	2.4550***	3.0562***
	(5.9037)	(4.3749)
Intercept	2.1650	0.6542
	(0.9982)	(0.1922)
Control Variables	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Adjust R^2	0.4124	0.4269
N	13062	13062

Table 9: The Effect of Corporate Governance on the Relationship between Social Trust and Firms' *R&D* expenditure

Table 9 presents the results on how corporate governance affects the relationship between social trust and firms' *R&D* expenditure. Panel A is for a firm's internal control and Panel B is based on whether or not a firm's ultimate owner's voting rights equal cash flow rights. We only report the coefficients on the variable of *Trust*, the interventional variable, and an interaction variable between the *Trust* and one of the two interventional variables. All control variables are defined in the Appendix. We control for industry fixed effect and year fixed effect and adopt the robust standard errors clustered at the firm level in the regression. Robust t-statistics in parentheses. ***. **. and * represent significance levels of 1%, 5%, and 10%, respectively.

Panel A: The effect of internal control

	R&D1	*R&D2*
	(1)	(2)
Trust	1.1192***	1.4412***
	(5.3226)	(3.8009)
*Trust*IC*	-0.6846**	-1.1213**
	(-2.3873)	(-2.2944)
IC	1.4204***	1.1761**
	(4.9548)	(2.4642)
Intercept	4.6477**	1.8136
	(2.0985)	(0.5195)
Control Variables	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Adjust R^2	0.4120	0.4263
N	13062	13062

Panel B The effect of controlling shareholders

	R&D1	*R&D2*
	(1)	(2)
Trust	1.2493***	1.4912***
	(5.5503)	(3.8747)
*Trust*SEPF*	-0.7251**	-1.1359**
	(-2.4211)	(-2.2476)
SEPF	0.4569	0.2304
	(1.6085)	(0.4940)
Intercept	1.5295	-0.4020
	(0.6738)	(-0.1128)
Control Variables	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Adjust R^2	0.4119	0.4252
N	13062	13062

Table 10 The Effect of Corporate Financial Characteristics on the Relationship between Social Trust and firms' *R&D* Expenditure

Table 10 presents the results on how corporate financial characteristics affect the relationship between social trust and firms' *R&D* expenditure. in Panel A is for firm size and Panel B is for a firm's cash flow . We only report the coefficients on the variable of *Trust*, the interventional variables, and an interaction variable between the *Trust* and one of the four interventional variables. All control variables are defined in the Appendix. We control for industry fixed effect and year fixed effect and adopt the robust standard errors clustered at the firm level in the regression. Robust t-statistics in parentheses. ***. **. and * represent significance levels of 1%, 5%, and 10%, respectively.

Panel A The effect of firm size

	R&D1	*R&D2*
	(1)	(2)
Trust	1.4536***	1.6497***
	(6.5473)	(4.4287)
*Trust*Size*	-1.2489***	-1.4846***
	(-4.8094)	(-3.4444)
Size	0.0683	0.5549***
	(0.6171)	(3.0877)
Intercept	-3.5594	-6.1016
	(-1.4243)	(-1.5411)
Control Variables	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Adjust R^2	0.4121	0.4266
N	13062	13062

Panel B The effect of firm's cash flow

	R&D1	*R&D2*
	(1)	(2)
Trust	1.0411***	1.5928***
	(5.4256)	(4.5565)
*Trust*CF*	-0.4486*	-1.3379***
	(-1.9221)	(-3.4053)
CF	10.6278***	10.0543***
	(5.8678)	(3.7075)
Intercept	2.8869	1.2609
	(1.3350)	(0.3733)
Control Variables	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Adjust R^2	0.4111	0.4266
N	13062	13062

Table 11 Robustness Tests

Table 11 reports the results of robustness tests for our main findings. Panel A reports results when we use the output of a firm's *R&D* expenditure to replace the firm's *R&D* expenditure as the dependent variables. Panels B reports results on the use of alternative proxies for social trust. Panel C reports the results based on Tobit regressions. We only report the coefficients on the variable of *Trust*. All control variables are defined in the Appendix. We control for industry fixed effect and year fixed effect and adopt the robust standard errors clustered at the firm level in the regression. Robust t-statistics in parentheses. ***. **. and * represent significance levels of 1%, 5%, and 10%, respectively.

