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# ESSAYS ON CORPORATE FINANCE

ZHOU SILI

SINGAPORE MANAGEMENT UNIVERSITY

2017

Essays on Corporate Finance

By

ZHOU Sili

Submitted to Lee Kong Chian School of Business in partial fulfilment of the requirements for the Degree of Doctor of Philosophy in Business (Finance)

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# Essays on Corporate Finance

Chapter 1:

## Policy Sensitive Firms and Market Value in China

Sili Zhou

Abstract: Economic Policy uncertainty under political opaqueness imposes great impact in the capital market. I construct ex ante cross-section of firm sensitivity to China Economic Policy Uncertainty (CEPU) index from Baker, Bloom and Davis (2013). This measure of policy sensitivity is significantly negatively predictive of a firm's market value and Tobin's Q. Cross sectional tests show that the negative effects are stronger in SOEs, for firms with higher agency problems, and for firms operating in market with lower degree of competition or market disciplining. The evidence suggests that high level of policy influence causes significant value destruction in the capital market.

Chapter 2:

## Export, Ownership and Innovation: Evidence from China

Xiaping Cao, Shuyu Xue, Sili Zhou

Abstract: We provide micro-firm evidence how global trade promotes corporate innovation in China. Firms with high level of foreign export innovate more than firms relying on domestic sales. The difference in patents for firms with high vs. low level of foreign exports is significant in magnitude and increases drastically

over time. Such difference is more pronounced in non-SOE subsample. A battery of endogeneity tests including RMB policy change or bilateral treaties show that export has a causality effect on innovations. Within industries evidence suggests that Chinese multinationals catch up on patents where US peers retreat. Firms with export enjoy technology spill-over from US innovation in low-tech industries but not high tech. Our research suggests that global export improves technology spill-over Chinese multinationals especially non-SOEs and low-tech firms.

Chapter 3:

## Trade Credit, Ownership and Informal Financing in China

Xiaping Cao, Sili Zhou

Abstract: We investigate informal financing such as accounts receivable and payable of state-owned enterprises (SOEs) and non-SOEs in China. The volume of informal financing dramatically increased and non-SOEs significantly more rely on them than SOEs. SOEs with abundance of liquidity or during financial crisis are able to provide informal financing to non-SOEs. Fast growing firms do not seem to rely more on informal financing. Our research highlights the importance of informal financing and ownership structures in emerging markets.

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# Chapter 1:

# Policy Sensitive Firms and Market Value in China

Sili ZHOU*

**Abstract**

Economic Policy uncertainty under political opaqueness imposes great impact in the capital market. I construct ex ante cross-section of firm sensitivity to China Economic Policy Uncertainty (CEPU) index from Baker, Bloom and Davis (2013). This measure of policy sensitivity is significantly negatively predictive of a firm's market value and Tobin's Q. Cross sectional tests show that the negative effects are stronger in SOEs, for firms with higher agency problems, and for firms operating in market with lower degree of competition or market disciplining. The evidence suggests that high level of policy influence causes significant value destruction in the capital market.

**Keywords:** Policy sensitivity, Firm value, Governance, China, Agency problem, Capital market

**JEL:** D80, G18, G32, G10

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# 1.1. Introduction

Changes in government's economic policies on fiscal, regulatory and monetary issues present an important source of policy uncertainty that casts great impacts on financial markets. However, the theoretical and empirical literatures about how the uncertainty on economic policy affects corporation's value offer contradictory predictions. The irreversible investment suggests that it is optimal for firms to defer their investment since the uncertainty increases the opportunity cost to wait and decreases value of firm (Bernanke (1983), McDonald and Siegel (1986), Pindyck (1991), Abel and Eberly (1994), Dixit and Pindyck (1994), Bulan (2005), Bloom et al. (2007), Bloom (2009)). On the other hand, there are other papers that the option to wait is less valuable thus uncertainty increases investment (Carballero (1991), Grenadier (2002), Weeds (2002), Abel et al. (1996), Hartman (1972) and Abel (1983)). Recently, Baker, Bloom and Davis (2013) empirically construct an index of aggregate policy uncertainty as a weighted average of three different components[1]. This index captures great policy uncertainty periods such as debt-ceiling crisis and presidential election, as investors require high compensation to bear undiversifiable policy risk (Pastor and Veronesi (2013), Brogaard and Detzel (2015), Kelly et al, (2016)).

In this paper, I employ the China Economic Policy Uncertainty (CEPU) index from Baker et al. (2013)[2] and focus on the impact of CEPU on firm market

[1] The frequency of newspaper references to economic policy uncertainty, the number of federal tax code provisions set to expire, and the extent of forecaster disagreement over future inflation and government purchases.

[2] To measure economic policy uncertainty for China, Baker, Bloom, Davis and Wang (2013) construct a

value. Chinese capital market is the ideal setting to examine whether a firm's policy association may destroy market value or enhance value. Unlike U.S. setting, Chinese government has strong influence on the market through direct channel such as changes in fiscal, monetary and regulatory policies. Secondly, many listed firms are state owned enterprises (SOEs) and their CEOs are indirectly influenced by the government policies and there is more policy uncertainty than private firms for the varying in government policies. SOEs by its ownership nature are likely to be sensitive to economic policy uncertainty. Non-SOEs on the other hand are also greatly sensitive to policy uncertainty, since they have incentives to establish policy connections to extract rents and gain favourable treatments from the government (Faccio, 2010).

One of the most challenging parts is to measure how firm policy uncertainty. Previous studies have use proxies such as volatility in stock return, dispersion in analyst forecasts to measure firm level uncertainty (Bloom et al. (2007), Bond and Cummins (2004)) . However, all these measures cannot truly capture the firm-specific policy uncertainty. To quantitatively measure the degree of policy uncertainty[3], I propose a new measure of corporate policy sensitivity by regression a firm's prior rolling monthly stock returns on the monthly CEPU using a modified CAPM model or Fama and French (1992)'s three factor method. The estimated coefficient of CEPU sensitivity provides an ideal score on how a firm

scaled frequency count of articles about policy-related economic uncertainty in the South China Morning Post (SCMP), Hong Kong's leading English-language newspaper.

[3]The economic policy uncertainty index of Baker et al. (2013) has been widely used in literature. (Pastor and Veronesi (2012,2013), Brogaard and Detzel (2015) and Kelly et al. (2016), Chen et al. (2016).

react to government policy uncertainty heterogeneously. [4]

China stock market is unique. Morck, Yeung and Yu (2000) find that Chinese stocks exhibit abnormally high systematic risk as measured as the R-squared in the CAPM model. Their interpretation is that firms' idiosyncratic risk is largely ignored due to synchronous trading behaviour of the investors. I modify their model by including the CEPU index in the CAPM model and estimate each firm's policy loadings on CEPU index. I show that firms cross-sectional have significant policy loadings on CEPU index, suggesting that policy uncertainty is important source of market volatility that is not captured by the market beta from CAPM alone. Similarly, I also use Fama and French's three factors by including CEPU index and estimate a firm's policy uncertainty loading.

Chen, Jiang and Tong (2016) investigate the impact of CEPU index on the time series variation of Chinese stock market expected return. Their findings mainly focus on the negative predictor of CEPU on future stock market turn on various investor horizons. Different from their results, my paper put emphasis on how policy uncertainty impacts on cross-sectional firm-level market value. I hypothesize that high degree of policy association destroys market value since investor disagreement is high. Cross-sectional I hypothesize that there exists greater value destruction effects for firms that suffer high degree of agency problem, such as dual agency problem faced by SOEs. In this paper, I find that higher sensitive firms lead firms Tobin Q drop about 2.0% to 3.1% and SOEs

[4]This estimation measure is approached by many researchers. (Brogaard and Detzel (2015), Xu(2016), Chen et al. (2016), Akey and Lewellen (2015)).

dominate the value destruction effect. Similar results are reported when alternative measures of firm market value such as current value of Tobin's Q or logarithm of market value is used. The negative effects of policy sensitivity on firm value are significantly larger for firms with low leverage, high degree of product market competition, high cash flows, and firms operating in market with low market index.

The other big challenge is identification issue. My first identifying approach is to disentangle whether the value destruction comes from cross-sectional or time-series differences. I use a shock to CEPU index to understand the different effect. By construction, the CEPU index is calculated from news coverage on Chinese polices. From 2004-2012, a new editor-in-chief Wang Xiangwei was in position and he is well known for being less independent to cover the uncertainty in South China Moring Post. Indeed, the policy uncertainty effect on firm value is more pronounced during 2004 and 2012. This confirms firm effect rather than time effect dominates market destroying. The second identifying strategy is to use 4 trillion yuan *Stimulation Plan* by central government in 2008 as a plausibly exogenous shock in the sample. Consistent with the hypothesis, I find that during the post three-year windows, the value destruction effect is more severe than other period. Finally, I used provincial leadership turnover of governors as geographic heterogeneously shocks to the policy sensitive firms. I argue that the positive (negative) type of turnover play opposite direction of firm value and amplify the risk level for those sensitive

firms.

My paper is the first to point out that firm market value destruction is caused by government economic policy uncertainty, which is distinct from the channels that have previously documented in political connection literature. There is a large literature shows that firm's political connection adds value. (Roberts (1990), Fisman (2001), Faccio (2006), Ramalho (2007), Li et al. (2008), Khwaja and Mian (2005), Goldman, Rocholl and So (2009), Cooper, Gulen and Ovtchinnikov (2010), Amore and Bennedsen (2013), Akey (2015)).On the contrary, political association may destroy value since connected firms may be less disciplined by capital markets and regulations (Berkman, Cole, and Fu (2010)), and therefore controlling shareholders of connected firms are more likely to retain earnings to expropriate minority shareholders (Qian, Pan, and Yeung(2011)). Fan,Wong, and Zhang (2007) shows that political connection destroys corporate market value for IPO firms in China. Instead of relying on individual director or manager's previous working experience as politicians or bureaucrats, I provide a most direct and generic measure of a firm's policy exposure by relying on market measure of stock's association with policy or CEPU index on monthly basis.

The paper is organized as flows. Section 2 summarizes the data and summary statistics. Section 3 describes the methodology for firm's sensitivity to China Economic Policy Uncertainty. Section 4 represents the main empirical results and Section 5 concludes the paper.

## 1.2. Data Construction and Summary Statistics

The monthly stock market trading data and monthly market trading data are obtained from Chinese Stock Market Accounting Research (CSMAR). The sample covers China-incorporated firms that are listed on the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE). Since class B shares are eligible for foreign investors with a discount on A shares (Sun, Tong, 2000), I only maintain stock return of class A shares. Those financial firms are excluded from my listed since they have different disclosure regulations and their liquidity positions are different from other firms. My main variables and firm characteristics data are also obtained from CSMAR for the period from 1998 to 2014. The sample period is chosen to match the availability of cash flow sheet in CSMAR database as CSMAR starts to collecting it from year 1998. I drop off delisted firms, such as ST or S*T because they have more strict regulation requirement by CSRC (China Security Regulation Committee). Considering the impact of extreme values and outliers, I winsorize all firm characteristics at the 1st and 99th percentiles. I also remove firms which have less than three years observation. As a result, the whole sample consists of 17,460 firm-year observations with 1,483 firms from 1999 to 2014.

I use a number of control variables suggested by previous literature in the Q specification. Appendix A lists the definitions of all key variables used in my analysis. Panel A of Table 1 give the summary statistics of key variables used in

this paper. The main dependent variable is Tobin's Q, defined as the book value of total assets minus book value of equity plus market value of equity scaled by book value of total assets. I also use two measurements of Q since the non-tradable shares is an important issue in China.[5] I also employ the natural logarithm of the market value (total market value) as an alternative measurement of firm market value. Size is the natural logarithm of the book value of total assets. Age is also the natural logarithm of the fiscal year minus the first IPO year. Cash flow is measured as EBIT plus depreciation and amortization minus interest expense and taxes scaled by lagged total assets. Leverage here is the sum of the short-term borrowings plus the long-term debts and divided by the lagged total assets. The measurement of firm-level investment here is the capital expenditures which includes the net cash payments from the acquisition of fixed assets, intangible assets and other long-term assets from the cash flow statement divided by the lagged book value of total assets.

As for the ownership information for state-owned enterprises (SOEs) and non-SOEs, I obtain the ultimate owner of listed firms as well as the largest shareholder ownership information from three different sources: WIND, RESSET, CSMAR. If their information conflict with each other, I recheck with the firm's official website as well as official news media such as Sina, Souhu etc. to double confirm the status of ownership at each year.

[5] Chen and Xiong (2002), Bai et al.(2004) discussed the issue of non-tradable shares in China maybe an important issue. We obtain other measurement of Tobin's Q as well and find similar results.

## 1.3. Sensitivity to China Economic Policy Uncertainty

My first task is to document how firms differ in their sensitivities to China economic policy uncertainty (CEPU). Based on my setting, I try to understand, among other things equal, what kinds of firms have a high policy sensitivity to CEPU and how sensitive firms various in other observable measurements: ownership (SOE v.s. non-SOE), leverage (high leverage v.s. low leverage), market competition (high HHI v.s. low HHI), cash flow (high CF v.s. low CF) and development of local market (high market index v.s. low market index). To begin with, I need to define a new measurement of firm's policy sensitivity.

I estimate each firm's exposure to economic policy uncertainty following Brogaard and Detzel (2015), Xu (2016) and use China Economic Policy Uncertainty (CEPU) by Baker et. al.(2015) as main measurement of policy uncertainty in China. Baker et al construct a monthly scaled frequency of articles about policy uncertainty in leading English-language newspaper starting from year 1995.

For each stock and for each month in my sample, I estimate the CEPU sensitivity from the monthly rolling regression of excess stock returns on CEPU over 60 month window:

$$R_{i,t} - Rf_t = \alpha + \beta_i^{CEPU} CEPU_t + \beta_i^{MKT} (Rm_t - Rf_t) + \varepsilon_{i,t}$$
$$t = m - 60, ..., m$$

The dependent variable is the monthly stock return with dividends. The risk free rate here is the monthly converted deposit and withdraws interest rate.

$CEPU_t$ is the China Economic Policy Uncertainty in month t and $\beta_i^{CEPU}$ measures the sensitivity of firm i to economic polity uncertainty. $Rm$ is defined as the monthly market return with dividends and here I adopted the value-weighted return[6].

Following Fama and French (1992), I estimate the beta of individual stocks using monthly return prior to 60 months if available with minimum of 24 months. Since the trading regulation (T+1) was introduced only after the year 1995, I start to use the monthly stock return after that period. Thus, the first non-missing CEPU sensitivity starts from December 1999. I obtain December of each year as the estimation of firm sensitivity score and combined with the annual financial report.

Following Akey and Lewellen (2015), I define a firm as being policy sensitive during the prior 60 months estimation if p-value is less than or equal to 0.10. I also differentiate a positive-sensitive firm from a negative-sensitive firm depending on the positive or negative of sensitivity score.

Panel B of Table 1 reports the summary statistics of sensitivity measurement by each year. I would find that roughly 10% of firms would be sensitive to CEPU since the p-value cutoff I have defined. Panel B also shows the time-series variation in the fraction of firms that sensitive to the CEPU. The most sensitive year is 2013, 2008 when a new central government takes over. But the

[6]As Chen and Xiong (2002), Bai et al.(2004) point out that non-tradable shares is an important issue in China, we consider two different measurements of value weighted market return: Current Value Weighted (CVW) market return and Total Value Weighted (TVW) market return. I also try to use the equalled-weighted return as for robustness check and the result is similar.

positive-sensitive firm v.s. negative-sensitive is totally different: 27% positive-sensitive v.s. 73% negative-sensitive in 2008 and 74% positive sensitive v.s. 26% negative-sensitive in 2013.

[Insert Table 1 here]

Figure 1 plots the geographic distribution of sensitivity percentage (as defined as number of sensitive firms to the total number of firms). It shows that Tibet, Qinghai and Xinjiang, ones with least developing areas have higher proportion of policy sensitive firms. While the most developing areas such as Zhejiang, Beijing, Shanghai, Guangdong, Jiangsu are among the middle position of this distribution.

[Insert Figure 1 here]

# 1.4. Empirical Results

## *1.4.1 Firm Performance and Policy Sensitivity*

Having documented that some firms are more sensitive to policy news than others, I now turn to answer the question, whether these policy-sensitive firms share lower values. Intuitively, policy sensitive firms will be more expropriated by politician thus their value should be less than policy-neutral firms.

I start to examine this channel formally in Table 2 and Table 3, where I regress firm market value on a firm's sensitivity score as well as sensitivity status. Specifically, in Table 2, I estimate panel regressions and include four-level

industry[7] and year fixed effects in all specifications. Standard errors are clustered at industry level. While in Table 3, I also conduct firm-year level estimation using the same procedure. Standard errors are clustered at firm level in Table 3. Tobin Q and the natural logarithm of (total) market value are employed as proxies for firm market value in both Table 2 and Table 3.

[Insert Table 2&3 here]

My interest variables are the firm's sensitivity score to policy uncertainty and the sensitivity dummy here. I find that sensitivity score are all significantly negative in all specification. The magnitude of sensitivity score is about -2.01% to -3.14%, indicating that each percent increase in sensitivity score in firms generally decrease the value of firm by about 2.01% to 3.14% on average. While the natural log of (total) market value as dependent variable, the magnitude of sensitivity score is about -1.11% to -1.19%[8]. As for the sensitivity dummy variable, the sensitive firms generally have -7.1% to 7.5% lower market value than those non-sensitive firms. Meanwhile, the sensitive firms have 3.3% to 3.4% lower in the measurement of the natural log of (total) market value.

I also find that smaller, older firm with more capital investment, lower leverage and more cash flow will generate higher Q. Besides, I also find that stated owned enterprise will have lower Q, which is consistent with the previous literature. All controls are significant except for capital investment in column 1 to column 4 when Tobin Q is dependent variable. In Table, I use firm fixed effect

[7] Four level CIS industry are used here. I also try to use different levels of industry classifications and the results are still robust.

[8] The magnitude is calculated like exp(-1.195%)-1 = -1.19%,exp(-1.117%)-1=-1.11%

instead of industry fixed effect and redo the regression. The results are quite similar as in Table 2. The sensitivity score are all negative and significant in all regression but the magnitude is much smaller. Most controls share the same sign as in Table 2 but the significance drops in column 1 to column 2 which may suffer from the potential multicollinearity problem when using the firm fixed effect.

### *1.4.2 Identification*

In this subsection, I first examine the time varying coefficient of sensitivity score on firm market value using the Fama-MacBeth(1973) cross-sectional regressions. Panel A in Table 4 reports the first step of cross sectional estimation for each year. I notice that most of coefficients are negative expect for the year 2013 and 2014.[9] Why this happens? Thus, I checked whether the turnover of the editor-in-chief of *South China Moring Post (SCMP)*. I find that Wang Xiangwei[10], a former Julin Province Committee, was promoted on February 2012 to be editor-in-chief. During his tenure in SCMP, more censorship was conducted and the suspicion of independence was raised by other media.[11] Therefore, I suspect that the coefficients of sensitivity on firm value should be varied. But the mean of the coefficients is still negative and it is still significant in all specification in Panel B in Table 4, consistent with the previous result.

[9] There are some positive coefficient years at the beginning of the sample. But this may become of the limited sample and I checked that they are not significant.

[10] See detailed of the announcement here: http://www.campaignasia.com/article/scmp-veteran-wang-xiangwei-steps-up-as-new-editor-in-chief/288831

[11] https://www.theguardian.com/media/greenslade/2012/jun/20/press-freedom-china.

[Insert Table 4 here]

I perform a variety of tests to mitigate the endogeneity issue of my main results. Firstly, I use the exogenous shock of November 9, 2008 when Chinese central government announced estimated at 4 trillion yuan (about 570 billion U.S. dollars) would be spent over the next two years to rescue the economic crisis at 2007.[12] Thus, this government spending should have larger effects on high sensitive firms to economic policy uncertainty.

In Table 5, I introduce a dummy variable *Simulation* to be one if the year is within next two years after stimulation plan was announced. Besides, the interaction term of stimulation dummy with sensitivity score is also included to capture the difference-in-difference of the post stimulation period v.s. the other period. As Table 4 has shown, the interaction terms are all significantly negative except for column 3 when log (MV) is dependent variable. Besides, the magnitude of interaction terms is much bigger controlling for the level of sensitivity score, which implies that value destruction is much stronger during monetary stimulation period. Similarly, the coefficient of sensitivity score is all negative and significant in all specifications, consistent with previous results.

[Insert Table 5 here]

In Table 6, I adopt another exogenous shock: the turnover of the provincial governor. Following Chen et al. (2005) and Li and Zhou (2005), I categorize

[12] China announced the economic-stimulus plan that will loosen credit conditions, cut taxes and embark on a massive infrastructure spending program to boost domestic demand to combat the crisis. Deng et al.(2015) have shown that the investment as well as credits of centrally controlled SOEs raises a lot after this monetary stimulation.

turnovers into two types: promotion turnover and terminal turnover. The promotion turnover is defined as cases when a top provincial leader gets promoted. On the other hand, the terminal turnover is defined as cases when a top leader is dead, demoted, resigned, or sentenced. I don't include the parallel-moved turnover (normal turnover) since the turnover may not necessarily have the outcome on the sensitivity changes on economic policy uncertainty. Thus, the Terminal (Promotion) Post Dummy equals to one if two years after a top provincial leader get promoted (terminated). As Table 5 shown, the interaction of sensitivity score with terminal (promotion) post dummy is significantly negative (positive). This result suggests that only negative shocks destroy firm value while the positive shocks, on the other hand, increase firm value.

[Insert Table 6 here]

I am also very interested to whether this kind of value destruction is stronger in SOEs or not. Thus I separate the sensitivity score into two parts: the interaction of SOE with sensitivity and the interaction of non-SOE with sensitivity and redo the regression as Table 2. The status of ultimate ownership is usually not time-variant, therefore I use industry fixed effect instead of firm fixed effect. From Table 7 we can see that the interaction term is all negative and significant for all specification. Specifically, the magnitude of sensitivity with SOE dummy is as twice bigger as sensitivity with non-SOE dummy. It suggests that the value destruction of policy sensitive firms is dominated by SOEs rather than non-SOEs.

[Insert Table 7 here]

Overall, the results indicate that more policy sensitive firms in China usually lead firm market value drop about 2.0% to 3.1% and the value destruction is especially stronger after monetary stimulation plan as well as two years after provincial top governor is terminated. Furthermore, SOE firms with more policy sensitivity may experience more from the drop of firm value.

### *1.4.3 Subsample Test*

In this session, I try to explore further about what kind of firms suffer from this policy sensitivity channel. Generally, I would divide full sample into two subsamples according to one of the firm characteristics: ownership, leverage, market competition, cash flow. Besides, I also consider whether the economic development of local market affect the channel of policy sensitivity on firm performance. Fan and Wang (2012) generate new measurement of market development indices in 31 provinces in mainland China based on five main components. It is widely used to measure how fast development of the market is in the geographical province. And I am interested to compare the cross-section difference of market development on how policy sensitivity destroys firm value.

Table 8 reports the regression results based on SOEs subsample and non-SOEs subsample. The coefficient of sensitivity is still negative but only significant in SOEs subsample. Besides, the magnitude of sensitivity in SOEs subsample is twice as big as that in non-SOEs subsample. This suggests that SOEs firms with more sensitive to economic policy uncertainty share lower market

value.

[Insert Table 8 here]

Table 9 separate the sample into firms with low leverage and firms with high leverage. I can see that firms with low leverage suffer more from value destroying with more sensitive to policy. This supports agency story, which means firms with more equity holders (low leverage) severally react more to the policy uncertainty than those firms with less equity holders.

[Insert Table 9 here]

In Table 10, I construct Herfindahl-Hirschman index (HHI) ratio by squaring the share of each firm sales at the industry level 2 and summing the share. Higher HHI usually means that industry exist a monopoly, or duopoly firm and lower HHI indicates nearly perfect or highly competitive market. I see that more competitive market is, more sensitive firms generate lower Tobin Q or (total) market value. While for relative monopoly industry, this relation is still negative but not significant.

[Insert Table 10 here]

Table 11 generates result for firms classified as high cash flow v.s. firms with low cash flow. We can see that firms in high cash flow subsample have lower firm value if they are more policy sensitive. It suggests that firms with less financial constraint dominated this value destruction channel, consistent with the agency story.

[Insert Table 11 here]

Finally, I employ the market index constructed by Fan and Wang (2012) to compare the developed (high market index) with developing (low market index) provinces in China. Since they only construct the data to year 2009, I match my firm level data with the availability of the market index data. I find that firm in those developing provinces suffer more from the value decreasing by more policy sensitive firms. Among developed areas like Shanghai, Beijing etc. do not have such strong linkage between sensitivity and value destroying.

[Insert Table 12 here]

In sum, I find that firm's sensitivity to policy uncertainty on firm value decreasing is dominated by SOEs and firms have lower leverage, more market competition, higher cash flow, and in less developed market.

## 1.5. Conclusion

I first construct the cross-section of firms' sensitivities to China Economic Policy Uncertainty (CEPU) by using Fama and French (1992) method. I show that firms with high sensitivity score destroy Tobin Q about 2% to 3% and other similar results when alternative measures of firm market value is used. I also report that firms suffer from high degree of agency problem such as SOEs, firms with low leverage, high product competition, high cash flows and firms operation in market with low market index, dominates this value destruction. My result is the first to document that shareholder devalue the changes in policy changes and shed light on the relationship between firms' policy uncertainty sensitivities and

their subsequent value destruction behavior. It has a pronounced policy implication and this is an interesting prospective area for future research.

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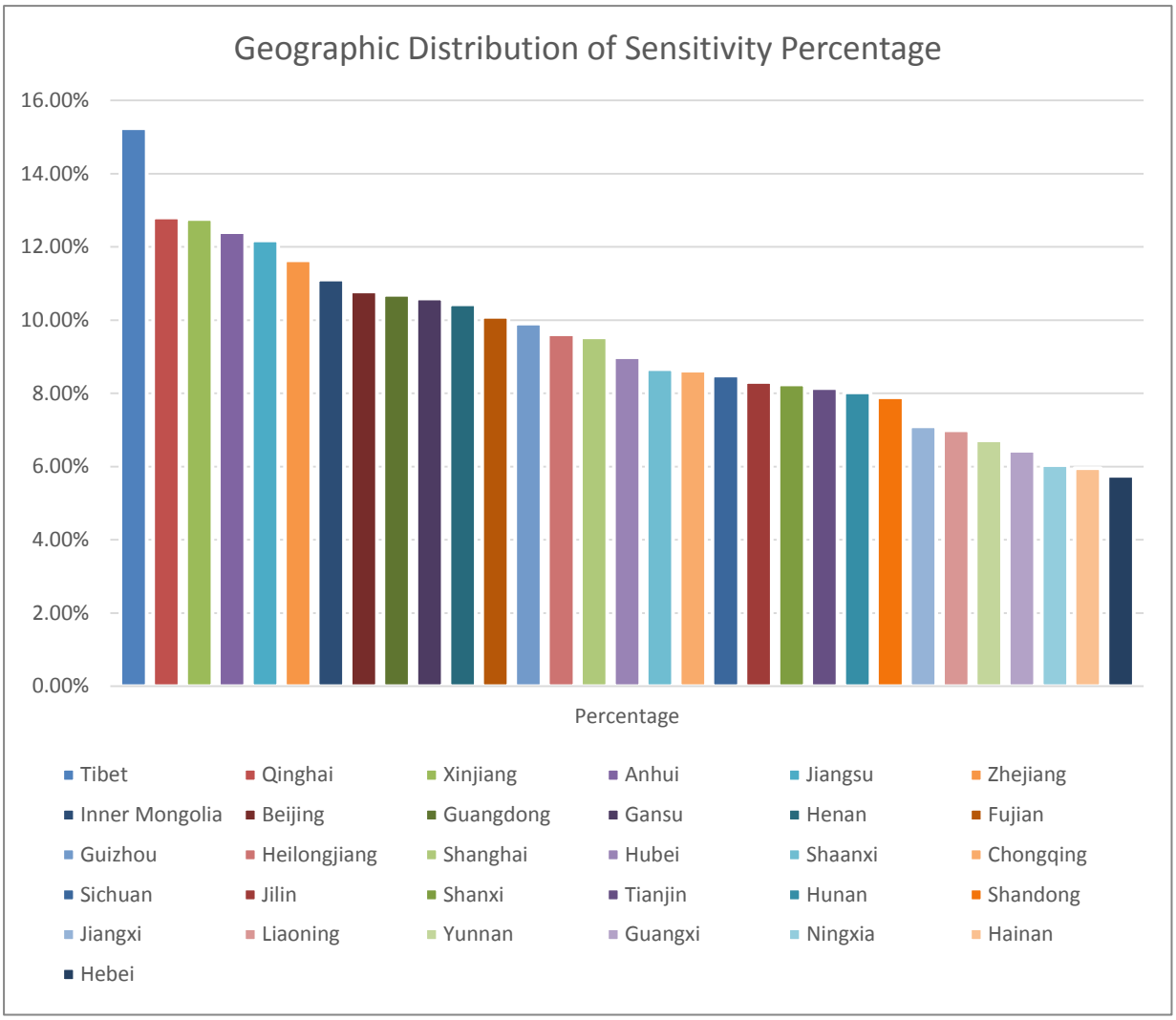
## Appendix 1.A : Variable Definition and Construction

| Variables | Definition | Source |
|---|---|---|
| Sensitivity | | |
| CEPU Index | China Economic Policy Uncertainty index constructed by using the policy-related economic uncertainty in the English-language newspaper *South China Morning Post* | Baker et.al (2015) |
| Sensitivity | 60-month coefficient estimation of the one month CEPU level in the CAPM model when using weighted monthly market return | CSMAR |
| Sensitivity Dummy | Indicator variable set to one if the p-value of the CEPU Sensitivity is below 0.10, otherwise zero. | CSMAR |
| Key Variables | | |
| Tobin's Qmv | Book value of total assets minus book value of equity plus market value of equity scaled by book value of total assets. | CSMAR |
| Tobin's Qtmv | Book value of total assets minus book value of equity plus total market value of equity scaled by book value of total assets. | CSMAR |
| MV | Tradable shares outstanding multiply by the close price at the end of fiscal year | CSMAR |
| TMV | Total shares outstanding multiply by the close price at the end of fiscal year | CSMAR |
| Capex | Capital expenditures divided by beginning-of-year book value of total assets where capital expenditures are calculated as cash payments from the acquisition of fixed assets, intangible assets and other long-term assets from the cash flow statement minus cash receipts from selling these assets, including cash paid for operating lease. | CSMAR |
| Size | Natural logarithm of the book value of total assets | CSMAR |
| Age | Natural logarithm of the difference between fiscal year and IPO year | CSMAR |
| Cash Flow | EBIT plus depreciation and amortization minus interest expense and taxes scaled by book value of total assets | CSMAR |
| Leverage | Book value of the short-term borrowing plus the long term debts scaled by book value of total assets. | CSMAR |
| SOE Dummy | Indicator variable set equal to one if the ultimate controlling shareholder of listed firms is state-owned, zero otherwise. | CSMAR,WIND and RESSET |
| Stimulation Plan | Dummy variable set to one if year is 2008, 2009, 2010 and zero otherwise. The 4 trillion RMB stimulation plan was announced at November 2008. | Hand Collected |
| Terminal Post | Dummy variable set to one if two years after provincial governor get terminated and zero otherwise. | Hand Collected |
| Promotion Post | Dummy variable set to one if two years after provincial governor get promoted and zero otherwise. | Hand Collected |
| Market index | Provincial marketization index for economic performance. | Fan et al. (2011) |

**Figure 1.1: Geographic distribution of sensitive firms**



## Table 1.1: Descriptive Statistics.

This table contains summary statistics of key variables in the sample. All variables are calculated from the year 1999 to 2014. We drop those firms with less than three years observations. Panel A presents summary statistics for the key variables used in the paper and the definition for the variables can be found at Appendix. All firm level variables are winsored at 1% to 99%. Panel B reports the number and mean sensitivity calculated by using China Economic Policy Uncertainty (CEPU) index from Baker, Bloom, and Davis (2015) based on my estimation procedure (detail of the procedure can be found in the text). I also report the fraction of sensitive firms as well as whose sensitivities are positive and negative, respectively.

**Panel A: Firms characteristics**

| Variable | Obs | Mean | S. D. | Min | Max |
|---|---|---|---|---|---|
| Size | 17460 | 21.590 | 1.284 | 11.348 | 28.509 |
| Capex | 17453 | 0.067 | 0.078 | -0.076 | 0.528 |
| Age | 17456 | 2.179 | 0.530 | 0.000 | 3.219 |
| SOE dummy | 17445 | 0.566 | 0.496 | 0.000 | 1.000 |
| Leverage | 17404 | 0.247 | 0.196 | 0.000 | 1.358 |
| Qtmv | 17460 | 2.394 | 1.774 | 0.742 | 17.587 |
| Qmv | 17460 | 1.685 | 1.325 | 0.387 | 14.462 |
| Cash flow | 16892 | 0.060 | 0.068 | -0.469 | 0.300 |

**Panel B: sensitivity measurement**

| Year | Obs | Sensitivity Score | # Sensitivity D | % Sensitivity D | % Positive | % Negative |
|---|---|---|---|---|---|---|
| 1999 | 550 | -0.84% | 52 | 9.45% | 57% | 43% |
| 2000 | 641 | -0.95% | 62 | 9.67% | 57% | 43% |
| 2001 | 722 | -0.68% | 54 | 7.48% | 60% | 40% |
| 2002 | 842 | -0.70% | 69 | 8.19% | 62% | 38% |
| 2003 | 914 | -0.61% | 77 | 8.42% | 62% | 38% |
| 2004 | 978 | -0.36% | 79 | 8.08% | 57% | 43% |
| 2005 | 1032 | 0.46% | 112 | 10.85% | 44% | 56% |
| 2006 | 1116 | 1.12% | 101 | 9.05% | 36% | 64% |
| 2007 | 1097 | 1.97% | 95 | 8.66% | 32% | 68% |
| 2008 | 1183 | 1.88% | 167 | 14.12% | 27% | 73% |
| 2009 | 1299 | 1.34% | 104 | 8.01% | 29% | 71% |
| 2010 | 1358 | 0.61% | 79 | 5.82% | 41% | 59% |
| 2011 | 1437 | -0.76% | 89 | 6.19% | 64% | 36% |
| 2012 | 1448 | -1.08% | 197 | 13.60% | 74% | 26% |
| 2013 | 1446 | -1.03% | 208 | 14.38% | 74% | 26% |
| 2014 | 1397 | -0.77% | 143 | 10.24% | 69% | 31% |

## Table 1.2: Firm Performance and Policy Sensitivity: Industry Level

This table presents firm market value with China Economic Policy Uncertainty Sensitivity using firm-year data from year 1999 to 2014. The dependent variable in columns (1) – (4) is Tobin Q (market value and total market value as denominators respectively) while the dependent variable in columns (5) – (8) is the natural logarithm of the amount of market value (total market value). *Sensitivity* used as the coefficient estimation of the CEPU level from the monthly CAPM model. The Sensitivity Dummy (*SensitivityD*) is the dummy variable to be one if the p-value of the coefficient below 10%, otherwise zero. All specifications control for lagged (current) one year firms' characteristics, which include size, capex, age, SOE dummy, Total leverage and cash flow. All specifications include level four industry and year fixed effect. The standard errors are clustered at industry level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | Qmv | | Qtmv | | log(mv) | | log(tmv) | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| lag(Sensitivity) | -2.012*** | | -3.144*** | | -1.195*** | | -1.117*** | |
| | (0.321) | | (0.434) | | (0.170) | | (0.154) | |
| lag(SensitivityD) | | -0.071*** | | -0.075** | | -0.033** | | -0.034** |
| | | (0.027) | | (0.035) | | (0.015) | | (0.014) |
| lag(Size) | -0.492*** | -0.492*** | -0.691*** | -0.693*** | 0.578*** | 0.578*** | 0.576*** | 0.576*** |
| | (0.016) | (0.016) | (0.020) | (0.020) | (0.007) | (0.007) | (0.007) | (0.007) |
| lag(Capex) | 0.024 | 0.043 | 0.024 | 0.053 | 0.772*** | 0.783*** | 0.796*** | 0.806*** |
| | (0.114) | (0.114) | (0.149) | (0.149) | (0.066) | (0.066) | (0.061) | (0.061) |
| Age | 0.194*** | 0.204*** | 0.175*** | 0.190*** | 0.056*** | 0.062*** | 0.017 | 0.023* |
| | (0.025) | (0.026) | (0.031) | (0.032) | (0.013) | (0.013) | (0.012) | (0.012) |
| SOE | -0.109*** | -0.109*** | -0.104*** | -0.103*** | -0.072*** | -0.072*** | -0.021** | -0.020** |
| | (0.019) | (0.019) | (0.024) | (0.024) | (0.010) | (0.010) | (0.009) | (0.009) |
| lag(Leverage) | -0.306*** | -0.301*** | -0.390*** | -0.383*** | -0.759*** | -0.756*** | -0.669*** | -0.666*** |
| | (0.072) | (0.072) | (0.094) | (0.094) | (0.030) | (0.030) | (0.028) | (0.028) |
| Cash flow | 0.823*** | 0.839*** | 2.437*** | 2.463*** | 2.848*** | 2.858*** | 3.250*** | 3.259*** |
| | (0.287) | (0.289) | (0.398) | (0.401) | (0.093) | (0.094) | (0.096) | (0.097) |
| Constant | 12.647*** | 12.664*** | 17.322*** | 17.344*** | 9.498*** | 9.507*** | 9.747*** | 9.755*** |
| | (0.340) | (0.341) | (0.415) | (0.416) | (0.146) | (0.145) | (0.147) | (0.147) |
| Industry Lv4 FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES | YES | YES |
| N | 15240 | 15240 | 15240 | 15240 | 15240 | 15240 | 15240 | 15240 |
| adj. R-sq | 0.429 | 0.428 | 0.438 | 0.436 | 0.805 | 0.805 | 0.773 | 0.772 |

## Table 1.3: Firm Performance and Policy Sensitivity: Firm Level

This table presents firm market value with China Economic Policy Uncertainty Sensitivity using firm-year data from year 1999 to 2014. The dependent variable in columns (1), (2) is Tobin Q (market value and total market value as denominators respectively) while the dependent variable in columns (3), (4) is the natural logarithm of the amount of market value (total market value). *Sensitivity* used as the coefficient estimation of the CEPU level from the monthly CAPM model. All specifications control for lagged one (current) year firms' characteristics, which include size, capex, age, SOE dummy, Total leverage and cash flow. All specifications include firm and year fixed effect. The standard errors are clustered at firm level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | (1) Qmv | (2) Qtmv | (3) log(mv) | (4) log(tmv) |
|---|---|---|---|---|
| lag(Sensitivity) | -0.841* | -1.684*** | -0.587** | -0.788*** |
| | (0.430) | (0.585) | (0.229) | (0.218) |
| lag(Size) | -0.731*** | -0.936*** | 0.356*** | 0.362*** |
| | (0.041) | (0.049) | (0.019) | (0.019) |
| lag(Capex) | 0.045 | -0.105 | 0.603*** | 0.727*** |
| | (0.123) | (0.166) | (0.074) | (0.073) |
| Age | 0.185* | 0.124 | 0.159** | 0.077 |
| | (0.111) | (0.129) | (0.067) | (0.057) |
| lag(Leverage) | 0.061 | 0.149 | -0.446*** | -0.315*** |
| | (0.085) | (0.119) | (0.044) | (0.041) |
| Cash flow | -0.206 | 0.882** | 2.018*** | 2.460*** |
| | (0.327) | (0.448) | (0.104) | (0.112) |
| Constant | 16.537*** | 22.908*** | 13.250*** | 14.248*** |
| | (0.850) | (1.031) | (0.392) | (0.388) |
| Firm FE | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |
| N | 15253 | 15253 | 15253 | 15253 |
| adj. R-sq | 0.391 | 0.379 | 0.816 | 0.689 |

## Table 1.4: Firm Performance and Policy Sensitivity: Fama-Macbeth Approach

This table presents firm market value with China Economic Policy Uncertainty Sensitivity using Fama-MacBeth (1973) approach from year 1999 to 2014. Panel A reports the 1st step of Fama-MacBeth approach for time-varying coefficient of Sensitivity on Tobin Q (market value and total market value as denominators respectively), while Panel B reports the mean of aggregated coefficient of all variables from 1st step. *Sensitivity* used as the coefficient estimation of the CEPU level from the monthly CAPM model. All specifications control for lagged one year (current) firms' characteristics, which include size, capex, age, Total leverage and cash flow. All specifications include firm fixed effect. The standard errors are clustered at firm level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| **Panel A: 1st Step** | (1)Qmv | (2)Qtmv |
|---|---|---|
| **lag(Sensitivity)** | | |
| **2000** | 0.433 | -0.223 |
| **2001** | -0.721 | -1.578 |
| **2002** | 0.560 | 2.813 |
| **2003** | -0.243 | 0.194 |
| **2004** | -1.134 | -2.114 |
| **2005** | -1.637 | -1.458 |
| **2006** | -2.508 | -5.214 |
| **2007** | -1.597 | -4.401 |
| **2008** | -2.135 | -3.113 |
| **2009** | -9.159 | -12.982 |
| **2010** | -6.406 | -8.376 |
| **2011** | -6.396 | -6.891 |
| **2012** | -3.787 | -3.823 |
| **2013** | 5.175 | 7.204 |
| **2014** | 4.749 | 5.979 |
| **Mean** | **-1.654** | **-2.266** |
| **N** | **15** | **15** |

| **Panel B: 2nd Step** | (1) Qmv | (2) Qtmv | (3) log(mv) | (4) log(tmv) |
|---|---|---|---|---|
| lag(Sensitivity) | -1.654** | -2.266** | -0.902** | -0.758** |
| | (0.716) | (1.001) | (0.375) | (0.321) |
| lag(Size) | -0.420*** | -0.711*** | 0.545*** | 0.582*** |
| | (0.067) | (0.056) | (0.022) | (0.019) |
| lag(Capex) | -0.117* | -0.275 | 0.735*** | 0.583*** |
| | (0.060) | (0.353) | (0.063) | (0.186) |
| Age | 0.159*** | 0.182*** | 0.026* | 0.007 |
| | (0.013) | (0.059) | (0.013) | (0.012) |
| lag(Leverage) | -0.124 | -0.374* | -0.685*** | -0.658*** |
| | (0.291) | (0.189) | (0.150) | (0.083) |
| Cash flow | 0.911** | 2.969*** | 2.935*** | 3.401*** |
| | (0.342) | (0.220) | (0.161) | (0.174) |
| Constant | 10.315*** | 17.180*** | 9.435*** | 9.320*** |
| | (1.755) | (1.221) | (0.427) | (0.489) |
| Firm FE | YES | YES | YES | YES |
| N | 15253 | 15253 | 15253 | 15253 |
| adj. R-sq | 0.288 | 0.315 | 0.585 | 0.674 |

## Table 1.5: Firm Performance and Policy Sensitivity: Stimulation Plan

This table presents firm market value with China Economic Policy Uncertainty Sensitivity using firm-year data from year 1999 to 2014. The dependent variable in columns (1), (2) is Tobin Q (market value and total market value as denominators respectively) while the dependent variable in columns (3), (4) is the natural logarithm of the amount of market value (total market value). Stimulation is a dummy variable takes to one if year is 2008, 2009 or 2010 and zero otherwise. *Sensitivity* used as the coefficient estimation of the CEPU level from the monthly CAPM model. All specifications control for lagged one year (current) firms' characteristics, which include size, capex, age, SOE dummy, Total leverage and cash flow. All specifications include industry and year fixed effect. The standard errors are clustered at industry level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | (1) Qmv | (2) Qtmv | (3) log(mv) | (4) log(tmv) |
|---|---|---|---|---|
| lag(Sensitivity)*Stimulation | -2.787*** | -4.053*** | -0.255 | -0.715** |
| | (0.784) | (0.983) | (0.362) | (0.335) |
| Stimulation | 0.331*** | 0.398*** | 0.066*** | 0.103*** |
| | (0.059) | (0.067) | (0.022) | (0.021) |
| lag(Sensitivity) | -1.043*** | -1.735*** | -1.107*** | -0.868*** |
| | (0.335) | (0.514) | (0.208) | (0.185) |
| lag(Size) | -0.495*** | -0.696*** | 0.578*** | 0.575*** |
| | (0.016) | (0.020) | (0.007) | (0.007) |
| lag(Capex) | 0.025 | 0.025 | 0.772*** | 0.796*** |
| | (0.114) | (0.149) | (0.066) | (0.061) |
| Age | 0.192*** | 0.172*** | 0.056*** | 0.017 |
| | (0.025) | (0.031) | (0.013) | (0.012) |
| SOE | -0.106*** | -0.099*** | -0.072*** | -0.020** |
| | (0.019) | (0.024) | (0.010) | (0.009) |
| lag(Leverage) | -0.302*** | -0.384*** | -0.758*** | -0.668*** |
| | (0.072) | (0.093) | (0.030) | (0.028) |
| Cash flow | 0.824*** | 2.439*** | 2.848*** | 3.251*** |
| | (0.286) | (0.397) | (0.093) | (0.096) |
| Constant | 12.724*** | 17.435*** | 9.505*** | 9.766*** |
| | (0.344) | (0.421) | (0.146) | (0.147) |
| Industry Lv4 FE | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |
| N | 15240 | 15240 | 15240 | 15240 |
| adj. R-sq | 0.430 | 0.439 | 0.805 | 0.773 |

## Table 1.6: Firm Performance and Policy Sensitivity: Governor Turnover

This table presents firm market value with China Economic Policy Uncertainty Sensitivity using firm-year data from year 1999 to 2014. The dependent variable in columns is Tobin Q (market value and total market value as denominators respectively) *Terminal Post* is a dummy variable takes to one if two years after provincial governor terminated. *Promotion Post* is a dummy variable takes to one if two years after provincial governor promoted. Sensitivity used as the coefficient estimation of the CEPU level from the monthly CAPM model. All specifications control for lagged one year (current) firms' characteristics, which include size, capex, age, SOE dummy, Total leverage and cash flow. All specifications include level four industry and year fixed effect. The standard errors are clustered at industry level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | (1) Qmv | (2) Qtmv | (3) Qmv | (4) Qtmv |
|---|---|---|---|---|
| lag(Sensitivity)*Terminal Post | -1.976* | -2.283* | | |
| | (1.059) | (1.327) | | |
| Terminal Post | -0.012 | -0.016 | | |
| | (0.025) | (0.032) | | |
| lag(Sensitivity)*Promotion Post | | | 1.389** | 1.778** |
| | | | (0.574) | (0.775) |
| Promotion Post | | | -0.021 | -0.027 |
| | | | (0.018) | (0.023) |
| SOE | -0.109*** | -0.103*** | -0.108*** | -0.102*** |
| | (0.019) | (0.024) | (0.019) | (0.024) |
| lag(Sensitivity) | -1.837*** | -2.943*** | -2.414*** | -3.659*** |
| | (0.328) | (0.446) | (0.384) | (0.520) |
| lag(Size) | -0.492*** | -0.691*** | -0.492*** | -0.692*** |
| | (0.016) | (0.020) | (0.016) | (0.020) |
| lag(Capex) | 0.027 | 0.027 | 0.026 | 0.025 |
| | (0.114) | (0.149) | (0.114) | (0.149) |
| Age | 0.193*** | 0.174*** | 0.195*** | 0.177*** |
| | (0.025) | (0.031) | (0.026) | (0.031) |
| lag(Leverage) | -0.309*** | -0.394*** | -0.305*** | -0.389*** |
| | (0.072) | (0.094) | (0.072) | (0.094) |
| Cash flow | 0.823*** | 2.437*** | 0.819*** | 2.433*** |
| | (0.287) | (0.398) | (0.287) | (0.398) |
| Constant | 12.648*** | 17.325*** | 12.658*** | 17.337*** |
| | (0.341) | (0.416) | (0.341) | (0.416) |
| Industry Lv4 FE | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |
| N | 15240 | 15240 | 15240 | 15240 |
| adj. R-sq | 0.429 | 0.438 | 0.429 | 0.438 |