Panel A The Measure of Patents

	Patent1	*Patent2*
	(1)	(2)
Trust	0.1677***	0.1836***
	(10.5066)	(10.0119)
Intercept	-11.5776***	-12.9390***
	(-43.5460)	(-44.9745)
Control Variables	Yes	Yes
Industry	Yes	Yes
Year	Yes	Yes
Adjust R^2	0.4418	0.4830
N	12967	12967

Panel B Variate Measure of Trust

	R&D1	*R&D1*	*R&D2*	*R&D2*
	(1)	(2)	(3)	(4)
Trust2	5.3881***		5.3057**	
	(3.7677)		(2.1718)	
Trust3		4.8077***		5.4108***
		(7.8978)		(5.0313)
Intercept	3.0797	-11.5289***	1.7066	-14.6367***
	(1.4188)	(-4.2626)	(0.5031)	(-3.1369)
Control Variables	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Adjust R^2	0.4102	0.4127	0.4257	0.4269
N	13062	13003	13062	13003

Panel C Tobit Regression

		R&D1		*R&D2*
	(1)	(2)	(3)	(4)
Trust	2.4172***	1.5702***	3.0957***	1.8153***
	(9.5318)	(6.1171)	(6.9286)	(3.9937)
Intercept	-32.0127***	-42.9862***	-79.2357***	-104.8776***
	(-19.3876)	(-10.7089)	(-17.0743)	(-14.4102)

Control Variables	No	Yes	No	Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Pseudo R^2	0.1367	0.1429	0.1539	0.1596
N	13062	13062	13062	13062

Appendix Variable definition

Variable	Definition	Computation
R&D1	A firm's *R&D* expenditure	A firm's *R&D* expenditure over by the firm's total asset
R&D2	A firm's *R&D* expenditure	A firm's *R&D* expenditure over by the firm's total operation income
Trust	Social trust	A province-level index from a survey conducted by the Chinese Enterprise Survey System
Size	Firm size	Natural logarithm of total assets;
ROA	Firm performance	The ratio of net earnings to total assets;
Lev	Leverage	The ratio of total liabilities to total assets;
Age	Firm age	The natural logarithm of the number of years since a firm's inception;
CF	Cashflow	A firm's total cash flow over by the firm's total asset
Share	Top shareholding	The proportion of shares held by the largest shareholder;
Dual	CEO-chairman duality	A dummy variable equals 1 if a firm's CEO also serves as the chairman of the board;
Ind	Independent directors	The proportion of independent directors;
Board	Number of directors	The natural logarithm of the number of directors on board;
Blood	Blood Donation	The percentage of the population who perform the duty to donate blood in a province in 2011;
Ethnicity	Ethnicity	The numbers of ethnic groups whose population exceeds 3% in a province;
Language	Language	The sum of Chinese dialects and minority languages in a province at year t according to Atlas of Chinese Language;
SOE	SOE	A dummy variable, taking the value of 1 if a firm is an SOE, and 0 otherwise;
MAR	The marketization index where the firm locates	Dummy variable, taking a value of 1 is the region has an above-median marketization index, and 0 otherwise.
IC	A firm's internal control	Dummy variable, Dibo internal control index developed by the Shenzhen Dibo Internal Control Database. The index is available from http://irmd.dibcn.com:8082/irmd/common/login.jsp
SEPF	Whether or not a firm's ultimate owner's voting rights equal to cash flow rights	Dummy variable, taking the value of 1 if the ultimate owner's voting rights equal to cash flow rights, and 0 otherwise
Patent1	A firm's patent application	The natural logarithm of the sum of numbers of patents applications in year *t*;
Patent2	A firm's patent application	The natural logarithm of the sum of numbers of patents, utility model and design applications in year *t*;