## Table 1.7: Market Performance and ownership interaction term

This table presents firm market value with China Economic Policy Uncertainty Sensitivity using firm-year data from year 1999 to 2014. The dependent variable in columns is Tobin Q (market value and total market value as denominators respectively) and natural logarithm of the amount of market value (total market value). I separate the sensitivity into two subsample group by introducing an interaction term with SOE (NONSOE). *Sensitivity* used as the coefficient estimation of the CEPU level from the monthly CAPM model. All specifications control for lagged one year (current) firms' characteristics, which include size, capex, age, SOE dummy, Total leverage and cash flow. All specifications include level four industry and year fixed effect. The standard errors are clustered at industry level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | (1) Qmv | (2) Qtmv | (3) log(mv) | (4) log(tmv) |
|---|---|---|---|---|
| lag(Sensitivity)*SOE | -2.718*** | -3.998*** | -1.603*** | -1.549*** |
| | (0.344) | (0.495) | (0.215) | (0.191) |
| lag(Sensitivity)*NONSOE | -1.125** | -2.071*** | -0.684*** | -0.574** |
| | (0.537) | (0.686) | (0.246) | (0.233) |
| SOE | -0.107*** | -0.101*** | -0.071*** | -0.019** |
| | (0.019) | (0.024) | (0.010) | (0.009) |
| lag(Size) | -0.492*** | -0.691*** | 0.578*** | 0.576*** |
| | (0.016) | (0.020) | (0.007) | (0.007) |
| lag(Capex) | 0.026 | 0.026 | 0.772*** | 0.797*** |
| | (0.114) | (0.149) | (0.066) | (0.061) |
| Age | 0.194*** | 0.176*** | 0.056*** | 0.018 |
| | (0.025) | (0.031) | (0.013) | (0.012) |
| lag(Leverage) | -0.309*** | -0.394*** | -0.761*** | -0.671*** |
| | (0.072) | (0.094) | (0.030) | (0.028) |
| Cash flow | 0.824*** | 2.439*** | 2.849*** | 3.251*** |
| | (0.287) | (0.398) | (0.093) | (0.096) |
| Constant | 12.646*** | 17.321*** | 9.498*** | 9.746*** |
| | (0.340) | (0.415) | (0.145) | (0.147) |
| Industry Lv4 FE | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |
| N | 15240 | 15240 | 15240 | 15240 |
| adj. R-sq | 0.429 | 0.439 | 0.806 | 0.773 |

## Table 1.8: Sub-Sample: Ownership

This table presents ownership subsample tests of firm value with China Economic Policy Uncertainty Sensitivity using firm-year data from year 1999 to 2014. The dependent variable in columns is Tobin Q (market value and total market value as denominators respectively) and natural logarithm of the amount of market value (total market value).*SOE* is a dummy variable takes to one if firm is state owned enterprises. *Sensitivity* used as the coefficient estimation of the CEPU level from the monthly CAPM model. All specifications control for lagged one year (current) firms' characteristics, which include size, capex, age, total leverage and cash flow. All specifications include firm and year fixed effect. The standard errors are clustered at firm level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | SOE | | | | NONSOE | | | |
|---|---|---|---|---|---|---|---|---|
| | (1)Qmv | (2)Qtmv | (3)log(mv) | (4)log(tmv) | (5)Qmv | (6)Qtmv | (7)log(mv) | (8)log(tmv) |
| lag(Sensitivity) | -1.045** | -2.153*** | -0.872*** | -1.282*** | -0.542 | -1.118 | -0.355 | -0.510 |
| | (0.436) | (0.609) | (0.301) | (0.263) | (0.800) | (1.050) | (0.349) | (0.331) |
| lag(Size) | -0.468*** | -0.610*** | 0.368*** | 0.386*** | -0.902*** | -1.178*** | 0.326*** | 0.312*** |
| | (0.047) | (0.057) | (0.022) | (0.023) | (0.064) | (0.078) | (0.031) | (0.027) |
| lag(Capex) | -0.012 | -0.188 | 0.674*** | 0.715*** | 0.287 | 0.135 | 0.470*** | 0.581*** |
| | (0.143) | (0.188) | (0.103) | (0.097) | (0.211) | (0.279) | (0.106) | (0.101) |
| Age | 0.276** | 0.252* | 0.152* | 0.121 | 0.075 | -0.030 | 0.221** | 0.009 |
| | (0.119) | (0.148) | (0.091) | (0.075) | (0.204) | (0.211) | (0.100) | (0.083) |
| lag(Leverage) | 0.038 | 0.013 | -0.512*** | -0.375*** | 0.105 | 0.461** | -0.333*** | -0.149** |
| | (0.096) | (0.118) | (0.060) | (0.052) | (0.141) | (0.209) | (0.064) | (0.062) |
| Cash flow | 0.778** | 1.690*** | 2.389*** | 2.692*** | -0.906* | 0.182 | 1.656*** | 2.012*** |
| | (0.363) | (0.530) | (0.167) | (0.167) | (0.468) | (0.630) | (0.129) | (0.141) |
| Constant | 11.618*** | 14.985*** | 13.853*** | 13.614*** | 20.135*** | 27.991*** | 13.863*** | 15.351*** |
| | (1.076) | (1.347) | (0.537) | (0.538) | (1.321) | (1.596) | (0.621) | (0.551) |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES | YES | YES |
| N | 8815 | 8815 | 8815 | 8815 | 6425 | 6425 | 6425 | 6425 |
| adj. R-sq | 0.375 | 0.387 | 0.816 | 0.683 | 0.411 | 0.398 | 0.799 | 0.691 |

## Table 1.9: Sub-Sample: Leverage

This table presents leverage subsample tests of firm value with China Economic Policy Uncertainty Sensitivity using firm-year data from year 1999 to 2014. The dependent variable in columns is Tobin Q (market value and total market value as denominators respectively) and natural logarithm of the amount of market value (total market value). *High leverage* is defined as the leverage ratio higher than median value of all listed firms by each year. *Sensitivity* used as the coefficient estimation of the CEPU level from the monthly CAPM model. All specifications control for lagged one year (current) firms' characteristics, which include size, capex, age, total leverage and cash flow. All specifications include firm and year fixed effect. The standard errors are clustered at firm level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | High Leverage | | | | Low Leverage | | | |
|---|---|---|---|---|---|---|---|---|
| | (1)Qmv | (2)Qtmv | (3)log(mv) | (4)log(tmv) | (5)Qmv | (6)Qtmv | (7)log(mv) | (8)log(tmv) |
| lag(Sensitivity) | -0.004 | 0.063 | -0.394 | -0.408 | -1.188* | -2.474*** | -0.734** | -1.086*** |
| | (0.437) | (0.594) | (0.284) | (0.287) | (0.700) | (0.924) | (0.336) | (0.289) |
| lag(Size) | -0.501*** | -0.720*** | 0.340*** | 0.303*** | -0.878*** | -1.061*** | 0.366*** | 0.410*** |
| | (0.049) | (0.061) | (0.020) | (0.022) | (0.068) | (0.080) | (0.027) | (0.023) |
| lag(Capex) | -0.079 | -0.184 | 0.660*** | 0.863*** | 0.102 | 0.234 | 0.351*** | 0.411*** |
| | (0.147) | (0.174) | (0.089) | (0.088) | (0.213) | (0.301) | (0.116) | (0.114) |
| Age | 0.029 | -0.093 | 0.101 | 0.078 | 0.287 | 0.231 | 0.158* | 0.041 |
| | (0.127) | (0.156) | (0.098) | (0.079) | (0.187) | (0.206) | (0.090) | (0.076) |
| lag(Leverage) | 0.318*** | 0.450*** | -0.429*** | -0.305*** | 0.027 | 0.165 | -0.381*** | -0.259*** |
| | (0.105) | (0.130) | (0.052) | (0.049) | (0.179) | (0.276) | (0.073) | (0.072) |
| Cash flow | -0.216 | 0.429 | 1.981*** | 2.329*** | 0.263 | 1.712** | 1.972*** | 2.311*** |
| | (0.306) | (0.463) | (0.123) | (0.141) | (0.544) | (0.745) | (0.160) | (0.159) |
| Constant | 11.890*** | 18.475*** | 13.700*** | 15.488*** | 19.376*** | 25.475*** | 12.968*** | 13.284*** |
| | (1.026) | (1.309) | (0.424) | (0.455) | (1.399) | (1.642) | (0.558) | (0.494) |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES | YES | YES |
| N | 7693 | 7693 | 7693 | 7693 | 7535 | 7535 | 7535 | 7535 |
| adj. R-sq | 0.356 | 0.387 | 0.804 | 0.673 | 0.414 | 0.385 | 0.813 | 0.704 |

## Table 1.10: Sub-Sample: HHI

This table presents competition subsample tests of firm value with China Economic Policy Uncertainty Sensitivity using firm-year data from year 1999 to 2014. The dependent variable in columns is Tobin Q (market value and total market value as denominators respectively) and natural logarithm of the amount of market value (total market value). *High HHI* is defined as the Herfindahl Index ratio higher than median value of all listed firms by each year. *Sensitivity* used as the coefficient estimation of the CEPU level from the monthly CAPM model. All specifications control for lagged one year (current) firms' characteristics, which include size, capex, age, total leverage and cash flow. All specifications include firm and year fixed effect. The standard errors are clustered at firm level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | High HHI | | | | Low HHI | | | |
|---|---|---|---|---|---|---|---|---|
| | (1)Qmv | (2)Qtmv | (3)log(mv) | (4)log(tmv) | (5)Qmv | (6) Qtmv | (7)log(mv) | (8)log(tmv) |
| lag(Sensitivity) | -0.237 | -0.657 | -0.194 | -0.483 | -1.158* | -2.174*** | -0.617** | -0.767*** |
| | (0.580) | (0.780) | (0.294) | (0.308) | (0.598) | (0.777) | (0.297) | (0.277) |
| lag(Size) | -0.638*** | -0.841*** | 0.335*** | 0.334*** | -0.795*** | -1.025*** | 0.352*** | 0.356*** |
| | (0.059) | (0.071) | (0.033) | (0.032) | (0.058) | (0.071) | (0.020) | (0.019) |
| lag(Capex) | 0.065 | 0.114 | 0.627*** | 0.701*** | 0.039 | -0.155 | 0.435*** | 0.625*** |
| | (0.172) | (0.241) | (0.101) | (0.109) | (0.181) | (0.252) | (0.103) | (0.099) |
| Age | 0.282* | 0.190 | 0.261*** | 0.088 | 0.021 | -0.048 | -0.055 | -0.032 |
| | (0.148) | (0.172) | (0.099) | (0.087) | (0.142) | (0.194) | (0.085) | (0.076) |
| lag(Leverage) | 0.004 | 0.021 | -0.449*** | -0.324*** | 0.139 | 0.256 | -0.387*** | -0.269*** |
| | (0.117) | (0.158) | (0.060) | (0.057) | (0.124) | (0.171) | (0.057) | (0.052) |
| Cash flow | -0.944* | -0.086 | 1.751*** | 2.248*** | -0.212 | 0.866 | 1.974*** | 2.377*** |
| | (0.497) | (0.654) | (0.127) | (0.140) | (0.394) | (0.567) | (0.120) | (0.132) |
| Constant | 14.568*** | 20.985*** | 13.615*** | 14.893*** | 19.721*** | 25.174*** | 14.718*** | 14.662*** |
| | (1.210) | (1.491) | (0.688) | (0.649) | (1.353) | (1.701) | (0.483) | (0.469) |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES | YES | YES |
| N | 6997 | 6997 | 6997 | 6997 | 8256 | 8256 | 8256 | 8256 |
| adj. R-sq | 0.369 | 0.394 | 0.807 | 0.696 | 0.397 | 0.387 | 0.805 | 0.669 |

## Table 1.11: Sub-Sample: CF

This table presents cash flow subsample tests of firm value with China Economic Policy Uncertainty Sensitivity using firm-year data from year 1999 to 2014. The dependent variable in columns is Tobin Q (market value and total market value as denominators respectively) and natural logarithm of the amount of market value (total market value). *High CF* is defined as the cash flow ratio higher than median value of all listed firms by each year. *Sensitivity* used as the coefficient estimation of the CEPU level from the monthly CAPM model. All specifications control for lagged one year firms' characteristics, which include size, capex, age, total leverage and cash flow. All specifications include firm and year fixed effect. The standard errors are clustered at firm level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | High CF | | | | Low CF | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) Qmv | (2) Qtmv | (3)log(mv) | (4)log(tmv) | (5) Qmv | (6) Qtmv | (7)log(mv) | (8)log(tmv) |
| lag(Sensitivity) | -1.581** | -2.073** | -0.919*** | -1.186*** | 0.791 | 0.106 | -0.155 | -0.372 |
| | (0.623) | (0.853) | (0.310) | (0.297) | (0.549) | (0.697) | (0.278) | (0.247) |
| lag(Size) | -0.467*** | -0.642*** | 0.441*** | 0.439*** | -0.882*** | -1.052*** | 0.297*** | 0.309*** |
| | (0.055) | (0.066) | (0.024) | (0.024) | (0.053) | (0.066) | (0.026) | (0.024) |
| lag(Capex) | -0.011 | -0.150 | 0.520*** | 0.597*** | 0.480*** | 0.296 | 0.618*** | 0.690*** |
| | (0.152) | (0.214) | (0.103) | (0.093) | (0.183) | (0.217) | (0.090) | (0.088) |
| Age | 0.182 | 0.057 | 0.180** | 0.056 | 0.321** | 0.370* | 0.149 | 0.156** |
| | (0.137) | (0.158) | (0.087) | (0.074) | (0.161) | (0.190) | (0.095) | (0.079) |
| lag(Leverage) | 0.232* | 0.380** | -0.479*** | -0.310*** | -0.057 | -0.022 | -0.346*** | -0.228*** |
| | (0.140) | (0.188) | (0.063) | (0.057) | (0.112) | (0.154) | (0.059) | (0.049) |
| Cash flow | 6.283*** | 10.310*** | 3.916*** | 4.541*** | -2.691*** | -3.345*** | 0.999*** | 1.186*** |
| | (0.563) | (0.693) | (0.245) | (0.242) | (0.394) | (0.522) | (0.084) | (0.090) |
| Constant | 10.426*** | 16.146*** | 11.274*** | 12.507*** | 19.501*** | 24.903*** | 14.461*** | 15.227*** |
| | (1.116) | (1.350) | (0.511) | (0.505) | (1.086) | (1.378) | (0.523) | (0.493) |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES | YES | YES |
| N | 7495 | 7495 | 7495 | 7495 | 7758 | 7758 | 7758 | 7758 |
| adj. R-sq | 0.400 | 0.463 | 0.821 | 0.706 | 0.452 | 0.412 | 0.816 | 0.705 |

## Table 1.12: Sub-Sample: Cross-sectional market index

This table presents result using firm-year data from year 1998 to 2009 matched with the availability of the market index. The dependent variable is Tobin Q using the current market value as denominator. *Sensitivity* here is used as the coefficient estimation of CEPU growth ratio from the monthly CAPM model when using different market return measurements. *High Market index* is defined as the market index higher than median value of all provinces by each year. All specifications control for lagged one year firms' characteristics, which include size, capital expenditure, total leverage and the cash flow. All specifications include level four firm and year fixed effect. The standard errors are clustered at firm and year level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | High Market Index | | | | Low Market Index | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) Qmv | (2) Qtmv | (3)log(mv) | (4)log(tmv) | (5) Qmv | (6) Qtmv | (7)log(mv) | (8)log(tmv) |
| lag(Sensitivity) | 0.041 | -0.906 | 0.013 | -0.579* | -1.580** | -2.758** | -0.929** | -1.246*** |
| | (0.633) | (1.075) | (0.356) | (0.319) | (0.662) | (1.134) | (0.367) | (0.353) |
| lag(Size) | -0.616*** | -0.947*** | 0.434*** | 0.415*** | -0.764*** | -1.069*** | 0.416*** | 0.420*** |
| | (0.113) | (0.163) | (0.032) | (0.032) | (0.095) | (0.122) | (0.031) | (0.032) |
| lag(Capex) | 0.189 | 0.135 | 0.522*** | 0.501*** | -0.013 | -0.232 | 0.257** | 0.232** |
| | (0.181) | (0.311) | (0.118) | (0.123) | (0.190) | (0.286) | (0.116) | (0.110) |
| Age | 0.219 | 0.311 | 0.213* | 0.181* | -0.310 | -0.669* | -0.058 | -0.199 |
| | (0.187) | (0.280) | (0.123) | (0.109) | (0.271) | (0.360) | (0.129) | (0.123) |
| lag(Leverage) | 0.116 | -0.094 | -0.420*** | -0.338*** | 0.430** | 0.437* | -0.318*** | -0.259*** |
| | (0.173) | (0.267) | (0.071) | (0.067) | (0.181) | (0.231) | (0.069) | (0.071) |
| Cash flow | -0.535 | 0.228 | 1.632*** | 1.856*** | -0.556 | 0.373 | 1.576*** | 1.749*** |
| | (0.468) | (0.738) | (0.158) | (0.156) | (0.593) | (0.794) | (0.133) | (0.137) |
| Constant | 14.035*** | 21.423*** | 11.099*** | 12.096*** | 17.559*** | 25.798*** | 12.042*** | 13.156*** |
| | (2.493) | (3.613) | (0.713) | (0.703) | (2.142) | (2.711) | (0.649) | (0.646) |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES | YES | YES |
| N | 4136 | 4136 | 4136 | 4136 | 4327 | 4327 | 4327 | 4327 |
| adj. R-sq | 0.462 | 0.434 | 0.793 | 0.710 | 0.477 | 0.450 | 0.817 | 0.736 |

# Chapter 2:

# Export, Ownership, and Innovation, Evidence from China

Xiaping Cao[*], Shuyu Xue[+], Sili Zhou[#]

**Abstract**

We provide micro-firm evidence how global trade promotes corporate innovation in China. Firms with high level of foreign export innovate more than firms relying on domestic sales. The difference in patents for firms with high vs. low level of foreign exports is significant in magnitude and increases drastically over time. Such difference is more pronounced in non-SOE subsample. A battery of endogeneity tests including RMB policy change or bilateral treaties show that export has a causality effect on innovations. Within industries evidence suggests that Chinese multinationals catch up on patents where US peers retreat. Firms with export enjoy technology spill-over from US innovation in low-tech industries but not high tech. Our research suggests that global export improves technology spill-over Chinese multinationals especially non-SOEs and low-tech firms.

**Keywords**: Emerging multinationals, Global trade, Foreign sales, China, Innovation, Patent, US, Technology spill-over

**JEL Codes:** F13; F15, O14, O31

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# 2.1 Introduction

According to the Global Agenda Forum of the World Economic Forum in 2012, innovative emerging multinationals become an important force in the global markets and start to successfully compete with well-established multinationals from developed countries. Emerging multinationals especially Chinese firms have made impressive progress in innovation activities. For example, The Economist has series of coverage to describe[13] how Huawei, the giant emerging telecom private firm in Shenzhen invests heavily in innovations, makes breakthrough innovations and grows to be a leader from a follower in the global market. The phenomenon of emerging multinationals on innovations and competitive advantage has fuelled wide concern among academic circles, market participants and policy makers. A large literature emerges to analyze the impact of emerging Chinese manufacturing firms on US and Europe corporations. For example, Bernard, Jensen and Schott (2006), Pierce and Schott (2015), Acemoglu et al. (2016), and Dorn et al. (2014) all study how Chinese rising manufacturing multinationals affect labor market in the US. Bloom et al (2016) and Autor et al (2016) look at the impacts of China's trade on European and US corporate innovation, respectively. The trade threat of Chinese emerging manufacturing firms may be transitory if they rely only on cheaper labor without core innovation edge.

[13]The Economist has continuously covers Huawei's growth in the global telecom market to be a leader. Reports can be found in the magazines on September 24th 2009, August 4th, 2012, September 20th 2014, May 30th, 2015.

Aw, Roberts and Xu (2011) theoretically model export and innovation and consider both are endogenous choices to promote growth. We follow their framework and try to identify a causal relationship between export and innovation using China as the context. China offers an ideal setting to study the effect of export and innovation since export has been an important impetus for promote economic growth. On the other hand, innovation has increasingly become a national strategy for Chinese government to advance industrialization and development. Hu, Zhang and Zhao (2017) show that China overtook U.S. in 2011 to become the country filing the largest number of patent applications. Liu and Qiu (2016) find that input tariff cut because of China's WTO accession results in less innovation undertaken by Chinese domestic firms. Different from these studies, we study whether corporate export propels firms to innovate in order to compete globally.

Paunov (2016) find that corruption smothers corporate patents but has no impacts on exporters using a global data. His finding suggests that exporters may behave differently from other corporations in their relationship with innovation. We thus take a systematic examination the causal effect of export on corporate innovation. Specifically, we try to answer the following questions. How does rising export of Chinese multinationals enhance their innovation? Are they gaining ground in innovations that just meet the needs of domestic consumers, or are they catching up with their global peers or even starting to replace them? With firm level data on exporting and patents, this paper provides concrete micro-evidence

on these questions by relating corporate global trading activities and to firm level innovation activities.

Our main hypothesis is that emerging multinationals have more incentives to innovate and they innovate more than other firms with less participation in global trading. We measure Chinese emerging multinationals with the weight of foreign sales in total sales. Those firms with greater exposure to foreign trades and competition, e.g., more foreign sales will have to compete globally for market share. To achieve this, they need to build up competitiveness in the global scale and through the fundamental approach of innovations. Although there is consensus in the media and press that Chinese corporations start to have a significant presence in investing in and promoting innovation, it remains unclear what firms are driving innovation waves in China. Our prior is that Chinese corporations that are participating global trading and competition become the emerging force to drive the innovation waves in China.

The second hypothesis posits that Chinese non-SOEs with active global export participations or trade exposures are innovation drivers. Although SOEs have a heavy presence in China's economy, they are often found to be inefficiently managed (Megginson, Nash, Randenborgh, 1994). Many consider SOEs big but not strong or competitive because the government allows SOEs to operate in monopolistic domestic sectors or regulated industries. As the environment lack of fierce competition, SOEs do not have a strong incentive to innovate. SOEs are notorious for being afflicted with severe agency problems and

moral hazard problems. Executives of SOEs in general do not invest in long-term projects such as innovation due to unique political incentives and short career horizon (Cao, Leng, Julio and Zhou, 2016). SOEs often enjoy the benefits of low cost of capital. On the other hand, firms especially non-SOEs with great participation in global market need to compete in global scales. The only approach is to innovate to build product and market competitiveness.

The third hypothesis is that Chinese emerging multinationals innovate more in areas or industries where their US peers are retreating. Despite of a popular view that Chinese manufacturing firms largely carry out reverse engineering in high-tech sectors, Chinese firms have significantly increased corporate expenditures on research and development (R&D) on technological innovations. Chinese multinationals are not only exporting low value-added products but also high-technology products in IT and telecommunications sectors. We therefore relate patenting activities of Chinese manufacturing multinationals to their US peers, and empirically test whether Chinese firms are able to benefit from technology spillover via trading activities. Falvey, Foster, Greenaway (2004), Fernandes (2007), Keller (1998), Liu and Buck (2007), Lumenga-Neso, Olarreaga, and Schiff (2005), and Madsen (2007) all show that trades serve as an important channel for knowledge transmission with macro evidence. Mancusi (2008) proposes that knowledge spillovers depend on a country's absorptive capacity of innovative performance. We further their question by providing micro firm evidence how exports work as a channel for knowledge transmission and the

effect of trade on innovation spillovers varies across firm ownership type, industries and exports.

We find that Chinese multinationals, firms with great foreign sales have significant more patents than other firms with low foreign sales do. Difference between firms with more foreign sales and no/low foreign sales is more pronounced in non-SOEs than in SOE subsample. The evidence suggests that Chinese multinationals especially non-SOEs improve their innovative performance from technology spillovers through channels of foreign exports. Furthermore, there is a significant and negative relationship between corporate patents of Chinese multinationals and sample average patents of their US peers at the industry level for high tech firms while the effect becomes positive for low-tech firms. This evidence suggests that Chinese multinationals are improving in innovative performance. There are intra-industry technology spillovers from US to China but only in low-tech sectors, consistent with Mancusi (2008)'s hypothesis.

One major concern of our empirical findings is the endogeneity problem – reverse causality, since innovative firms may export more products and thus they experience more foreign sales than less innovative firms do. We address this concern with tests including a Difference-in-Difference (DiD) approach on RMB policy reform and instrumental variable regressions with bilateral treaties signed between China and foreign nations. The policy reform on RMB exchange regime initiated by the Chinese government in 2005[14]. The RMB policy change provides

[14] Chinese central government unexpectedly implemented a policy change allowing RMB to deviate from a

a quasi-natural experiment since it affected foreign sales greatly but not corporate innovation performance. The DiD tests show that foreign sales have a causal effect on corporate innovation. Secondly, we collect data on Chinese government's bilateral investment treaties[15] (BITs) signed over years and use them as instrumental variables for foreign exports. Signing BITs is shown to affect foreign sales and foreign trade exposures (Dixit, 2012). We report robust results that instrumented foreign sales have positive and significant effect on corporate patents. Lastly, we run the test with the quasi-natural experiment with control firms selected from the propensity score matching.[16] The results remain robust.

The paper is organized as follows. Section 2 summarizes the data and summary statistics. Section 3 describes the main empirical results. Section 4 represents the detailed cross-sectional tests and Section 5 concludes the paper.

## 2.2. Data, Variable Construction, and Descriptive Statistics

The sample we used in the paper includes Chinese listed corporations during the period of 2002 to 2013. We start our sample from year 2002 since

pegging rate to the US dollar alone to float with to a basket of currencies. As a result, RMB started to appreciate right after the reform starting in 2005 against major currencies especially US dollar.

[15] Bilateral Investment Treaty is an important international legal mechanism to improve enforcement of contracts and property rights in order to remove impediments to foreign investment. BITs require countries to protect the property rights of foreign firms and allow international bodies, such as the International Convention on the Settlement of Investment Disputes (ICSID), a member of the World Bank, to arbitrate any foreign investment disputes.

[16] For each multinational firm, we match it with another firm having no foreign sales. The matching score controls for size, industry, growth potential, leverage, profitability and other firm characteristics.

fewer firms report their international market sales before year 2001, the time when China joined the World Trade Organization (WTO). We construct our sample from several sources. Corporate financial data is obtained from the China Stock Market & Accounting Research (CSMAR) Database. The foreign sales data come from the Wind Database (a major data vendor on listed firms in China) and is manually checked by segments files from CSMAR.

We collect firm ownership data manually combined from CSMAR, RESSET Financial Research Database (RESSET/DB) and Wind Database, as well as official websites of listed companies. All the patent data is hand collected from the State Intellectual Property Office of China (SIPO) before year 2014, which is directly affiliated to China State Council and is responsible for registering intellectual properties including patents. For each patent, we obtain the assignee names from SIPO and manually match it with the name of the listed company both in Shanghai Stock Exchange (SSE) and in Shenzhen Stock Exchange (SZSE).

Considering the impact of extreme values and outliers, we winsorize all firm characteristics at the 1$^{st}$ and 99$^{th}$ percentiles. We drop off listed firms under special treatment (ST) because they have different regulation requirement by CSRC (China Security Regulation Committee).[17] We exclude firms belonging to financial and utility industry since they have different financial disclosure regulations and their liquidity positions are different from others. Similarly, we

[17]ST firms are those in financial distress and under warning by the stock exchanges.

drop listed firms with class B shares since such shares are only eligible for foreign investors with a discount on A shares (Sun, Tong and Tong, 2002). The final sample consists of 2,251 firms and 17,710 firm-year observations with non-missing foreign sales and patent data, including 825 (36.65%) of these companies never having any foreign sales and 1,426 of these firms having record of foreign sales. According to ownership type, 938 (41.67%) firms are SOEs and the rest of the firms are non-SOEs.

### *2.2.1. Innovation Measurement*

The voluminous literature on the economics of innovation, such as Seru (2012) for publicly traded firms and Lerner, Sorensen, and Stromberg (2011) for privately held firms, widely accepts patent as a primary measure of innovative output. The second reason for using the patent data as the innovation is the data availability. This patent data is available from the year 1985, long before the R&D expense[18] (research expense or development expense). We use patent innovation data from the manually collected database, which covers all patents filed and granted by the State Intellectual Property Office of China (SIPO). The database provides detailed information on patent assignee (owner) names, the patent number, application year and grant year. For specifying the year of the patent, we use the patent's application year instead of grant year, following Griliches et al

[18]The R&D expense is part of intangible assets before 2007. After 2007 accounting reform, it becomes an independent item in the balance sheet.

(1988).

Comparing with the United States Patent and Trademark Office (USPTO), the SIPO has its own classifications on patents. According to Chinese Patent Law, the Chinese patents are categorized into three groups, invention patents, utility model patents and design patents. These three types of patents cover different innovation areas. Invention patents are for the new technological solutions that would have substantial and fundamental improvements on products or applications, while utility model patents are associated with improvements on shapes or structures of products. Design patents only focus on the innovation of art and design of the industrial products, including new art layout, new shape creation and new colour improvements.

To better identify the different areas of innovation as well as innovation quality in Chinese SIPO system, we construct two innovation variables. First, *PatentAll* is the number of patent applications filed in a given year eventually granted. This total number of patent granted captures overall quantity of innovation output. However, patent counts do not distinguish ground breaking inventions from incremental technological discoveries. To address this, we construct *Patent1* variable, which is the number of invention patent applications filed in a given year eventually granted. Invention patents are associated with high quality of innovation among three groups of patents in the SIPO system. Under the Chinese Patent Law, to successfully file the patent as invention patents (Type 1 patent), it would take three years to review and examine in order to make sure that

these invention patents are making substantial and original contributions to the field. Since the data from SIPO is lack of the citations received to measure innovation quality (Hall et al., 2001; Harhoff, Narin, Scherer, & Vopel, 1999), we take the number of invention patents, which is high quality innovation, as the proxy of innovation quality.

As for US market, we use patent data of all listed firms from Harvard University's patent database. This database includes all patents filed and granted by the United States Patent and Trademark Office (USPTO) from 1990 to 2010. Similarly, we match patent assignee (owner) names, the patent number with the ticker names in Compustat and manually check with the errors (Griliches et al., 1988, Cao et al., 2016). We construct industry level patent of U.S. by taking the average number of patents[19] by each industry under the Global Industry Classification Standard (GICS) by MICS and S&P Global. GICS is a four-tiered, hierarchical industry classification system. It consistent of 11 sectors, 24 industry groups, 60 industries and 157 sub-industries (GSECTOR, GGROUP, GIND, GSECTOR in Compustat respectively). The detailed industry classifications are in Appendix B. The China Security Index Company adopted the GICS classification to develop a Chinese Security Industry Classification (CSIC) and made the industry comparable. We match the U.S. industry level patent with the corresponding CSIC as the proxy for the dynamic innovation environment coming from US industry peers.

[19]We also construct the median patent of each industry for the robustness check in unreported tables. The results are upon request.

### *2.2.2. Foreign Sales Measurement*

We gather information on firm's foreign sales based on the Supplement Information on Sales in the annual report starting from 2002. Our main measure of *foreign sales ratio* is the proportion of a firm's total foreign sales divided by the total revenue. This variable is a proxy for how much the firms rely on the foreign market. Firms generally provide a regional breakdown of their sales. If a firm does not disclose its segment sales, we code the firm's foreign sales as zero.

In China, the stock exchanges recommend firms to disclose their foreign sales starting from 2000 but, after 2007, require all listed firms to disclose if the foreign sales ratio is more than 10%. Thus, we also define a dummy variable, *MNC10*, for Chinese multinational corporations, which is one if the foreign sales ratio is greater than 10% and zero if the company does not have any foreign sales.[20]We use 10 percent cutoff for potential censored issue as described. Besides, this threshold is widely used in past literature (eg. Jorion, 1990; He & Ng, 1998; Pinkwitz, Stulz, Williamson, 2012). However, there are other researches using different thresholds of foreign sales ratio to differ the firms. Shaked (1986) and Tallman & Li (1996) define MNCs as ones when firms having 20 percent of sales abroad. Fernandes & Gonenc (2016) use 25 percent above as the standard. Following both strands of literature, we employ two different thresholds in paper: *MNC10* (if more than 10%) and *MNC25* (if more than 25%) and use them

[20]We treat firms with foreign sales between zero to ten percent as missing.

alternatively.

### *2.2.3. Construct control variables*

We use a number of controls suggested by previous literature (e.g., Hall and Ziedonis, 2001; Aghion, et al. 2005; Aghion, Reenen and Zingales, 2013). The main control variable is Tobin's Q, defined as the book value of total assets minus book value of equity plus market value of equity scaled by book value of total assets. We also use two measurements of Q since the non-tradable share is an important issue in China.[21] Size is the natural logarithm of the book value of total assets. Return on Asset (ROA) is defined as operating income before depreciation divided by total assets. Age is also the natural logarithm of the fiscal year minus the time when firm go public. Cash flow is measured as EBIT plus depreciation and amortization minus interest expense and taxes scaled by lagged total assets. Leverage here is the sum of the short-term borrowings plus the long-term debts and divided by the lagged total assets. Firm-level investment is the capital expenditures which includes the net cash payments from the acquisition of fixed assets, intangible assets and other long-term assets from the cash flow statement divided by the lagged book value of total assets. Due to the limitation of R&D Expense, we use tangibility instead.[22]Tangibility is the ratio of tangible assets

[21] Chen and Xiong (2002), Bai et al.(2004) discussed the issue of non-tradable shares in China maybe an important issue. We obtain other measurement of Tobin's Q as well and find a similar result.

[22]New Accounting Standards for Enterprises No.6 Segment- Intangible Assets require firms to identify, quantify and disclose the R&D expense. The R&D expense is disclosed as independent item afterwards. These standards are effective on Jan 1st 2008. Before 2008, the R&D expense was reported in the tangible

divided by total assets.

### *2.2.4. Descriptive Statistics*

Table 1 shows the descriptive statistics for the firm-years observations with non-missing data on foreign sales and patent information. There are 17,710 firm-year observations within the period from 2002 to 2013. We winsorize all variables at 1% and 99% level.

[Insert Table 1]

Panel A of Table 1 describes summary statistics for the main dataset of the empirical analysis. We start by listing the innovation variables: *ln(1+Patent1)* and *ln(1+Patent All)*. Each year, the average number of invention patents and total patents for each firm are 8.19 and 17.81, respectively. For the key independent variables, we use the foreign sales ratio and two foreign sales dummy variables. The average foreign sales ratio for each firm each year is more than 10% in despite of the median foreign sales ratio is still zero. Then, our firm level controls include total assets, firm age, a measure of firm profitability (ROA), a measure of growth opportunity (Tobin's Q), a measure of investment(CAPEX), tangibility, leverage and cash flow.; After excluding observations with missing financial information, our final sample consists of only 14,608 firm-year observations.

Panel B of Table 1 describes the innovation variables and firm characteristics for firms with foreign sales and purely domestic firms. 53.65% of

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assets item.

our firm-year observations are domestic firms. For these companies, they have fewer patent numbers, smaller size and lower ROA. However, the univariate tests indicate that firms without foreign sales are more mature, have higher Tobin's Q and more tangible assets. The univariate tests show that the firms with foreign sales and domestic firms have little difference in terms of leverage and cash flow. In order to show that our sample is not unbalanced in terms of different industries, Panel C of Table 1 combined CSIC with GICS into the ten industry sectors and reports the industry distribution of the number of firms with foreign sales and domestic firms. While all industries have firms with foreign sales, the industries in which more firms do so, according to the percentage, are Industrials, Materials and Consumer Discretionary. Not surprisingly, these are industries in which the global competition and scientific knowledge may play important roles.

## 2.3. Empirical Results

The objective of our study is to compare the innovation output of multinationals and pure domestic firms. In the baseline analysis, we examine the innovation output of multinationals and domestic firms and report the results in Section 3.1. In Section 3.2, to further show the causal effect of foreign sales we perform a quasi-natural experiment using the exchange rate reform as the exogenous shock to corporate foreign sales but not to firm patents directly. We use different-in-difference approach to draw the causality relationship between foreign sales and corporate innovations.

### *2.3.1. Baseline Regression Result*

We start by examining the innovation output of firms with foreign sales and firms without foreign sales. The model we used is as following,

$$LnPatent_{i,t+1} = \beta_0 + \beta_1 Fsales_{i,t} + \gamma' X_{i,t} + \varphi_t + \alpha_i + \omega_j + \varepsilon_{i(j),t} \quad (1)$$

Where *i*, *j*, and *t* refer to firm *i*, industry *j*, year *t*, respectively. The dependent variables in Equation (1) captures firm innovation outcomes: *Ln(1+Patent1)* is the natural logarithm of one plus the number of invention patents granted by the company in year *t+1* to capture innovation quality while *Ln(1+Patent_all)* is the natural logarithm of one plus the total number of patents granted by the company in year *t+1* to capture innovation quantity. We measure the foreign sales *(FSales)* in year *t* by using both continuous and discrete variables: foreign sales ratio, dummy of 10% cut-off *(MNC10)* and dummy of 25% cut-off *(MNC25)*. X is a vector of controls that includes firm-level total assets, firm age, ROA, Tobin's Q, leverage, investment and tangibility; all are measured in year *t*, except for firm age (t+1). Various specifications include year fixed effects (φ) firm fixed effects (α) or industry fixed effects (ω).In all regressions, robust standard errors adjusted for firm-level clustering are reported in parentheses.

There are two econometric techniques commonly used to ruled out potentially unobserved individual effect and variable yearly economic cycles: the pooled ordinary least squares (OLS) regression controlling for industry and year fixed effects, and the panel regression controlling for firm and year fixed effects.

Notwithstanding firm effects play more accurate firm level individual effect; it does have some shortcoming. As shown in the table 1, more than half of firms are without foreign sales so it is difficult to distinguish the invariant firm effect from the foreign sales dummies. Thus, we also choose pooled OLS regression fixed by industry to avoid potential multicollinearity problem existing between the MNC dummies and the firm identity. In Table 2, for column 2, 3, 5 and 6, when involving MNC dummies, industry fixed effect rather than firm fixed effect are used for better explaining the coefficient of the MNC dummies.

[Insert Table 2]

Panel A of Table 2 reports the result from pooled OLS regression between the number of invention patents and foreign sales. The coefficient estimates of foreign sales ratio, MNC10, MNC25 are all positive and significant at the 5% level across all specifications, suggesting multinational firms innovate more than those domestic firms. The economic effect is sizable. The coefficient estimate in column1, for example, suggests that a one standard deviation increase in foreign sales promotes a 33.6%[23] increase in the number of invention patents in the following year. In column 4, a coefficient estimate of 0.264 suggests that a one standard deviation increase in foreign sales is associated with a 30.2% increase in the total number of patents in the following year. As for the case of MNC dummies, their magnitude is much larger. Those multinational firms (with 10% or more foreign sales) produce 38.3% more invention patents, 50.7% more total

[23] Exp(0.290)-1=33.6%

patents than firms without foreign sales, and the multinational firms (with 25% more foreign sales) generally have 33.8% and 41.2% more invention patents and total patents, respectively than those without foreign sales.

Regarding control variables, we find that their coefficient estimates are consistent with findings in earlier work. Larger firms and firms with higher capital expenditures are associated with more patents. Firms with higher growth opportunities are more innovative. Further, the debt ratio or leverage is negatively associated with patents. Financial constraints are also negatively related to patent counts. Firm age matters; young firms have more patents.

Overall, our baseline regression results suggest a positive association between foreign sales and firm innovation, consistent with our first hypothesis that the foreign sales enhance firm innovation. We also want to study whether the ownership of the companies would influence the association between foreign sales and firm innovation. As we suggest, the companies with more foreign sales need to compete in global market and have more competition pressures; this competition pressure forces the firm to output more innovations. However, the State Owned Enterprises (SOEs) face less competitive pressure, so foreign sales or global market does not affect their patents or innovations. Table 3 helps us to explain the results.

In Table 3, we perform a regression analysis where we augment our baseline specification above by including the SOE interaction term. The model we use is as following:

$$LnPatent_{i,t+1} = \beta_0 + \beta_1 SOE \times Fsales_{i,t} + \beta_2 NonSOE \times Fsales_{i,t} + \beta_3 SOE_{i,t} + \gamma' X_{i,t} + \varphi_t + \alpha_i + \omega_j + \varepsilon_{i(j),t} \quad (2)$$

We report the results in the columns (1) to (6) of Table 3. We include the same control variables as in regression specification of Equation (1), but we add the interaction term of SOE indicator and non-SOE indicator with foreign sales to identify the influence related to ownership type. We also control for the level of ownership may influence the innovation output as Tan et al. (2015) argued. To demonstrate the time invariant result, we still control for aggregate trends by including year fixed effects. Additionally, since our main variable of interest is the interaction term of SOE indicator and foreign sales, we include firm level SOE indicators to control the level of ownership's effect suggest by Tan et al. (2015).

[Insert Table 3]

We find that foreign sales' effect on corporate patents is majorly coming from private firms (non-SOE). In terms of economic magnitude, one standard deviation increase in the foreign sales for non-SOEs increase the number of invention patents and the number of total patents by 49.0% and 64.0%, respectively. In the contrast, for SOEs it only results in an increase by 30.7% and 6.3%, respectively. Meanwhile, the significance also drops for the interaction of SOEs with foreign sales, suggesting foreign sales or global market competition may not affect SOEs regarding their innovative activity. When MNC25 dummy variables are employed alternatively, the interaction term between foreign sales dummy and non-SOE remain positive and significant while interaction terms between foreign sales dummy and SOE have less significance. This suggests that

foreign sales only affect non-SOEs' innovation activities.

After checking the ownership structure, to examine the competitive theory, we compare the innovation outputs of Chinese companies with their corresponding industries company in the U.S. First, we add the average number of patents in each industry in the US to check the relationship of US innovation and Chinese innovation. The model we use is as following:

$$LnPatent_{i,t+1} = \beta_0 + \beta_1 US\_Patent_{j,t} \times Fsales_{i,t} + \beta_2 US\_Patent_{j,t} + \beta_3 Fsales_{i,t} + \gamma' X_{i,t} + \varphi_t + \alpha_i + \omega_j + \varepsilon_{i(j),t} \quad (3)$$

We form an interaction term by using the foreign sales times the US patent. We want to know that, within one specific industry, when the innovation output in the US is dropping, how the innovation of Chinese companies' response and also how the foreign sales help the innovation. For the US patent information, we use patent innovation data on publicly listed US corporations from Harvard University's patent database. This database includes all patents filed and granted by the United States Patent and Trademark Office (USPTO) from 1990 to 2010. The database provides detailed information on patent assignee (owner) names and the patent number. We combine the patent database with COMPUSTAT to get the companies' innovation output data; then we aggregate the firm level data to industry level by using the GICS, 24 groups classification. We manually match the Chinese Security Industry Classification with the GICS 10 sectors and 24 groups. (The matching details are in Appendix B). Thus, the variable, *USPatent*, is calculated by average the number of patents in the corresponding industry. Due to the limitation of U.S. patent database, the period of matched sample is dropped to

the year before 2009 and the number of observation decreases to 9143.

[Insert Table 4]

We report the results estimating equation (3) in Table 4. In the regression, the signs of the interaction term and the US patent variables are negative. This negative association means in the industry where US innovation is decreasing, the increase of foreign sales in Chinese firms would help to increase the firms' innovations. For example, in column (1), one standard deviation decreases of average number of patents among US corresponding industry with one standard deviation increase in Chinese firm's foreign sales would leads to 0.113 patents for each company. This negative relationship also implies that when the US companies are retreating in an industry and the US companies decrease the innovation output in industry level, Chinese firm's innovation can increase more by increasing their foreign sales. When the US companies are not actively competing in an industry, the Chinese firms have more incentive to capture the market. The result is also consistent with competing theory. For multinationals with high foreign sales ratio, they are more relying on the global market. When they find the US is decreasing the innovation output in the industry, they have more incentives to step into the industry. So, they increase their innovations to win the competitiveness.

To further examine our hypothesis, we consider the sub-sample regression analysis between different industries. According to our theory, the pressure of competition is much severer in the industries that US companies are also devoting

to innovate, for example, high tech industries. So, the competition phenomenon is more obvious among these industries. Similarly, for the traditional industries, US companies are outsourcing the operations so that the Chinese multinationals face less competition. Low competitions generate the complementary effect. Being the follower, the Chinese multinationals are mimicking the innovation of US companies through the foreign sales. In Table 5, we present the results for different industries.

[Insert Table 5]

In Table 5, we find the consistent result of the significant effect for different industries. We define the company as high-tech companies through the definition of tax deduction policy from the Chinese government. We group the companies having high-tech tax deduction into the high-tech category and the rest companies as the low-tech category. The results show that with high tech group, the coefficient of interaction terms of US patent and foreign sales are negative, meaning the competition relationship between the US companies and Chinese multinationals. However, for the low-tech group, all the coefficients are positive, which demonstrate the complementary relationship between the US companies and Chinese multinationals.

In this section, the results of our baseline regression analysis are consistent with our initial hypothesis. Assumed by the competition theory, non-SOE multinationals in high tech industry have more innovation outputs since they face high competition pressure both domestically and internationally.

### *2.3.2. The Difference-in-difference Approach*

Our baseline analysis utilizes the pooled ordinary least squares (OLS) regressions. However, there is a plausible concern that these regression results may suffer from endogenous problems, that is, firms with better growth prospects or with anticipation in innovation may be more attractive in global market and have more foreign sales. This could also explain the positive association between foreign sales and innovation output, leading to concerns on reverse causality.

To test a causal effect of foreign sales and innovation and rule out the possibility of reverse causality, we perform a quasi-natural experiment using the Exchange Rate Reform in China as the exogenous shock to corporate foreign sales. This Exchange Rate Reform in 2005 was an unexpected event to corporations and the market. Since 1997, People's Bank of China (PBOC), the Chinese central bank, had effectively pegged the CNY to the USD at rate of 8.28 yuan/dollar. However, on July 21, 2005, PBOC announced that CNY would be managed to float with reference to a basket of currencies. On August 9, 2005, the Governor of PBOC disclosed a list of 11 reference currencies, which made the CNY appreciated for 2% suddenly. The sudden shock for the currency due to this unexpected exchange policy reform provides a quasi-natural experiment that generates plausibly exogenous variation in corporate foreign sales for exporting firms in our sample. To control for unobserved firm heterogeneity and remove potential bias due to time-invariant firm-level omitted variables, we run regressions with firm fixed

effects and industry fixed effects. This allows our analysis to be free from unobserved firm individual effects that may explain their patents.

We employ a difference-in-difference (DiD) regression to compare the innovation output of the treatment firms and control firms three years before (2003-2005) and three years after (2006-2008) the announcement of the Exchange Rate Reform. Treatment group includes the firms with foreign sales and influenced by the exchange rate reform in 2005. Control group is the firms without foreign sales and not influenced by the exchange rate reform. The number of observations in treatment group is 3,781 while the number of observations in control group is 3,162. We perform the DiD tests in a multivariate regression framework by estimating the following regression model:

$$LnPatent_{i,t+1} = \beta_0 + \beta_1 ExPolicy_{i,t} \times Fsales_{i,t} + \beta_2 ExPolicy_{i,t} + \beta_3 Fsales_{i,t} + \gamma' X_{i,t} + \varphi_t + \alpha_i + \omega_j + \varepsilon_{i(j),t} \quad (4)$$

Where the dependent variable captures firm innovation outcomes. *ExPolicy* is a dummy variable that equals one for period after 2005 (2006-2008) and zero for period (2002-2005). X consists of a vector of control variables used in Equation (4); $\varphi_t, \alpha_i, \omega_j$ capture year fixed effects, firm fixed effect and industry fixed effect. The coefficient estimate of $ExPolicy \times Fsales$ is the DiD estimator that captures the causal effect of firm with foreign sales and influenced by the Exchange Rate Reform on firm innovation.

[Insert Table 6]

Table 6 reports the regression results estimating Equation (3) with standard errors clustered at the firm level. In column 1 to column 3, the dependent variable

is *Ln (1+Patent1)*, the number of invention patents; for column 4 to column 6, the dependent variable is *Ln (1+Patent All)*, the total number of patents. The interactions of *ExPolicy* with foreign sales are significant and positive at 1% level. The innovation driven is mainly caused by the multinational firms after the passage of Exchange Rate Reform. Our identification tests based on the DiD approach suggest that there appears to be a positive, causal effect of foreign sales on firm innovation. The evidence is consistent with our first hypothesis that foreign sales enhance firm innovation.

To exclude the selection bias problem, we approach on propensity score matching (PSM) method to control for any potential bias. For each year we match multinational firms with firms without foreign sales but having similar firm characteristics on the right sides such as size, growth opportunity, leverage and profitability. The distance (caliber distance) of matching we used is 0.05 by each year and the treatment groups are those multinational firms we defined as *MNC10* and *MNC25*. In Figure 1, we present the level of innovation output (*Patent 1* as well as *Patent All*) of two types of firms after PSM. The left panel shows the number of invention patents while the right panel of figures are using the total number of patents. In this univariate analysis, we show that difference between multinationals and domestics is larger after the passage of exchange policy reform.

We then approach the DiD multivariate analysis after the PSM procedure and present the results in Table 6. The number of observation drops since we only

keep data within distance of treatment groups with control groups. *TMNC10* and *TMNC25* measure the foreign sales in the treatment groups after matching the sample with PSM, changing the cut-off ratio from 10% to 25%.

[Insert Table 7]

As shown in Table 7, the regressions estimated coefficients of the interaction term between foreign sales dummy and policy dummy are still positive, with slightly drop of significance. We also show that after 2005, the influence from foreign sales on innovations becomes much stronger, which is consistent with the univariate tests in Figure 1. The greater coefficients on TMNC10 and TMNC25 after the exchange reform suggest that the increase in innovation output is larger for the treatment groups than for the control groups after the exchange reform.

The evidence from the DiD tests suggests that multinationals experience a larger increase in their innovation output compared to the pure domestic companies after the exchange reform. The reform can be used as a shock since it is only influences the foreign sales and relatively unrelated with the innovation output. This quasi natural experiment confirms that the change of foreign sales proportion can have a positive effect on the output of innovation in Chinese firms.

### *2.3.3. Robust Test on Endogeneity Problem with Bilateral Treaties*

We further address the endogeneity concern by using the Bilateral Investment Treaties (BIT) signed between China and another country as an

instrument for foreign sales, since signing more BITs encourages more exports.

Bilateral Investment Treaty is an important international legal mechanism to improve enforcement of contracts and property rights to remove impediments to foreign investment. BITs require countries to protect the property rights of foreign firms and allow international bodies, such as the International Convention on the Settlement of Investment Disputes (ICSID), a member of the World Bank, to arbitrate any foreign investment disputes. While BITs were designed to encourage the capital flows to foreign countries, signing BITs affects the foreign sales and the foreign exposures (Dixit, 2012), as two signed nations often have favored treatment on sales of products (Dolzer and Stevens, 1995).

Thus, using the BITs as the instrument variable helps to measure the influence of foreign sales on innovation not due to firm's innovations. We show that the exogenous increase in foreign sales due to new BITs has a positive effect on innovation, suggesting that the correlation between foreign sales and innovation is not primarily due to self-selection. We consider the inclusion of number of signed BITs as an instrumental variable for foreign sales. BIT would encourage export for several reasons. Prior literatures have demonstrated the close relationship between the foreign exposures and signature of new BITs (Dunning, 1998; Busse, Königer and Nunnenkamp, 2010; Berger, Busse, Nunnenkamp and Roy, 2011). Furthermore, BIT provides protection of foreign operations which often results in sharp increase of foreign sales. We thus first show that the number of the BITs and the weighted export by the number of

BITs are significant positively correlated with companies' foreign sales, which is one of the requirements for number of BITs to be a valid instrument. BIT is between two nations which does not influence any company's R&D or innovation. It allows us to take out any firm specific factors related to innovation and identify the causal effect of foreign sales.

We collect the BITs data from the ICSID website. This data contains the signatory States, the particular treaty and year of signature. We only look at the data that one signatory nation is China. The data on BIT covers from 2001 to 2012. After merged with our innovation and financials database, there will be 13,257 year-firm observations remaining. We use the cumulative number of BITs that China signed with other countries as the instrumental variable in the first stage (Tobin and Rose-Ackerman, 2005). Alternative instrumental variable is the increase in number of BITs, weighted by the share of changing export to the region signed BIT with China accounts for relative to the total changing export of China (Neumayer and Spess, 2005). The weighting is to account for differences in the size of exporting a country makes for via signing a BIT. Figure 2 shows the cumulative number of BITs signed by China per year and the increase number of BITs weighted by changing export. When we measure the time of signed BITs, since we need to compare the influence of BITs to the company's foreign sales, we consider the BITs signed before June having the influence on the same year but the BITs signed after June having the effect on the next following year.

[Insert Figure 2]

We report the IV regressions in Table 8. We present the weak instrument variable test and Hausman based test to examine the validity of the BITs as instrumental variables, and report two-stage least squares (2SLS) results in the following section. The first column reproduces the baseline regression; columns 2 and 4 present the first stage where we regress the foreign sales on the cumulative number of BITs and the exporting weighted number of BITs and all other controls. As expected, the instrument is positive and highly significant. It is clear that signing new BITs lead to increase the foreign sales. In the column 3 and column 5, we present the results of using the forecasted foreign sales as the explanatory variable and remain the same control variable. Interestingly, the foreign sales variable remains highly significant with a coefficient that is much larger than column 1. The BITs instrument shows that instrumented foreign sales increase patent counts. The one standard deviation increase in the foreign sales, which is caused by the increase of the cumulative signed BITs, would, on average, increase the number of type 1 patent and the number of all patent by 140 and 321, respectively.

[Insert Table 8]

Thus, by using the increase of BITs as the instrumental variable, we show that the influence of foreign sales on the innovation becomes much stronger. Adding the BITs into the regression helps us to identify the increase of foreign sales irrelevant to the firm performance and other factors that would also

influence the innovation. These isolated increases of foreign sales give a sharp surge on innovation. Because of the sharp rise in the magnitude and the significance for the coefficients, we are confident about the causality between the foreign sales and innovation. As shown in Table 8, after excluding other factors' influence on sales, the significant and positive effect of foreign sales on innovation becomes very robust.

## 2.4. Conclusion

This paper studies how Chinese multinationals are emerging to innovate more and become competitive globally. We show that Chinese firms with greater foreign sales exhibit more patents than other firms with no or less foreign sales. Cross sectional tests show that the difference in patents is more pronounced in firms with greater incentives to innovate, e.g., firms with low degree of agency problem, firms operating in competitive product market, and firms of high-tech sectors. Further, the effect of difference in patents only exists in non-SOE firms, suggesting that non-SOE firms with more foreign sales are the driving force for the increase in corporate innovations. Chinese emerging multinational corporations innovate more when their US industry peers are retreating in patents. This evidence suggests that the participation in the foreign market is positively associated with more innovation activities.

We utilize several tests to show our results are not caused by the endogeneity problem which states that innovative firms are more competitive and

export more goods, resulting in higher foreign sales. We first use propensity score matching method to compare the difference in patents between firms with greater foreign sales and those with no/less foreign sales. Second, we utilize a quasi-natural experiment when Chinese government reformed its RMB regime from fixed rate to floating rate which causes an exogenous shock to corporate foreign sales. The difference-in-difference approach yields consistent and robust results. Corporate foreign sales have a casual effect on corporate patents. The combined evidence suggests that non-SOE firms with great participation in global trading activities drive corporate innovations.

Our research has the important and general implication for policy makers, market participants and academic circles. It highlights the importance of the success of Chinese trading activities in global scales that has greatly fuelled corporate innovation activities. Chinese emerging multinationals are becoming more innovative and they starting to catch up or even replace some of innovation activities dominated by their US peer firms. Participation in global trading activities serves an important drive for innovations that are pivotal for economic growth.

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## Appendix 2.A: Variable Definition and Construction

| Variables | Definitions | Source |
|---|---|---|
| **Innovation** | | |
| Patent 1 | The total number of invention patent applications filed (and eventually granted) by a firm in a given year. All missing variables are replaced by zero. | Hand Collected |
| Patent All | The total number of patents filed (and eventually granted) by a firm in a given year. All missing variables are replaced by zero. | Hand Collected |
| **Foreign Sales** | | |
| Fsales | The ratio of foreign sales to the total sales and missing foreign sales are checked with the annual reports and equals to zero if a firm do not export. | Wind |
| MNC10 | Dummy variable set equal to one if foreign sales is more than 10% of total sales and equal to zero if foreign sales is zero. | Wind |
| MNC25 | Dummy variable set equal to one if foreign sales is more than 25% of total sales and equal to zero if foreign sales is zero. | Wind |
| **Key Variables** | | |
| Ln(Total Assets) | The logarithm of the book value of total assets measured at the end of fiscal year t. | CSMAR |
| Ln(Age) | Natural logarithm of one plus the number of years since the firm has its listed price. | CSMAR |
| ROA | Return on assets, defined as operating income before depreciation divided by total assets, measured at the end of the fiscal year t-1. | CSMAR |
| Tobin's Q | Book value of total assets minus book value of equity plus market value of equity scaled by book value of total assets at the end of fiscal year t. | CSMAR |
| CAPEX | Capital expenditure divided by book value of total assets measured at the end of the fiscal year t-1. | CSMAR |
| Tangibility | Book value of tangible assets scaled by book value of total assets, measured at the end of fiscal year t-1. | CSMAR |
| Leverage | Ratio of total debt to total assets, measured at the end of fiscal year t-1. | CSMAR |
| Cash Flow | EBIT plus depreciation and amortization minus interest expense and taxes divided by book value of assets, measured at the end of fiscal year t-1. | CSMAR |
| SOE Dummy | Indicator whether the largest shareholder or the ultimate owner of the listed firms is state-owned at the end of year t. | CSMAR, Wind, Hand Collected |
| HHI | Herfindahl index of GICS industries classifications to which the firm belongs, measured at the end of the fiscal year t-1. | CSMAR |
| KZ | The KZ index measured at the end of fiscal year, calculated as -1.002 ×Cash flow [(Income before extraordinary items + Depreciation and Amortization)/Lagged net property, plant and equipment] + 0.283 × Q [Market value of equity + book value of total assets-book value of equity-balance sheet deferred tax] + 3.139×Leverage[Total debt/Total assets] - 39.368 × Dividends [(Dividends)/Lagged net property, plant and | CSMAR |

| | | |
|---|---|---|
| | equipment] - 3.315 × Cash holdings [(Cash and short-term investment)/(Lagged net property, plant and equipment)]. | |
| High Tech Dummy | Indicator equals to one when firms are qualified as the high-tech requirement made by government and thus received benefits like tax deduction at the end of year t. | CSMAR |
| US Patent | The industry-level average number of patents in the U.S. market; this number was matched through corresponding industry (GICS four levels) to Chinese firms. | Harvard US Patent Database |

## Appendix 2.B: Global Industry Classification Standard (GICS): China vs. U.S.[24]

The Chinese Securities Industry Classification (CSIC) provided by China Security Index Co. Ltd (CSI) is widely used in China. It follows similar classification rules according to the Global Industry Classification Standard (GICS) by MICS and S&P Global.

| **Industry Name** | **CSIC** | **GICS** |
|---|---|---|
| **Level 1** | CSIClv1 | Gsector |
| Energy | 00 | 10 |
| Materials | 01 | 15 |
| Industrials | 02 | 20 |
| Consumer Discretionary | 03 | 25 |
| Consumer Staples | 04 | 30 |
| Health Care | 05 | 35 |
| Financials | 06 | 40 |
| Information Technology | 07 | 45 |
| Telecommunication Services | 08 | 50 |
| Utilities | 09 | 55 |
| Real Estate | | 60 |
| **Level 2** | CSIClv2 | Ggroup |
| Energy | 0001 | 1010 |
| Materials | 0101 | 1510 |
| Capital Goods | 0201 | 2010 |
| Commercial Services & Supplies | 0202 | 2020 |
| Transportation | 0203 | 2030 |
| Automobiles & Components | 0301 | 2510 |
| Consumer Durables & Apparel | 0302 | 2520 |
| Consumer Services | 0303 | 2530 |
| Media | 0304 | 2540 |
| Retailing | 0305 | 2550 |
| Food & Staples Retailing | 0401 | 3010 |
| Food, Beverage & Tobacco | 0402 | 3020 |
| Household & Personal Products | 0403 | 3030 |
| Health Care Equipment & Services | 0501 | 3510 |
| Pharmaceuticals, Biotechnology & Life Sciences | 0502 | 3520 |
| Banks | 0601 | 4010 |
| Diversified Financials | 0602 | 4020 |
| Insurance | 0603 | 4030 |
| Real Estate | 0604 | 4040 |
| Software & Services | 0701 | 4510 |
| Technology Hardware & Equipment | 0702 | 4520 |
| Semiconductors & Semiconductor Equipment | 0703 | 4530 |

[24]Detailed information can be found here: https://www.msci.com/gics.

| | | |
|---|---|---|
| Telecommunication Services | 0801 | 5010 |
| Communications Equipment | 0802 | |
| Utilities | 0901 | 5510 |

## Figure 2.1: Propensity Score Matching for DiD Test

The figure below plots the change in the number of patents that a firm file measured in the log scale, following the exchange reform policy in 2005.Foreign sales data is only available from year 2002, year after China joined the WTO. The top panel of the figure presents relationship between the control group and treatment group of MNC10 while the bottom panel of the figure presents relationship between the control group and treatment group of MNC25. The left panel of figures are using the number of invention patents while the right panel of figures are using the total number of patents. To exclude potential selection bias issue, treatment groups are using propensity score matching (PSM). For each year, we select multinational firms with domestic firms by choosing similar characteristics, such as size, growth opportunity, leverage and profitability, as control variables in the multivariate analysis. We use caliper matching procedure that each firm have a matching distance with a 0.05 using *psmatch2* in Stata. The results are robust whatever caliper parameters are chosen.

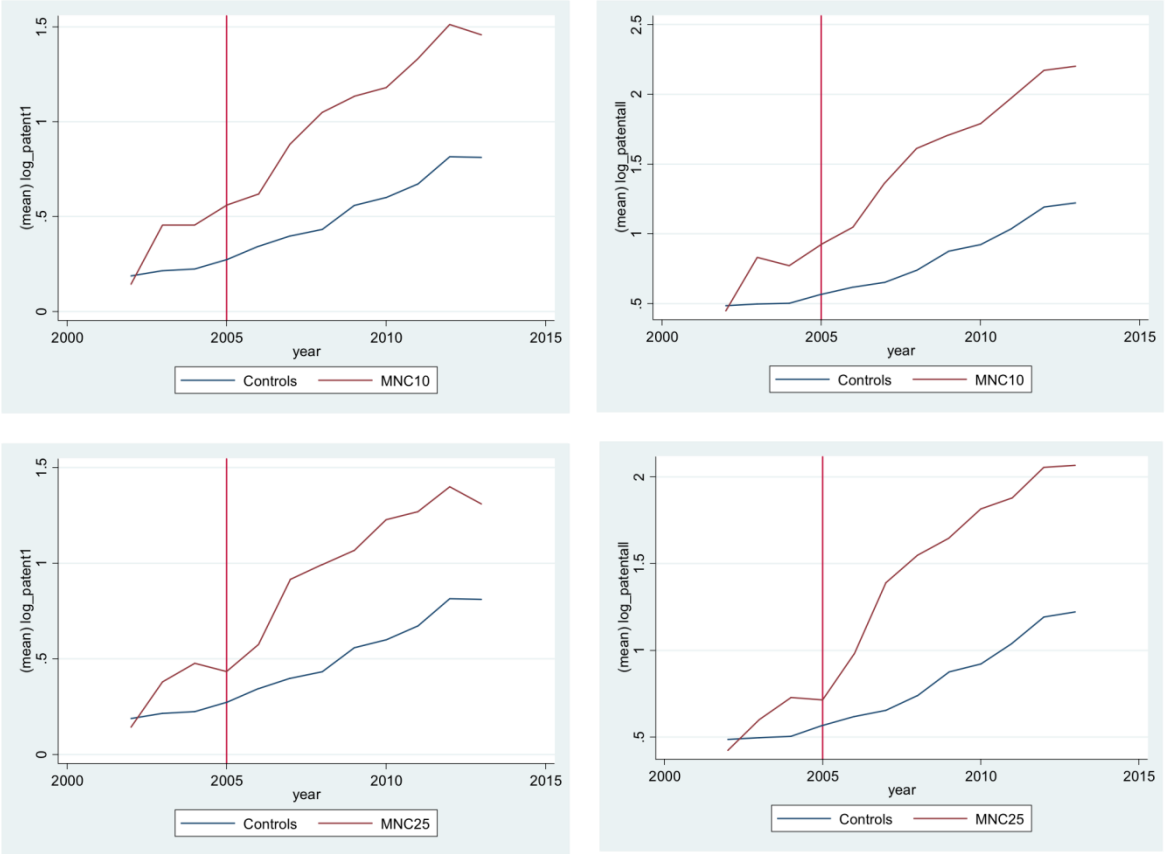
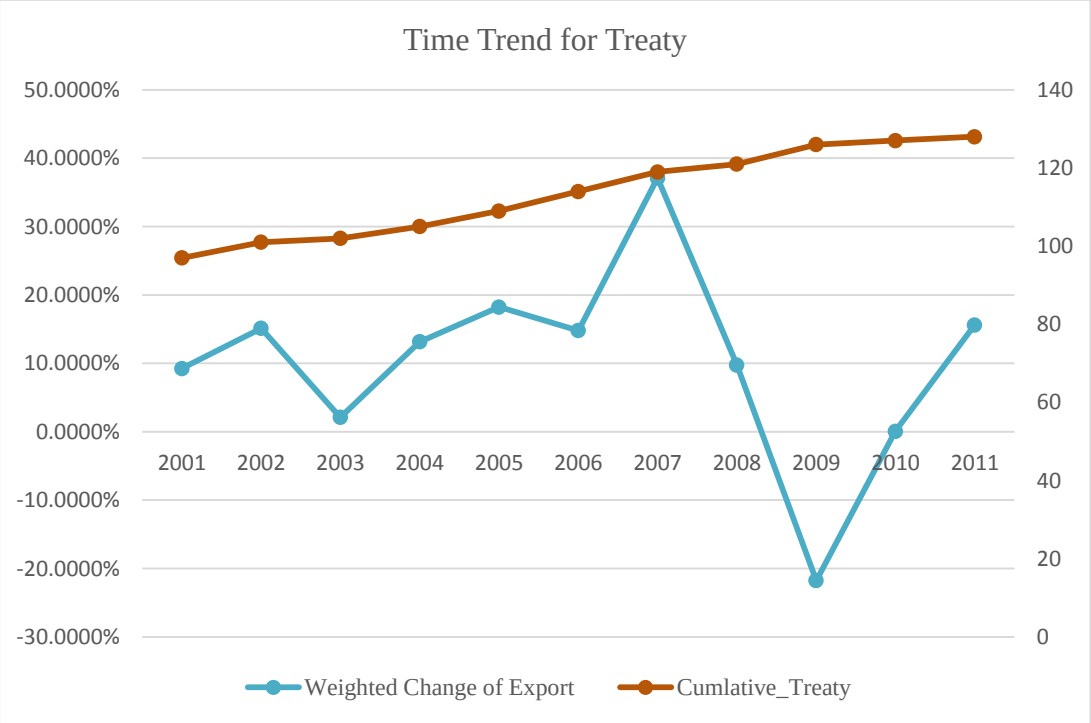


**Figure 2.2: Time Trend for Treaty**

This figure shows the time trend of the cumulative number of Treaties which is signed by China in each year and the weighted change of export from 2001 to 2011. The weighted change of export is the calculated by using the number of treaties signed between specific country and China multiplied by the percentage of the change of export from China to this country proportional to the total changed of Chinese export.



## Table 2.1: Descriptive Statistics

This table reports descriptive statistics for our sample firms during the period 2002-2013. All variables are defined in Appendix A. We start with the patent data and control variables. Panel A presents the summary statistics for firms' innovation output and other control variables. Panel B presents the comparisons between the firms without foreign sales and firms with foreign sales. The last column reports the difference in mean between the two types of firms. ***, **, and * indicate significance at 1%,5% and 10% levels, respectively using robust standard errors for two-tailed tests. Panel C reports the industry distribution of the number of firms with foreign sales and domestic firms. The industry classifications are using the China Securities Industry Classification (CSIC) consistent with Global Industry Classification Standard (GICS).

**Panel A: Summary Statistics**

| Variables | N | Mean | S.D. | Min. | Median | Max. |
|---|---|---|---|---|---|---|
| ln(1+Patent1) | 17,710 | 0.7646 | 1.1453 | 0.0000 | 0.0000 | 8.6618 |
| ln(1+Patent All) | 17,710 | 1.2252 | 1.4956 | 0.0000 | 0.6931 | 8.7513 |
| Fsales | 17,710 | 0.1048 | 0.1974 | 0.0000 | 0.0000 | 0.9927 |
| MNC10 | 14,313 | 0.3361 | 0.4724 | 0.0000 | 0.0000 | 1.0000 |
| MNC25 | 12,147 | 0.2177 | 0.4127 | 0.0000 | 0.0000 | 1.0000 |
| Ln(Total Assets) | 16,328 | 21.3892 | 1.1678 | 17.8078 | 21.2391 | 26.1661 |
| Ln(Age) | 17,696 | 2.3123 | 0.5324 | 0.0000 | 2.3979 | 3.3322 |
| ROA | 16,328 | 0.0460 | 0.1023 | -0.5795 | 0.0376 | 1.2596 |
| Tobin's Q | 17,161 | 2.1322 | 1.6042 | 0.6692 | 1.6573 | 24.2719 |
| CAPEX | 16,328 | 0.0740 | 0.0884 | -0.2640 | 0.0486 | 0.7397 |
| Tangilibity | 16,328 | 0.3144 | 0.2148 | 0.0000 | 0.2728 | 2.2896 |
| Leverage | 16,263 | 0.2287 | 0.2154 | 0.0000 | 0.1993 | 2.2463 |
| Cash Flow | 15,951 | 0.0810 | 0.1142 | -0.5159 | 0.0686 | 1.8419 |
| SOE Dummy | 17,661 | 0.4733 | 0.4993 | 0.0000 | 0.0000 | 1.0000 |

**Panel B: Mean Comparison**

| Variables | Without FSales(0) | | With FSales(1) | | (0)-(1) |
|---|---|---|---|---|---|
| | Obs | Mean | Obs | Mean | Mean Diff |
| ln(1+Patent1) | 9,502 | 0.4918 | 8,208 | 1.0804 | -0.5886*** |
| ln(1+Patent All) | 9,502 | 0.8160 | 8,208 | 1.6989 | -0.8829*** |
| Ln(Total Assets) | 8,859 | 21.2712 | 7,469 | 21.5293 | -0.2581*** |
| Ln(Age) | 9,492 | 2.3244 | 8,204 | 2.2982 | 0.0262*** |
| ROA | 8,859 | 0.0439 | 7,469 | 0.0484 | -0.0045*** |
| Tobin's Q | 9,191 | 2.2244 | 7,970 | 2.0259 | 0.1985*** |
| CAPEX | 8,859 | 0.0684 | 7,469 | 0.0807 | -0.0123*** |
| Tangilibity | 8,859 | 0.3188 | 7,469 | 0.3092 | 0.0097*** |
| Leverage | 8,816 | 0.2296 | 7,447 | 0.2276 | 0.002 |
| Cash Flow | 8,562 | 0.0808 | 7,389 | 0.0811 | -0.0003 |

| | | | | | | |
|---|---|---|---|---|---|---|
| SOE Dummy | 9,471 | 0.5177 | 8,190 | 0.4220 | 0.0957*** | |

**Panel C: Industry Distribution**

| **Industry Names** | **Without FSales** | | **With FSales** | | **Total** | |
|---|---|---|---|---|---|---|
| | **Obs** | **Percent** | **Obs** | **Percent** | **Obs** | **Percent** |
| Consumer Discretionary | 2,000 | 21.05 | 1,479 | 18.02 | 3,479 | 19.64 |
| Consumer Staples | 1,007 | 10.6 | 503 | 6.13 | 1510 | 8.53 |
| Energy | 416 | 4.38 | 216 | 2.63 | 632 | 3.57 |
| Health Care | 782 | 8.23 | 533 | 6.49 | 1315 | 7.43 |
| Industrials | 2,480 | 26.1 | 2,193 | 26.72 | 4,673 | 26.39 |
| Information Technology | 779 | 8.2 | 982 | 11.96 | 1761 | 9.94 |
| Materials | 1,805 | 19 | 2,070 | 25.22 | 3,875 | 21.88 |
| Telecommunication Services | 233 | 2.45 | 232 | 2.83 | 465 | 2.63 |
| **Total** | **9,502** | **100** | **8,208** | **100** | **17,710** | **100** |

## Table 2.2: Baseline Regression

This table reports the regressions of firm innovation on firm foreign sales. The dependent variable is the natural logarithm of one plus the number of invention patents filed (and eventually granted) by a firm in a given year in panel A. In panel B, the dependent variable is natural logarithm of one plus total number of patents filed (and eventually granted) by a firm in a given year. The main variables of interest are foreign sales ratios, 10% cut-off foreign sales ratio dummy and 25% cut-off foreign sales ratio dummy. The foreign sales ratio is calculated as the percentage of revenue from foreign countries on the total revenue. The 10% cut foreign sales ratio dummy equals to one if the foreign sales ratio is greater than 10% and equals to zero if the firm doesn't have foreign sales. The 25% cut foreign sales ratio dummy equals to one if the foreign sales ratio is greater than 25% and equals to zero if the firm doesn't have foreign sales. The set of control variables includes the natural logarithm of firm assets, the natural logarithm of one plus firm age at the IPO year, return on assets, Tobin's Q, firm leverage, firm investment measured by capital expenditure scaled by firm assets, tangibility measured by PPE scaled by firm assets. All regressions include firm (industry), year fixed effect. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

| | **Panel A: Ln(1+Patent1)** | | | **Panel B: Ln(1+Patent All)** | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| lag(Fsales) | 0.290** | | | 0.264** | | |
| | (0.113) | | | (0.124) | | |
| lag(MNC10) | | 0.324*** | | | 0.410*** | |
| | | (0.047) | | | (0.061) | |
| lag(MNC25) | | | 0.291*** | | | 0.345*** |
| | | | (0.062) | | | (0.076) |
| lag(Ln(Total Assets) | 0.239*** | 0.342*** | 0.306*** | 0.258*** | 0.421*** | 0.387*** |
| | (0.036) | (0.038) | (0.041) | (0.039) | (0.042) | (0.044) |
| Ln(Age) | 0.462*** | -0.228*** | -0.231*** | 0.649*** | -0.377*** | -0.378*** |
| | (0.114) | (0.048) | (0.047) | (0.130) | (0.064) | (0.063) |
| lag(ROA) | -0.136* | 0.278** | 0.238* | -0.092 | 0.491*** | 0.464*** |
| | (0.076) | (0.135) | (0.139) | (0.096) | (0.172) | (0.175) |
| lag(Tobin's Q) | 0.016** | 0.065*** | 0.057*** | 0.015* | 0.071*** | 0.067*** |
| | (0.007) | (0.012) | (0.013) | (0.008) | (0.016) | (0.017) |
| lag(Leverage) | -0.109** | -0.452*** | -0.399*** | -0.131* | -0.773*** | -0.711*** |
| | (0.055) | (0.082) | (0.081) | (0.071) | (0.117) | (0.116) |
| lag(CAPEX) | 0.022 | 0.597*** | 0.611*** | 0.073 | 0.802*** | 0.851*** |
| | (0.092) | (0.148) | (0.151) | (0.114) | (0.194) | (0.197) |
| lag(Tangibility) | 0.077 | -0.060 | -0.045 | 0.079 | 0.002 | 0.008 |
| | (0.061) | (0.095) | (0.096) | (0.077) | (0.127) | (0.130) |
| Constant | -5.498*** | -6.627*** | -5.873*** | -5.850*** | -7.665*** | -6.966*** |
| | (0.748) | (0.801) | (0.865) | (0.835) | (0.898) | (0.938) |
| Firm FE | Y | N | N | Y | N | N |
| Industry Lv2 FE | N | Y | Y | N | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |

| | | | | | | |
|---|---|---|---|---|---|---|
| N | 14608 | 12078 | 10420 | 14608 | 12078 | 10420 |
| adj. R-sq | 0.158 | 0.285 | 0.265 | 0.147 | 0.311 | 0.291 |

## Table 2.3: Baseline Regression of SOE Ownership

This table reports the regressions of firm innovation on firm foreign sales and adds the SOEs interaction term. The dependent variable is the natural logarithm of one plus the number of invention patents filed (and eventually granted) by a firm in a given year in panel A. In panel B, the dependent variable is natural logarithm of one plus total number of patents filed (and eventually granted) by a firm in a given year. The SOE indicator equals to one if the largest shareholder is government or related parties otherwise equals to zero. The main variables of interest are foreign sales ratios interacted with SOE indicator, 10% cut-off foreign sales ratio dummy interacted with SOE indicator and 25% cut-off foreign sales ratio dummy interacted with SOE indicator. The foreign sales ratio is calculated as the percentage of revenue from foreign countries on the total revenue. The 10% cut foreign sales ratio dummy equals to one if the foreign sales ratio is greater than 10% and equals to zero if the firm doesn't have foreign sales. The set of control variables includes the natural logarithm of firm assets, the natural logarithm of one plus firm age at the IPO year, return on assets, Tobin's Q, firm leverage, firm investment measured by capital expenditure scaled by firm assets, tangibility measured by PPE scaled by firm assets. All regressions include firm (industry), year fixed effect. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

| | **Panel A: Ln(1+Patent1)** | | | **Panel B: Ln(1+Patent All)** | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| SOE* | 0.268* | | | 0.061 | | |
| lag(Fsales) | (0.161) | | | (0.209) | | |
| nonSOE* | 0.399*** | | | 0.495*** | | |
| lag(Fsales) | (0.131) | | | (0.163) | | |
| SOE* | | 0.354*** | | | 0.390*** | |
| lag(MNC10) | | (0.068) | | | (0.090) | |
| nonSOE* | | 0.285*** | | | 0.416*** | |
| lag(MNC10) | | (0.060) | | | (0.076) | |
| SOE* | | | 0.223*** | | | 0.183* |
| lag(MNC25) | | | (0.084) | | | (0.109) |
| nonSOE* | | | 0.336*** | | | 0.462*** |
| lag(MNC25) | | | (0.079) | | | (0.095) |
| SOE Dummy | -0.028 | -0.064 | -0.054 | -0.022 | -0.067 | -0.054 |
| | (0.042) | (0.044) | (0.045) | (0.057) | (0.058) | (0.059) |
| lag(Ln(Total Assets) | 0.364*** | 0.349*** | 0.318*** | 0.444*** | 0.432*** | 0.401*** |
| | (0.036) | (0.040) | (0.043) | (0.040) | (0.044) | (0.046) |
| Ln(Age) | -0.240*** | -0.227*** | -0.223*** | -0.384*** | -0.371*** | -0.364*** |
| | (0.046) | (0.048) | (0.048) | (0.062) | (0.064) | (0.063) |
| lag(ROA) | 0.180 | 0.275** | 0.215 | 0.394** | 0.464*** | 0.419** |
| | (0.127) | (0.137) | (0.140) | (0.164) | (0.174) | (0.177) |
| lag(Tobin's Q) | 0.050*** | 0.064*** | 0.058*** | 0.049*** | 0.071*** | 0.068*** |
| | (0.011) | (0.012) | (0.013) | (0.015) | (0.016) | (0.017) |
| lag(Leverage) | -0.510*** | -0.472*** | -0.422*** | -0.847*** | -0.806*** | -0.749*** |
| | (0.080) | (0.083) | (0.082) | (0.114) | (0.117) | (0.115) |

| | | | | | | |
|---|---|---|---|---|---|---|
| lag(CAPEX) | 0.650*** | 0.598*** | 0.589*** | 0.862*** | 0.796*** | 0.817*** |
| | (0.149) | (0.149) | (0.152) | (0.191) | (0.195) | (0.198) |
| lag(Tangibility) | -0.031 | -0.042 | -0.027 | 0.057 | 0.025 | 0.029 |
| | (0.093) | (0.096) | (0.098) | (0.125) | (0.128) | (0.131) |
| Constant | -6.969*** | -6.721*** | -6.092*** | -8.045*** | -7.865*** | -7.264*** |
| | (0.755) | (0.835) | (0.907) | (0.847) | (0.927) | (0.970) |
| Industry Lv2 FE | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |
| N | 14557 | 12035 | 10378 | 14557 | 12035 | 10378 |
| adj. R-sq | 0.269 | 0.285 | 0.267 | 0.294 | 0.312 | 0.295 |

## Table 2.4: Baseline Regression of Comparing with Innovation in the U.S.

This table reports the regressions of firm innovation on firm foreign sales and adds the US patent as interaction term. The dependent variable measures the number of invention patents in panel A. In panel B, the dependent variable measures total number of patents. The main variables of interest are interaction of foreign sales with US patent number. The US patent number is the industry level average of total number of patents in the U.S. for level 2 GICS, 24 sectors. The foreign sales ratio is calculated as the percentage of revenue from foreign countries on the total revenue. The MNC10 equals to one if the foreign sales ratio is greater than 10% and equals to zero if the firm doesn't have foreign sales. The measure is the same as MNC25. The set of control variables includes the natural logarithm of firm assets, the natural logarithm of one plus firm age at the IPO year, return on assets, Tobin's Q, firm leverage, firm investment measured by capital expenditure scaled by firm assets, tangibility measured by PPE scaled by firm assets. All regressions include firm (industry), year fixed effect. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

| | **Panel A: Ln(1+Patent1)** | | | **Panel B: Ln (1+Patent All)** | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| lag(Fsales)* | -0.113* | | | -0.105 | | |
| lag(log(1+USPatent)) | (0.067) | | | (0.079) | | |
| lag(Fsales) | 0.472** | | | 0.462** | | |
| | (0.187) | | | (0.213) | | |
| lag(MNC10)* | | -0.030 | | | -0.030 | |
| lag(log(1+USPatent)) | | (0.031) | | | (0.046) | |
| lag(MNC10) | | 0.311*** | | | 0.380*** | |
| | | (0.077) | | | (0.111) | |
| lag(MNC25)* | | | -0.012 | | | -0.023 |
| lag(log(1+USPatent)) | | | (0.038) | | | (0.056) |
| lag(MNC25) | | | 0.266*** | | | 0.319** |
| | | | (0.095) | | | (0.135) |
| lag(log(1+USPatent)) | -0.121*** | -0.177*** | -0.186*** | -0.147*** | -0.229*** | -0.242*** |
| | (0.024) | (0.029) | (0.030) | (0.029) | (0.038) | (0.040) |
| lag(Ln(Total Assets) | 0.198*** | 0.300*** | 0.272*** | 0.197*** | 0.410*** | 0.385*** |
| | (0.041) | (0.039) | (0.039) | (0.046) | (0.046) | (0.046) |
| Ln(Age) | 0.273** | -0.201*** | -0.198*** | 0.486*** | -0.304*** | -0.293*** |
| | (0.122) | (0.053) | (0.051) | (0.142) | (0.073) | (0.069) |
| lag(ROA) | 0.064 | 0.346** | 0.315* | 0.201* | 0.568*** | 0.570*** |
| | (0.089) | (0.163) | (0.167) | (0.113) | (0.208) | (0.212) |
| lag(Tobin's Q) | 0.011 | 0.067*** | 0.059*** | 0.006 | 0.087*** | 0.082*** |
| | (0.008) | (0.013) | (0.013) | (0.009) | (0.019) | (0.020) |
| lag(Leverage) | -0.030 | -0.270*** | -0.210*** | -0.018 | -0.570*** | -0.502*** |
| | (0.056) | (0.081) | (0.076) | (0.076) | (0.125) | (0.121) |
| lag(CAPEX) | -0.038 | 0.351** | 0.324** | 0.116 | 0.512** | 0.517** |
| | (0.096) | (0.154) | (0.153) | (0.125) | (0.209) | (0.208) |
| lag(Tangibility) | 0.021 | -0.053 | -0.013 | -0.016 | -0.051 | -0.014 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (0.059) | (0.094) | (0.094) | (0.082) | (0.134) | (0.137) |
| Constant | -4.135*** | -5.456*** | -4.859*** | -4.121*** | -7.135*** | -6.631*** |
| | (0.844) | (0.825) | (0.833) | (0.987) | (0.985) | (0.984) |
| Firm FE | Y | N | N | Y | N | N |
| Industry Lv2 FE | N | Y | Y | N | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |
| N | 9143 | 7905 | 6998 | 9143 | 7905 | 6998 |
| adj. R-sq | 0.136 | 0.251 | 0.237 | 0.119 | 0.265 | 0.251 |

## Table 2.5: Regression of Competition with U.S. Innovative Environment

This table reports the estimation of baseline regression after adding innovative environment from U.S. industry. The main interested variable here is the interaction of foreign sales measurement with the U.S. industry level innovation. The U.S. industry average number of patents is defined in the Appendix and we are using the level 2 GICS/CSIC matching procedure to identify the same industry. To avoid potential endogenous concerns, we lagged one year of the US patent. The High Tech Dummy equals to one if a firm qualified the high tech requirement made by government and thus received benefits like tax deduction in China. The dependent variables are measures of innovation productivity including the number of invention patents and the total number of patents. The main explanatory variables are foreign sales ratios, 10% cut-off foreign sales ratio dummy and 25% cut-off foreign sales ratio dummy. The set of control variables includes the natural logarithm of firm assets, the natural logarithm of one plus firm age at the IPO year, return on assets, Tobin's Q, firm leverage, firm investment measured by capital expenditure scaled by firm assets, tangibility measured by PPE scaled by firm assets. All regressions include firm (industry), year fixed effect. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

| | **Panel A: Ln(1+Patent1)** | | | | | |
|---|---|---|---|---|---|---|
| | (1) | | (2) | | (3) | |
| | High Tech | Low Tech | High Tech | Low Tech | High Tech | Low Tech |
| lag(Fsales)* | -0.140 | 0.202*** | | | | |
| lag(USPatent) | (0.094) | (0.076) | | | | |
| lag(Fsales) | 0.462** | 0.102 | | | | |
| | (0.232) | (0.150) | | | | |
| lag(MNC10)* | | | -0.082* | 0.069* | | |
| lag(USPatent) | | | (0.043) | (0.038) | | |
| lag(MNC10) | | | 0.319*** | 0.158* | | |
| | | | (0.107) | (0.086) | | |
| lag(MNC25)* | | | | | -0.097* | 0.104** |
| lag(USPatent) | | | | | (0.054) | (0.047) |
| lag(MNC25) | | | | | 0.326** | 0.106 |
| | | | | | (0.137) | (0.098) |
| lag(USPatent) | -0.210*** | -0.040 | -0.198*** | -0.052 | -0.257*** | -0.035 |
| | (0.053) | (0.033) | (0.060) | (0.035) | (0.063) | (0.035) |
| lag(Ln(Total | 0.357*** | 0.286*** | 0.350*** | 0.267*** | 0.334*** | 0.229*** |
| Assets) | (0.041) | (0.051) | (0.043) | (0.054) | (0.044) | (0.056) |
| Ln(Age) | -0.099 | -0.151** | -0.110 | -0.164*** | -0.101 | -0.168*** |
| | (0.066) | (0.062) | (0.067) | (0.062) | (0.068) | (0.059) |
| lag(ROA) | 0.396 | 0.065 | 0.394 | 0.158 | 0.435 | 0.127 |
| | (0.270) | (0.159) | (0.282) | (0.166) | (0.293) | (0.170) |
| lag(Tobin's Q) | 0.075*** | 0.053*** | 0.094*** | 0.060*** | 0.083*** | 0.053*** |
| | (0.023) | (0.015) | (0.024) | (0.015) | (0.024) | (0.016) |
| lag(Leverage) | -0.372*** | -0.203** | -0.352*** | -0.167** | -0.252* | -0.131* |
| | (0.132) | (0.082) | (0.136) | (0.080) | (0.140) | (0.075) |

| | | | | | | |
|---|---|---|---|---|---|---|
| lag(CAPEX) | 0.476* | 0.214 | 0.368 | 0.241 | 0.379 | 0.192 |
| | (0.246) | (0.183) | (0.254) | (0.178) | (0.261) | (0.170) |
| lag(Tangibility) | -0.241* | 0.150 | -0.216 | 0.073 | -0.176 | 0.098 |
| | (0.139) | (0.103) | (0.141) | (0.101) | (0.149) | (0.101) |
| Constant | -6.582*** | -5.628*** | -6.531*** | -5.211*** | -6.080*** | -4.445*** |
| | (0.918) | (1.052) | (0.971) | (1.111) | (0.995) | (1.145) |
| Industry Lv2 FE | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |
| N | 4172 | 4740 | 3533 | 4175 | 3040 | 3774 |
| adj. R-sq | 0.266 | 0.230 | 0.288 | 0.238 | 0.282 | 0.226 |

| | **Panel B: Ln(1+Patent All)** | | | | | |
|---|---|---|---|---|---|---|
| | (1) | | (2) | | (3) | |
| | High Tech | Low Tech | High Tech | Low Tech | High Tech | Low Tech |
| lag(Fsales)* | -0.233* | 0.298** | | | | |
| lag(USPatent) | (0.121) | (0.122) | | | | |
| lag(Fsales) | 0.596** | -0.149 | | | | |
| | (0.285) | (0.247) | | | | |
| lag(MNC10)* | | | -0.118* | 0.128** | | |
| lag(USPatent) | | | (0.060) | (0.062) | | |
| lag(MNC10) | | | 0.435*** | 0.111 | | |
| | | | (0.144) | (0.139) | | |
| lag(MNC25)* | | | | | -0.163** | 0.165** |
| lag(USPatent) | | | | | (0.071) | (0.078) |
| lag(MNC25) | | | | | 0.470*** | 0.013 |
| | | | | | (0.176) | (0.164) |
| lag(USPatent) | -0.340*** | 0.012 | -0.303*** | -0.021 | -0.374*** | -0.010 |
| | (0.069) | (0.048) | (0.075) | (0.053) | (0.080) | (0.053) |
| lag(Ln(Total | 0.462*** | 0.406*** | 0.446*** | 0.390*** | 0.429*** | 0.361*** |
| Assets) | (0.050) | (0.059) | (0.052) | (0.063) | (0.052) | (0.065) |
| Ln(Age) | -0.170* | -0.195** | -0.203** | -0.202** | -0.182** | -0.204** |
| | (0.093) | (0.087) | (0.092) | (0.088) | (0.088) | (0.086) |
| lag(ROA) | 0.620* | 0.407* | 0.495 | 0.438* | 0.543 | 0.462* |
| | (0.346) | (0.218) | (0.339) | (0.233) | (0.347) | (0.239) |
| lag(Tobin's Q) | 0.060** | 0.078*** | 0.090*** | 0.095*** | 0.078*** | 0.095*** |
| | (0.029) | (0.022) | (0.029) | (0.025) | (0.030) | (0.027) |
| lag(Leverage) | -0.611*** | -0.523*** | -0.567*** | -0.510*** | -0.462** | -0.472*** |
| | (0.186) | (0.141) | (0.184) | (0.145) | (0.187) | (0.145) |
| lag(CAPEX) | 0.680** | 0.353 | 0.553* | 0.411* | 0.630* | 0.372 |
| | (0.313) | (0.243) | (0.319) | (0.243) | (0.322) | (0.235) |
| lag(Tangibility) | -0.382** | 0.275* | -0.405** | 0.190 | -0.360* | 0.198 |
| | (0.186) | (0.157) | (0.185) | (0.158) | (0.197) | (0.161) |
| Constant | -7.887*** | -7.921*** | -7.673*** | -7.555*** | -7.214*** | -6.971*** |
| | (1.094) | (1.247) | (1.139) | (1.328) | (1.137) | (1.380) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Industry Lv2 FE | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |
| N | 4172 | 4740 | 3533 | 4175 | 3040 | 3774 |
| adj. R-sq | 0.309 | 0.223 | 0.329 | 0.234 | 0.324 | 0.221 |

## Table 2.6: Difference-in-Difference (DiD) Multivariate Regression

This table reports the diagnostics and results of the DiD regressions designed for testing on how a plausibly exogenous shock to foreign sales due to the passage of the Exchange Rate Reform in 2005 affects firm innovation. Sample selection begins with all firms with non-missing variables and observation outcomes in the three years before exchange rate reform (2003-2005) and three years after exchange rate reform (2006-2008). Treatment group includes the firms with foreign sales and influenced by the exchange rate reform. Control group is the firms without foreign sales thus would not influenced by the exchange rate reform. We run the multivariate DiD test results with standard errors adjusted for firm-level clustering. All regressions include firm (industry), year fixed effect. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

| | **Panel A: Ln(1+Patent1)** | | | **Panel B: Ln(1+Patent All)** | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| ExPolicy* | 0.317*** | | | 0.392*** | | |
| lag(Fsales) | (0.122) | | | (0.149) | | |
| lag(Fsales) | 0.057 | | | 0.054 | | |
| | (0.139) | | | (0.160) | | |
| Expolicy* | | 0.162*** | | | 0.267*** | |
| lag(MNC10) | | (0.057) | | | (0.078) | |
| lag(MNC10) | | 0.144** | | | 0.144* | |
| | | (0.056) | | | (0.086) | |
| Expolicy* | | | 0.228*** | | | 0.402*** |
| lag(MNC25) | | | (0.077) | | | (0.102) |
| lag(MNC25) | | | 0.103 | | | 0.017 |
| | | | (0.069) | | | (0.097) |
| ExPolicy | 0.105** | 0.051 | 0.046 | 0.089 | 0.027 | 0.010 |
| | (0.051) | (0.047) | (0.050) | (0.064) | (0.065) | (0.069) |
| lag(Ln(Total | 0.196*** | 0.311*** | 0.289*** | 0.195*** | 0.432*** | 0.412*** |
| Assets) | (0.044) | (0.048) | (0.050) | (0.053) | (0.053) | (0.055) |
| Ln(Age) | 0.237 | -0.201*** | -0.190*** | 0.466** | -0.286*** | -0.271*** |
| | (0.154) | (0.065) | (0.064) | (0.182) | (0.086) | (0.084) |
| lag(ROA) | -0.007 | 0.238 | 0.217 | 0.093 | 0.424* | 0.437* |
| | (0.108) | (0.171) | (0.173) | (0.144) | (0.232) | (0.236) |
| lag(Tobin's Q) | -0.001 | 0.080*** | 0.074*** | -0.012 | 0.106*** | 0.102*** |
| | (0.010) | (0.017) | (0.018) | (0.013) | (0.023) | (0.024) |
| lag(Leverage) | -0.101 | -0.287*** | -0.227** | -0.153* | -0.641*** | -0.576*** |
| | (0.068) | (0.093) | (0.090) | (0.089) | (0.137) | (0.134) |
| lag(CAPEX) | 0.045 | 0.355** | 0.304* | 0.236 | 0.527** | 0.520** |
| | (0.116) | (0.170) | (0.175) | (0.161) | (0.238) | (0.245) |
| lag(Tangibility) | 0.047 | -0.094 | -0.065 | 0.091 | -0.115 | -0.079 |
| | (0.070) | (0.101) | (0.104) | (0.102) | (0.146) | (0.150) |
| Constant | -4.297*** | -5.856*** | -5.461*** | -4.454*** | -7.885*** | -7.533*** |
| | (0.909) | (0.979) | (1.035) | (1.131) | (1.119) | (1.153) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Firm FE | Y | N | N | Y | N | N |
| Industry Lv2 FE | N | Y | Y | N | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y |
| N | 6009 | 5254 | 4669 | 6009 | 5254 | 4669 |
| adj. R-sq | 0.089 | 0.225 | 0.212 | 0.070 | 0.245 | 0.235 |

## Table 2.7: Difference-in-Difference (DiD) Regression after Adding Propensity Score Matching

This table reports the diagnostics and results of the Propensity Score Matching (PSM) and DiD regressions designed for testing on how a plausibly exogenous shock to foreign sales due to the passage of the Exchange Rate Reform in 2005 affects firm innovation. We only keep the sample by using the PSM method by selecting purely domestic firms with similar characteristics with multinational firms by each year. TMNC10 and TMNC25 measure the foreign sales in the treatment group after selecting and matching the sample with the rest. TMNC10 equals to one if the firm in the treatment group have more than 10% foreign sales ratio and equals to zero if the firm is in the control group without any foreign sales; same as TMNC25, changing the cut-off ratio from 10% to 25%. We run the subsample test results with standard errors adjusted for firm-level clustering. All regressions include industry and year fixed effect. The controls remain the same. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

| | **Pre-ExPolicy (ExPolicy=0)** | | | | **Post-ExPolicy (ExPolicy=1)** | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | **Ln(1+Patent1)** | | **Ln(1+Patent All)** | | **Ln(1+Patent1)** | | **Ln(1+Patent All)** | |
| TMNC10 | 0.177*** | | 0.174** | | 0.274*** | | 0.380*** | |
| | (0.056) | | (0.086) | | (0.058) | | (0.077) | |
| TMNC25 | | 0.133* | | 0.043 | | 0.301*** | | 0.388*** |
| | | (0.070) | | (0.098) | | (0.077) | | (0.099) |
| lag(Ln(Total | 0.307*** | 0.288*** | 0.452*** | 0.433*** | 0.317*** | 0.308*** | 0.425*** | 0.404*** |
| Assets) | (0.055) | (0.061) | (0.063) | (0.066) | (0.046) | (0.054) | (0.053) | (0.058) |
| Ln(Age) | -0.092 | -0.066 | -0.104 | -0.109 | -0.324*** | -0.350*** | -0.489*** | -0.504*** |
| | (0.062) | (0.061) | (0.084) | (0.084) | (0.087) | (0.089) | (0.113) | (0.112) |
| lag(ROA) | 0.169 | 0.100 | 0.209 | 0.198 | 0.513** | 0.597** | 0.758** | 0.950*** |
| | (0.235) | (0.218) | (0.363) | (0.337) | (0.227) | (0.256) | (0.316) | (0.350) |
| lag(Tobin's Q) | 0.127*** | 0.121*** | 0.146*** | 0.147*** | 0.058*** | 0.052*** | 0.086*** | 0.076*** |
| | (0.031) | (0.031) | (0.047) | (0.046) | (0.017) | (0.019) | (0.026) | (0.026) |
| lag(Leverage) | -0.318*** | -0.207** | -0.709*** | -0.534*** | -0.268** | -0.158 | -0.585*** | -0.442*** |
| | (0.105) | (0.103) | (0.176) | (0.174) | (0.120) | (0.129) | (0.159) | (0.166) |
| lag(CAPEX) | 0.377 | 0.387 | 0.542 | 0.535 | 0.394 | 0.211 | 0.519 | 0.484 |
| | (0.248) | (0.244) | (0.333) | (0.330) | (0.251) | (0.257) | (0.337) | (0.349) |
| lag(Tangibility) | -0.067 | -0.114 | -0.022 | -0.073 | -0.136 | -0.074 | -0.206 | -0.150 |
| | (0.123) | (0.123) | (0.170) | (0.170) | (0.118) | (0.128) | (0.171) | (0.185) |
| Constant | -6.108*** | -5.774*** | -8.799*** | -8.414*** | -5.564*** | -5.375*** | -7.128*** | -6.717*** |
| | (1.145) | (1.263) | (1.335) | (1.403) | (1.013) | (1.163) | (1.180) | (1.269) |
| Industry Lv2 | | | | | | | | |
| FE | Y | Y | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y | Y | Y |
| N | 2408 | 2150 | 2408 | 2150 | 2739 | 2314 | 2739 | 2314 |
| adj. R-sq | 0.180 | 0.165 | 0.193 | 0.187 | 0.223 | 0.226 | 0.258 | 0.257 |

## Table 2.8: 2SLS regression result for two instrumental variables

This table reports the comparison of the OLS regressions and 2SLS regression result. There are two instrumental variables using, one is the cumulative number of BITs (Bilateral Investment Treaty), another one is the change of percentage export weighted by number of new sign BITs. The main interested variable is still the foreign sales ratio. Panel A reports the result for depedent variable used as patent type 1 and Panel B reports the result for dependent variable used as all patent types. We run the subsample test results with standard errors adjusted for firm-level clustering. All regressions include industry and year fixed effect. The controls remain the same. Robust standard errors are reported in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

| **Panel A: Ln(1+Patent1)** | | | | | |
|---|---|---|---|---|---|
| | **OLS** | **2SLS_Cumlative Number of BITs** | | **2SLS_Export Weighted Number of BITs** | |
| | (1) | (3) | (4) | (6) | (7) |
| | **Ln(1+Patent1)** | **lag(Fsales) (1st Stage)** | **Ln(1+Patent1)** | **lag(Fsales) (1st Stage)** | **Ln(1+Patent1)** |
| lag(Fsales) | 0.290** | | | | |
| | (0.113) | | | | |
| Num_Treaty | | 0.484*** | | 0.051*** | |
| | | (0.025) | | (0.019) | |
| lag(Fsales)_*Hat* | | | 4.955*** | | 5.776*** |
| | | | (0.392) | | (1.257) |
| lag(Ln(Total Assets) | 0.240*** | -0.009*** | 0.386*** | 0.000 | 0.386*** |
| | (0.036) | (0.002) | (0.035) | (0.002) | (0.035) |
| Ln(Age) | 0.461*** | -0.042*** | -0.041 | -0.002 | -0.033 |
| | (0.114) | (0.005) | (0.043) | (0.004) | (0.042) |
| lag(ROA) | -0.148** | 0.065*** | 0.052 | 0.090*** | -0.013 |
| | (0.075) | (0.025) | (0.150) | (0.025) | (0.201) |
| lag(Tobin's Q) | 0.016** | -0.009*** | 0.091*** | -0.003*** | 0.093*** |
| | (0.007) | (0.001) | (0.009) | (0.001) | (0.012) |
| lag(Leverage) | -0.106* | 0.032*** | -0.494*** | 0.014 | -0.513*** |
| | (0.055) | (0.011) | (0.078) | (0.011) | (0.082) |
| lag(CAPEX) | 0.023 | 0.039 | 0.234 | 0.067*** | 0.165 |
| | (0.093) | (0.024) | (0.154) | (0.025) | (0.179) |
| lag(Tangibility) | 0.080 | -0.022** | 0.086 | -0.032*** | 0.125 |
| | (0.061) | (0.009) | (0.093) | (0.009) | (0.099) |
| Constant | -5.518*** | -1.908*** | -8.107*** | 0.086** | -8.198*** |
| | (0.750) | (0.104) | (0.712) | (0.040) | (0.778) |
| Industry Lv2 FE | Y | N | Y | N | Y |
| Year FE | Y | N | Y | N | Y |
| Hausman Test | | 0.000 | | 0.000 | |

| | | | | | |
|---|---|---|---|---|---|
| N | 14598 | 10784 | 10792 | 10784 | 10792 |
| adj. R-sq | 0.158 | 0.039 | 0.248 | 0.004 | 0.223 |

| **Panel B: Ln(1+PatentAll)** | | | | | |
|---|---|---|---|---|---|
| | **OLS** | **2SLS_Cumlative Number of BITs** | | **2SLS_Export Weighted Number of BITs** | |
| | (1) | (2) | (3) | (4) | (5) |
| | **Ln(1+PatentAll)** | **lag(Fsales) (1st Stage)** | **Ln(1+PatentAll)** | **lag(Fsales) (1st Stage)** | **Ln(1+PatentAll)** |
| lag(Fsales) | 0.264** | | | | |
| | (0.124) | | | | |
| Num_Treaty | | 0.484*** | | 0.051*** | |
| | | (0.025) | | (0.019) | |
| lag(Fsales)_*Hat* | | | 6.326*** | | 4.492*** |
| | | | (0.549) | | (1.600) |
| lag(Ln(Total Assets) | 0.259*** | -0.009*** | 0.496*** | 0.000 | 0.495*** |
| | (0.039) | (0.002) | (0.040) | (0.002) | (0.039) |
| Ln(Age) | 0.647*** | -0.042*** | -0.102* | -0.002 | -0.095* |
| | (0.130) | (0.005) | (0.056) | (0.004) | (0.056) |
| lag(ROA) | -0.116 | 0.065*** | 0.284 | 0.090*** | 0.465* |
| | (0.091) | (0.025) | (0.195) | (0.025) | (0.249) |
| lag(Tobin's Q) | 0.015* | -0.009*** | 0.109*** | -0.003*** | 0.101*** |
| | (0.008) | (0.001) | (0.012) | (0.001) | (0.015) |
| lag(Leverage) | -0.126* | 0.032*** | -0.854*** | 0.014 | -0.840*** |
| | (0.072) | (0.011) | (0.116) | (0.011) | (0.119) |
| lag(CAPEX) | 0.075 | 0.039 | 0.369* | 0.067*** | 0.473** |
| | (0.114) | (0.024) | (0.200) | (0.025) | (0.231) |
| lag(Tangibility) | 0.084 | -0.022** | 0.154 | -0.032*** | 0.114 |
| | (0.076) | (0.009) | (0.129) | (0.009) | (0.135) |
| Constant | -5.881*** | -1.908*** | -10.035*** | 0.086** | -9.851*** |
| | (0.835) | (0.104) | (0.793) | (0.040) | (0.867) |
| Industry Lv2 FE | Y | N | Y | N | Y |
| Year FE | Y | N | Y | N | Y |
| Hausman Test | | 0.000 | | 0.000 | |
| N | 14598 | 10784 | 10792 | 10784 | 10792 |
| adj. R-sq | 0.147 | 0.039 | 0.268 | 0.004 | 0.245 |

# Chapter 3:

# Trade Credit, Ownership and Informal Financing in China

Xiaping Cao*, Sili Zhou+

**Abstract**

We investigate informal financing such as accounts receivable and payable of state-owned enterprises (SOEs) and non-SOEs in China. The volume of informal financing dramatically increased and non-SOEs significantly more rely on them than SOEs. SOEs with abundance of liquidity or during financial crisis are able to provide informal financing to non-SOEs. Fast growing firms do not seem to rely more on informal financing. Our research highlights the importance of informal financing and ownership structures in emerging markets.

**Keywords**: Informal financing, SOEs, China, Accounts receivable, Accounts payable, Growth, financial crisis

**JEL Codes:** G01, G30, G32

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# 3.1. Introduction

Informal financing plays important role in corporations especially in the sectors with financing constraints. For example, Petersen and Rajan (1997) show that US firms especially SMEs rely heavily on trade credit when formal debt financing is not available. China, the largest emerging market, has witnessed a rapid growth despite of its weak institutions and informal financing plays important role in economic growth (Allen, Qian and Qian, 2007). Trade credit has been shown to facilitate firm growth in emerging markets. Fisman and Raturi (2004) and Fabbri and Klapper (2009) show that financially constrained firms rely on trade credit to expand sales. China with its unique legal and financial system thus becomes an ideal setting to examine the role of trade finance in corporations. In fact, it has been a puzzle why China achieves incredible economic growth with a relatively less developed financial market[25] and low efficient banking system (Cull and Xu, 2003). In this paper, we try to shed new lights on the role of trade credit to support firm financing and growth in China. In particular, we focus on the liquidity provision of trade credit such as accounts payable and receivable among firms in China.

King and Levine (1993) and Rajan and Zingales (1998) suggest that financial development is important in explaining economic growth as financial

[25] Allen, Qian and Qian find that informal financing through private relationship supports entrepreneurial activities in Chinese private sectors. Ayyagari, Demirgüç-Kunt and Maksimovic (2010) on the other hand argue that formal financing provided by banks support firm growth.

development reduces external financing cost. Demirguc-Kunt & Maksimovic (2001), Biais & Gollier (1997), Frank & Maksimovic (2004) state that the use of trade credit is influenced by the development of a country's legal and financial system. Cull, Xu and Zhu (2009) find that poorly performing SOEs tend to redistribute credit to other SOEs with less privileged access to loans via trade credit, and they attribute this phenomenon to a substitution effect of trade credit for loans. We hypothesize that non-SOEs rely more on trade credit compared to SOEs. Jain (2001) suggests that trade creditor plays a role as the second layer between financial intermediaries (here mainly banks) and borrowers. Frank & Maksimovic (2004) also indicate this special second layer role is helpful for both suppliers and buyers to reduce their needs for external finance, especially in inefficient financial market and market where suppliers have more power. Since in Chinese market, the financial market is not efficient and often SOEs have great power over suppliers, it makes China the ideal setting to study the trade credit as an important source of informal financing. Burkart, Ellingsen and Giannetti (2011) show that the use of trade credit depends on bank-firm relationship, SOEs are shown to have preferential access to formal bank loans, SOEs therefore can become intermediary by providing trade credit to other firms especially non-SOEs in need of liquidity.

In financial crisis, most firms face liquidity problem due to the breakdown of lending market and capital market in general. Garcia-Appendini and Montoriol-Garriga (2013) show that US large firms with high liquidity extend

informal financing to those needing them more. Fabbri and Klapper (2009) find that firms with more liquidity during financial crisis increase trade credit to their suppliers. Following the breakout of financial crisis starting in 2008, many Chinese firms face a negative liquidity shock, and non-SOEs will be greatly affected than SOEs. SOEs therefore may increase the provision of trade credit during the financial crisis to non-SOEs or those needing liquidity greatly.

We aim to understand the informal financing market in China by systematically examining listed firms' usage of trade credit, with proxies as accounts receivables and accounts payables. Accounts receivable is used as a proxy for how much a firm as a supplier lend its customer, while accounts payable is a proxy for how much a firm borrow from its supplier. Those two variables therefore capture both sides of trade credit relationship between firms regarding their supplier/customer financing.

We find that non-SOEs experience significantly greater level of accounting payables than SOEs. This is suggestive of the greater reliance of non-SOEs for liquidity that is provided by SOEs. Similarly, non-SOEs also have significantly greater level of accounts receivables than SOEs, indicating that non-SOEs seem to provide more trade credit for their customers. Overall, trade credit has a significantly greater role for non-SOEs than for SOEs. Cross-sectional evidence on firms shows that non-SOEs with low liquidity have significantly greater level of accounts payables and receivables, confirming our prior findings that they need more trade credit. We further explore whether growth firms rely more on trade

finance than firms with slow growth especially for non-SOEs. The evidence however shows that growth firms rely less on trade finance.

We exploit the reliance of trade credit for firms by using a natural experiment – global financial crisis. This setting allows us to draw causality inference. We find that non-SOEs during financial crisis experience significantly higher level of accounts payables and receivables. This evidence suggests that SOEs do rely heavily on trade finance of both credit and debt.

Our research sheds new lights on the proliferation of trade finance in China and how firms especially SOEs help intermediate by providing trade credit to non-SOEs, especially SOEs with high level of liquidity or SOEs during the financial crisis. This is consistent with the observation of Demirguc-Kunt & Maksimovic (2001) that it is out of control of firms to improve macroeconomic factors. Therefore firms especially those with difficult access to formal financing such as loans, e.g., non-SOEs to rely more on informal financing such as trade credit in their capital structure, similar to the conclusion of Guariglia & Mateut (2006) in the sense that trade credit is extended by firms during tight monetary period. Demirguc-Kunt & Maksimovic (2001) claim that in a country with imperfect financial system, firms can suffer financial access limitation easily so that the source of funds needed is shifted to suppliers who are non-financial institutions. In our setting, we provide supporting empirical evidence to their prediction by showing that SOEs supply trade credit to non-SOEs.

The rest of paper is organized as follows. Section 2 describes the

hypotheses and specifies the empirical regression models. Section 3 summarizes the data and sample statistics. Section 4 presents the main results and Section 5 concludes the paper.

## 3.2. Hypothesis and Empirical Specifications

Petersen & Rajan (1997) suggest that trade finance is used by firms who cannot easily get financial support from traditional channels even it costs more than bank credit. This description applies to non-SOEs since they depend more on trade credits financing because Chinese banking system favors SOEs. As a result, they value trade liquidity position more than their SOEs counterpart. SOEs, on the other side generally access trade credit less in China since they have advantage of banking system and public capital raising activities. Besides, cash-poor non-SOEs rely more on this kind of financing since they have the most several moral hazard and asymmetric information and are least to obtain liquidity through formal financing channels.

*Hypothesis 1: non-SOEs more involved in trade credit financing and less liquid non-SOEs rely more on this informal financing from lending activities.*

Our basic specification can be written as

$$\begin{aligned} AR_{it}(AP_{it}) = {} & \alpha_{ij} + \beta_1 non-SOE_i + \beta_2 CashLiq_{it} \\ & + \beta_3 non-SOE_i \times CashLiq_{it} \\ & + \beta_4 X_{it} + \beta_5 X_{jt} + \varepsilon_{ijt} \end{aligned} \qquad (1)$$

In equation (1), $AR_{it}(AP_{it})$ refers the total amount of account receivables

(account payables) scaled by total sales in supplier's balance sheet.[26] $non-SOE_i$ is a dummy variable equals to one if suppliers are non-SOE firms. $CashLiq_{it}$ denotes that suppliers cash liquidity positions measured as cash and cash equivalents plus marketable securities scaled by total assets. The interaction term captures how many credits non-SOEs used when they are liquid. Our focus lies on the coefficient of non-SOE dummy and its interaction term. According to our main hypotheses, the coefficient of non-SOE dummy should be positive while the coefficient of interaction term should be negative.

Moreover, we also want to examine how those firms act when other sources of external finance are scarce during crisis. Many theories argue that customers resort to trade credit when bank markets are in trouble. (Biais and Gollier, 1997; Burkart and Ellingsen, 2004) When liquidity dries up, customers prefer to finance themselves through trade credits. SOEs are usually regards as less financial constrained and their liquidity are relatively unrestricted during the crisis. SOE suppliers are able to extend trade credit to their customers since they have an advantage to overcome moral hazard and asymmetric information frictions with respect to banks. Our second hypothesis is that SOEs and high liquid firms are more willing to provide trade credits to their clients during crisis. So they increase lending levels when their main customers are in trouble with financing.

*Hypothesis 2: During Crisis, SOE firms as well as high liquid firms*

[26] We also use total assets to be scalar and the result is robust.

*increase trade credit provision*

To test this hypothesis, we add crisis and its interaction terms into the basic specification:

$$\begin{aligned} AR_{it}(AP_{it}) = {} & \alpha_{ij} + \beta_1 SOE_i + \beta_2 CashLiq_{it} + \beta_3 Crisis_t \\ & + \beta_4 SOE_i \times CashLiq_{it} + \beta_5 SOE_i \times Crisis_t \\ & + \beta_6 Crisis_t \times CashLiq_{it} + \beta_7 X_{it} + \beta_8 X_{jt} + \varepsilon_{ijt} \end{aligned} \quad (2)$$

The indicator variable Crisis takes value of one during the financial crisis, specifically from the year 2008 to the year 2009 and it witness the drop of other external finance following the onset of the crisis. Its interaction term with non-SOE dummy captures how much non-SOE are willing to provide trade credits during the crisis and its interaction term with liquidity shows whether high liquid firms are ready to use liquidity during the crisis. Based on our hypothesis, we predict that the coefficient of Crisis is negative and these two interactions should be also both negative. The interaction of non-SOE with liquidity term measures the level of high liquid non-SOEs in the crisis.

In our models we include controls variables for $x_{it}$, the supply side of firm, and also control for demand side, $x_{jt}$. Supply side includes supplier's size, age, investment properties and fixed investment, net profit margin, sales growth, net worth, total debt and Tobin's q and demand side includes size, investment properties and fixed investment, net profit margin, sales growth, net worth and total debt (See Garcia-Appendini & Montoriol-Garriga, 2013). Similarly, we introduce the ratio of accounts receivable used by customer j to total sales of supplier i, which measures the account receivables weights of each customer.

Interfirm is an indicator takes one when supplier lend its own firms or totally control firms. We scale all liquidity measures and firms variables by total assets. All variable definition and construction can be seen in Appendix.

## 3.3. Data Description, Variable Definition and Summary Statistics

Our sample consists of all China-incorporated firms from A-share, main board market. We only include the main board market because the Growing Enterprise Market (GEM) started from 2009 and has very short historical data. We exclude financial and utility firms since they have different disclosure regulations and their liquidity measures or positions are different from other firms. Our main variables and firm characteristics data are obtained from the Chinese Stock Market Accounting Research (CSMAR) for the period from 1999 to 2013. The sample period is chosen to match the availability of listed firms' financial statements (cash flow statements) in the CSMAR database, as CSMAR starts collecting cash flow statements data from 1998. We drop off delisted firms within our sample period. We also use balance sample to avoid new listing effect, especially after the year 2007 when SME in SSE opened. Considering the impact of extreme value and outliers, we winsorize all firm characteristics at the 1st and 99th percentiles. The whole sample consists of 18,829 firm-year observations with 1,874 firms while the balance sample consists of 10,200 firm-year observations with 680 firms.

We collect information about firms' key customers using notes of annual financial statement in WIND. According to CSRC Statements of Listed Company Information Disclosure No. 15, listed firms are required to disclose the amount of five main customers in annual report and encourage reporting the name of the main customers. But due to some reasons, plenty of firms do not disclose it. So we obtain the information of supplier-customer from WIND and search the customers' names within the database to obtain financial statement for the suppliers. The main advantage of doing so is that the results are based on supplier-customer pair and we can test dependent variables by controlling both supplier and customer factors. However, the matched sample has some limitation. The main drawback is that the data only disclosure the five main customers of each supplier, so supplier especially for those large firms with various customers do not disclose some of their most important customers. Secondly, CSRC just recommend not required to disclose the name of customers, many suppliers do not report their customer names in account receivables. Even if they disclose the names they cannot be fully matched due to the abbreviation problem. We are unable to find matches for many customer firms -- for example, small unlisted firms, foreign firms, firms which lack financial statements in the WIND database. Finally, we have about 3,450 non-missing values in all relevant variables and used in the regression analyses. Table 1 contains key descriptive statistic for unmatched and matched sample. The matched sample is about 18% of the whole unmatched sample.

Table 1 present the summary statistics of main variables used in unbalance

sample and balance sample respectively. From both samples, we can see non-SOE firms usually are smaller, younger, rely more on trade credits, less fixed investment, less net profit and more investment opportunities. As for balance sample, non-SOE firms are also likely to have less net worth capability and lower leveraged. But the cash liquidity is different for these two samples: unbalance sample show that non-SOE have more cash while balance sample show the opposite. One of the potential reasons is that new listing (IPO) firms after 2007 are mainly non-SOE in Small and Median Enterprise (SME) and they will bring more cash holding for non-SOE than SOE.

[Insert Table 1 here]

Figure 1 plots the average of accounts receivable and accounts payable in two samples. From the figure we can see that the trade credits grow fast during our sample period, especially after the year 2008. Non-SOEs have lower mean level of trade credits than SOEs but the ratio of these trade credits are much higher as shown in Table 1 since their size and sales are much smaller than SOEs. Panel A shows that mean level of accounts receivable is quite stable before the year 2008 for the whole sample. But after financial crisis, the number booms up to over double in the year 2013 and SOEs increase larger than Non-SOEs. From the perspective of accounts payable, we do not witness this sudden rise around financial crisis in Panel B. The average level of accounts payable continuous grows from below 200 million RMB for both types of firms to over 1200 million RMB for SOE firms and to over 400 million RMB for Non-SOEs.

[Insert Figure 1 here]

## 3.4 Empirical Results

### *3.4.1. Baseline Regression: Determinants of Trade Credit*

The empirical analysis starts the regression estimation of the basic specification of Eq. (1) with full samples controlling for supplier's firm liquidity characteristics. The balance sample is used to avoid unexpected cash inflows after new listing. Both balance and unbalance sample has the advantage of representativeness, they provide motivations for the rest of our analysis. The result is shown in Table 2. For each sample, the dependent variables we used are accounts receivable in first two columns and accounts payables in last two columns. We focus on our attention on first main hypothesis: non-SOEs rely more on trade credits (the coefficient of non-SOE dummy) and less liquid non-SOEs rely even more than the rest (the coefficient of the interaction term).

[Insert Table 2 here]

The Columns 1 and 2 use accounts receivable to sales as dependent variable in complete sample. The coefficient of non-SOE dummy is significantly positive and implies that the fraction of account receivables to sales in average non-SOEs are 6.3% higher than that in average SOEs in column 1. The economic magnitude of non-SOE dummy in column 2 is 6.1% (0.087-0.141*0.187) .The interaction term of cash liquidity with SOE dummy is significantly negative. This

support our main hypothesis that each decrease of ratio of cash reserves to total assets in non-SOEs implies an mean decreases fraction of accounts receivable to sales by 14% percentage on yearly basis. As for accounts payable, the coefficient of non-SOE dummy are still significantly positive as shown in columns 3 and 4. But the magnitude of the dummy is much smaller compared with that of accounts receivable and the interaction term with cash liquidity is negative but insignificant. This result highlights that non-SOEs rely more on trade credits especially for lending activities (accounts receivable) and non-SOEs with less liquid are more likely to balance their liquidity position using account receivables from their customers rather than borrowers.

Next regression uses balanced sample to avoid the new listing effect. In column 5 and 6, the coefficient of non-SOE dummy is still significantly positive and the magnitude is greater than that in unbalance sample. The coefficient of the interaction term in column 6 is more significantly positive compared with that in column 2, which is consistent with our hypothesis. Besides, the coefficient of non-SOE dummy is marginally significant and its interaction is no longer significant if the dependent variable is accounts payable, even though the sign of the coefficients are the same. It supports our hypothesis much stronger.

Regarding the control variables, our results suggest that firms that have more access to outside financing offer an average more trade credit. The coefficients of cash liquidity and size are negative, which shows that firms with larger scale and more cash holding are in the good liquidity position decrease the

usage of trade credits to both their customers and suppliers. Having controlled for size and cash liquidity position, we find a negative but not significant coefficient for age, suggesting that long established firms with more reputation access less trade credits, which is consistent with Burkart, Ellingsen and Giannetti (2011). Besides, we find that firms with lower net profit margins and smaller ratios of fixed investment and investment properties to total assets use more trade credit and it is also consistent Burkart, Ellingsen and Giannetti (2011). The coefficient of sales growth is negative, suggesting that firms with low growth can maintain their sales using extension of trade credit. This finding is consistent with Petersen and Rajan (1997). Finally, inconsistent with Garcia-Appendini, Montoriol-Garriga (2013), we find that firms with higher ratios of net worth to assets and leverage lend more to their customers, possibly because they have better access of formal financing channels from bank or other outside markets. The coefficients are just opposite when firms as borrower. Firms with fewer banks dependent are in a better liquidity position use less account payables from their suppliers.

Table 3 explores two important reasons for firms use trade credits: sales maintenance reasons and macroeconomics reasons. We use the growth of gross domestic product (GDP) as a proxy of macroeconomics condition. From Table 3, we see that high sales growth dummy is negative and significant for all columns, suggesting that firms do use trade credit as a market tool to maintain their higher sales. It is consistent with finding of Emery (1984) and Wilson & Summers (2002) but not with Petersen & Rajan (1997). The interaction term of high sales growth

dummy with non-SOE dummy is negative but only significant when accounts receivable as dependent variable, which shows that non-SOE firms use this marketing strategy to maintain their relation between customers in order to increase their sales. As for macroeconomics condition, the coefficient of high GDP growth dummy and its interaction with non-SOE dummy is all negative when accounts receivable as dependent variable, all positive when accounts payable as dependent variable. However, they are no longer significant except for the interaction term when accounts payable is dependent variable in balance sample. It means that firms decrease accounts receivable but increase accounts payable when there is a decrease in macroeconomic in firms as firm's ability of obtaining bank credit is limited. This explanation supports Huyghebaert (2006), Garcia-Teruel & Martinez-Solano (2010b) and Niskanen & Niskanen (2006) which firms offer less trade credit to customers and use more trade credit from borrowers during high developed macroeconomic situation, especially for those non-SOEs.

[Insert Table 3 here]

### *3.4.2. Determinants of Trade Credit during Crisis*

We test our second hypothesis by examining firms as liquidity providers when the other sources of external finance are scarce. We present the results using firm's accounts receivable to sales as dependent variable in Table 4. The coefficient of crisis dummy is negative and significant in all cases, suggesting that

ratio of accounts receivable to sales drop from 7.7% to 15% during the crisis. We focus our attention on the three different interaction terms: interaction of crisis dummy with liquidity position; interaction of crisis with non-SOE dummy; and interaction of liquidity with non-SOE dummy. The first interaction is positive and significant with its coefficient about 28%. So the economic magnitude for crisis dummy with liquidity is more than 5%, which means high liquidity firms will offer 5% more accounts receivables to sales to maintain their customer's liquidity level during the crisis. Secondly, we see that the coefficient of crisis dummy with non-SOE dummy is significantly negative, suggesting that non-SOE firms use 6% less trade credits during crisis on the yearly basis. Finally, the coefficient of liquidity interacted with non-SOE dummy is also strongly negative which is similar with the result shown in Table 2. These results consistently support our second hypothesis that high-liquid and SOE firms as suppliers provide liquidity though trade credits channel during the crisis. Table 5 tests this specification using the balanced data. We see that the coefficients of crisis dummy as well as these three interaction terms are still significantly and the sign is same in Table 4. Besides, these effects are much stronger and the magnitudes are bigger in Table 5.

[Insert Table 4&5 here]

Table 6 reports the regression with accounts payable to sales as dependent variable during the crisis. From Table 6, we see that the coefficient of crisis dummy is consistently negative but no longer as significant as before, indicating that firms use slightly less borrowing through trade credits during crisis. Besides,

none of these three interactions are significant and the signs of interactions are all negative. In sum, the result for firms as customers is much weaker than the result for firms as suppliers. It also strengths our first hypothesis that non-SOE do not usually use this informal financing from lending activities even during the crisis when limited rationing exists in financing markets.

[Insert Table 6 here]

### *3.4.3 Determinants of Trade Credit: Supplier-Customer Relations*

One of the main concerning factors of the baseline regression is that we cannot directly control for demand side effects. The previous results can be driven by the demand for trade credits, which leads supplier to offer trade credits for customers. To rule out this demand driven factor, we run the regression of Eq(1) by introducing customer firms characteristics. In this sample, each observation is a supplier – customer pair. Therefore, we can control for the demand of trade credits by time invariant supplier-customer pairs fixed effect. This matched sample allows us to verify whether suppliers of SOEs extend trade credits is forced by their customer's demand.

Table 7 report the result for this matched sample. The first four column use accounts receivable to sales as dependent variable to exam trade credits from the supplier firms to customer firms, while the last three column use accounts payable as dependent variable to test trade credits from the opposite direction. Column 1 contains the baseline regression in table 2 with controls for both supplier and

customer characteristics. Consistently with our main hypothesis, we find that the interaction term of cash liquidity with supplier non-SOE dummy is negative but not significant. The insignificance may due to the limited observation of matched sample. In Columns 2 and 3, we explore this effect during the financial crisis. The coefficient for crisis dummy is significantly negative, suggesting that firms use less trade credits when external financing situations are limited for both suppliers and customers. When all the interaction terms are introduced in column 3, the magnitude of crisis dummy is much bigger and the coefficient of interaction terms are negative except for the interaction of crisis with cash liquidity position. It is consistent with result in Table 3 but we do not find it to be significant.

[Insert Table 7 here]

Most importantly, the coefficient of interaction term of cash liquidity with supplier non-SOE changes to be positive in column 4, suggesting that non-SOE is receiving some trade credit from other firms. However, the magnitude of the interaction is only 5% and it is not significant. In column 5 , we show that the crisis dummy is negative but not significant, which indicating that the borrowing activity of customer from supplier is decreasing but not so much during the crisis. But when we control for the interaction term in column 6 as what we did in Table 5, we observe that the coefficient of cash liquidity with non-SOE dummy is still positive but not significant and the magnitude is much bigger than in column 4. This matched sample may indicate that non-SOE firms are receiving trade credits while SOE firms are providing these informal financing if we control for

supplier-customer pair effects.

## 3.5. Conclusion

China is an ideal setting to understand the role of informal financing or growth. We systematically study the use of trade finance by corporations in China according to ownership structure. Chinese financial market is not well developed and market friction can plague non-SOEs due to the discrimination of lending and state control of banks. Since non-SOEs often have difficulty in accessing loans or even the equity market, trade finance especially credit can be an important source of funds for their capital structure. We empirically show that non-SOEs rely significantly greater than SOEs on trade credit. Cross sectional evidence shows that the reliance of trade credit is stronger for non-SOEs with low liquidity. Further, we utilize the recent financial crisis as an exogenous shock to firm liquidity and find that non-SOEs experience an increase in trade credit during the financial crisis. Our evidence also supports a substitution hypothesis between formal and informal debt such as trade credit. Non-SOEs do not show strong reliance on trade credit but also they seem to provide trade finance to support their revenues. Compared to SOEs, non-SOEs exhibit significantly higher level of accounts receivable, especially those with low leverage ratio.

Our paper highlights the important role of institutions, ownership and financial market in determining the use of trade finance by corporations. Our paper highlights the important role of institutions, ownership and financial market

in determining the use of trade finance by corporations. The evidence suggests that firms rely on credit trade, an important of informal financing for liquidity provision among themselves especially during 2008 global financial crisis.

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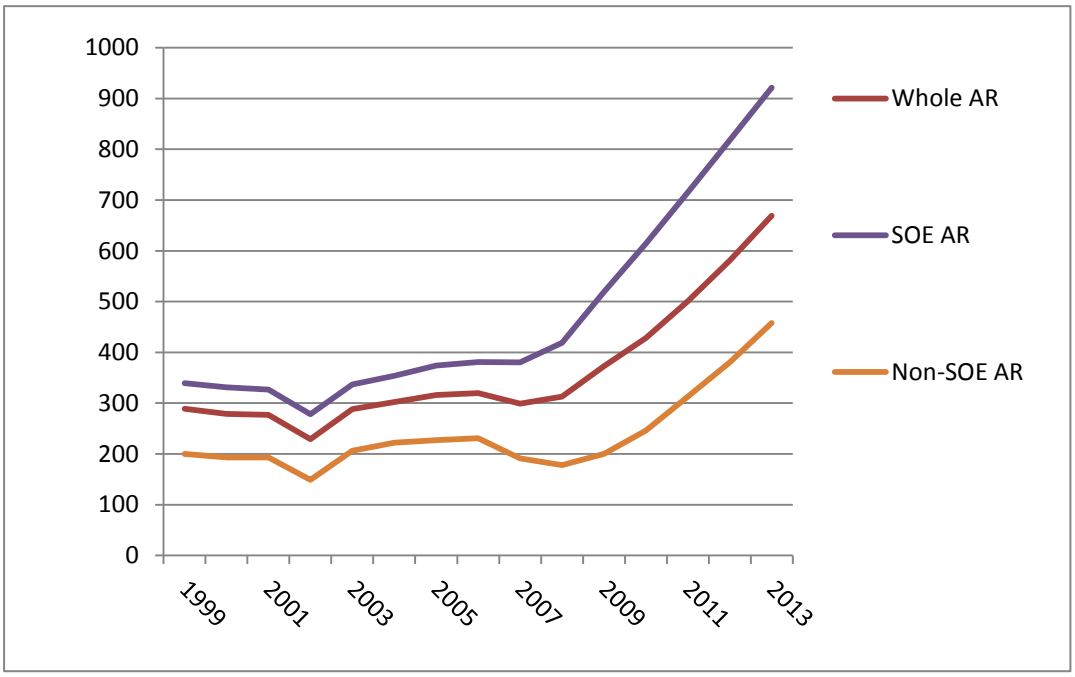
## Appendix 3.A: Variable Definition and Construction

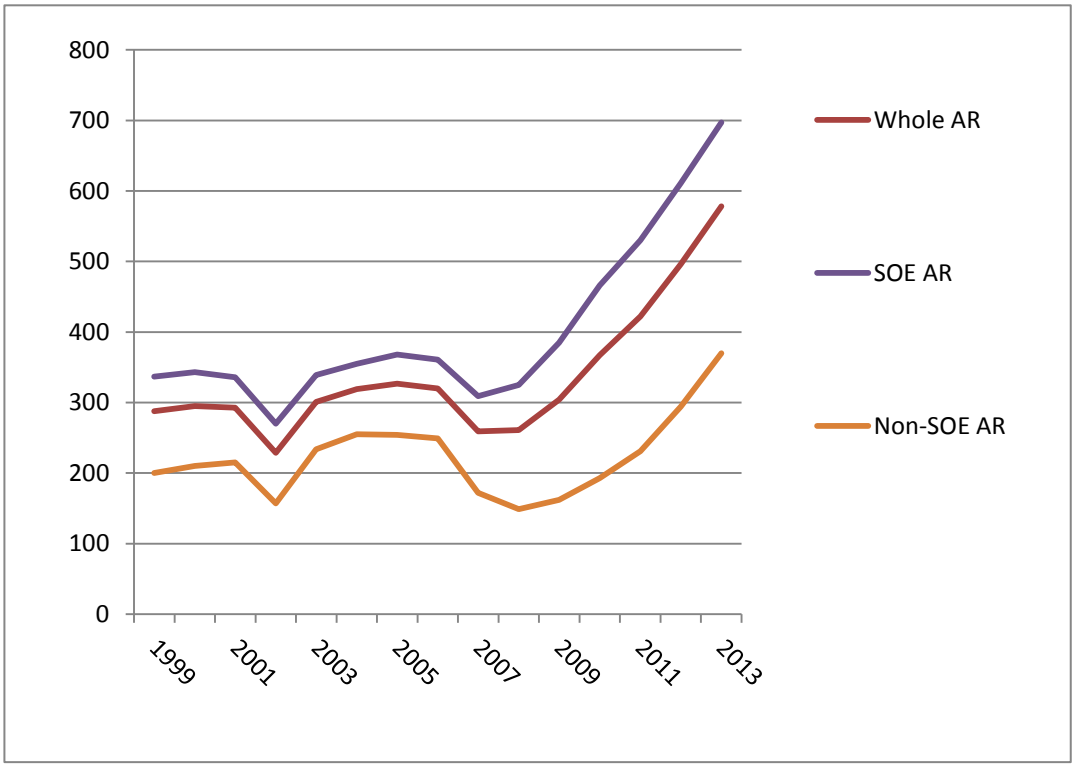
| Variables | Definition | Source |
|---|---|---|
| Account Receivables | Annual net account receivables | CSMAR |
| Account Payables | Annual net account payables | CSMAR |
| Cash Liquidity | Cash and cash equivalent plus marketable securities divided by the book value of total assets | CSMAR |
| Size | Natural logarithm of the book value of total assets | CSMAR |
| Age | Year since firm established. | CSMAR |
| Fixed Investment and Investing Property | Net value of fixed investment and net value of investing property[27]. | CSMAR |
| Net Profit Margin | Net profit divided by total sales. | CSMAR |
| Net Worth | Difference between total assets and total liabilities | CSMAR |
| Total Debt | Sum of short-term debt and long-term debt | CSMAR |
| Total Sales Growth | Firm level annual total sales growth rate. | CSMAR |
| Q | Book value of total assets minus book value of equity plus market value of equity scaled by book value of total assets. | CSMAR |
| Non-SOE Dummy | Dummy variable equals to one if the ownership type of the listed firm is not state-owned, zero otherwise | CSMAR |
| Weight | Account receivables to customer divided by supplier's total account receivables. | Hand collected |
| Interfirm | Dummy variable equals to one if the supplier firm and customer firm is same, zero otherwise | Hand collected |

[27]The net value of investing property started from 2007 and reports in balance sheet.

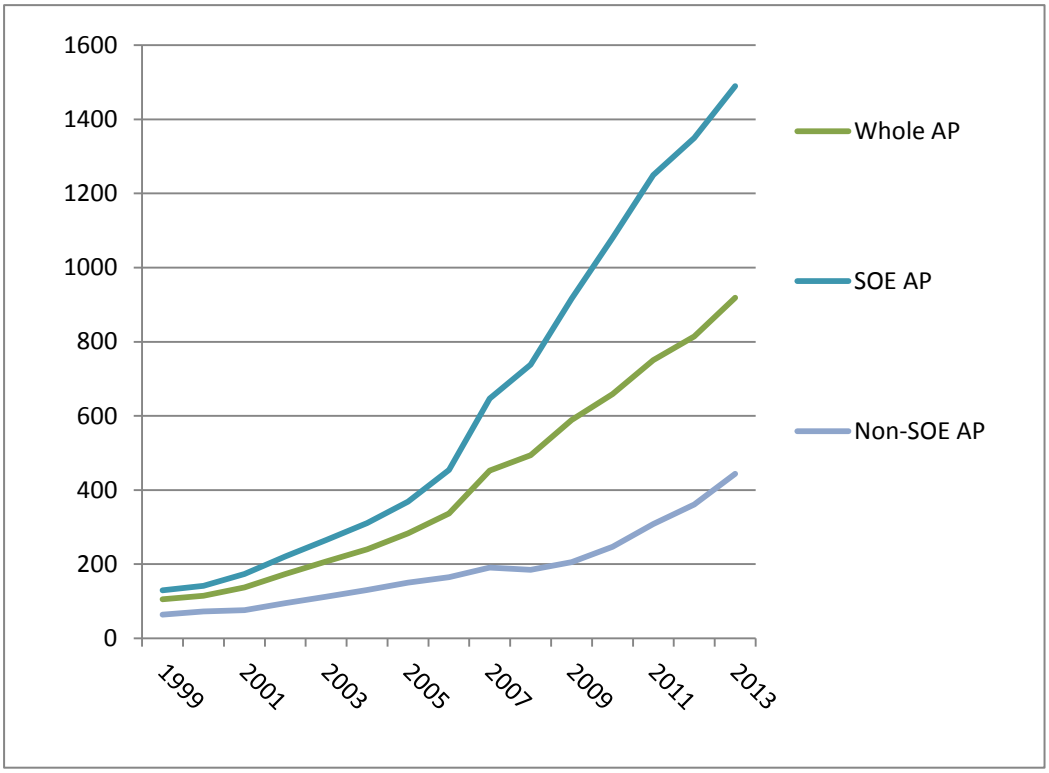
**Figure 3.1: Average Accounts Receivable and Accounts Payable (unit: million RMB)**

Panel A: Average Accounts Receivable by year (Upper: Unbalanced; Lower : Balanced)



Panel B: Average Accounts Payable by year (Upper: Unbalanced; Lower : Balanced)



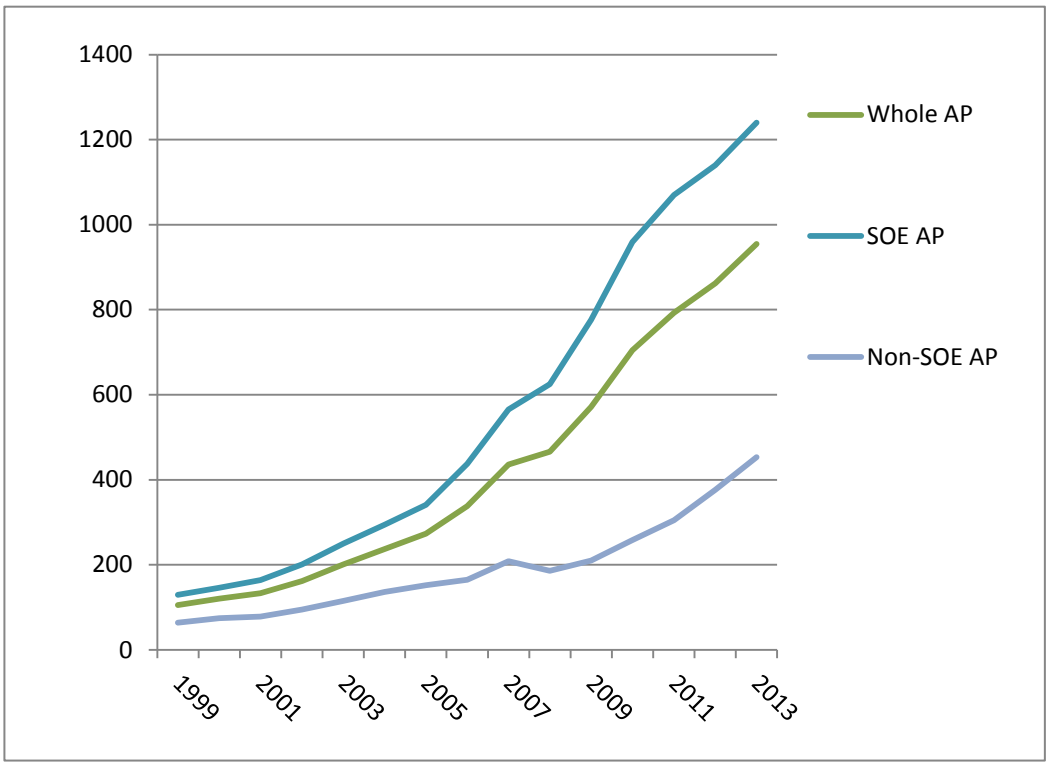



**Table 3.1: Descriptive Statistics.**

This table contains summary statistics of key variables in two samples: unbalanced sample and balance sample. All variables are calculated from the year 1999 to 2013. Mean difference between SOE and Non-SOE are shown in the last column. ***,** and * indicate significance at the 1%, 5% and 10% level, respectively.

| | A. Whole Sample | | | B. SOE | | | C. Non-SOE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables name | Obs | Mean | S.D. | Obs | Mean | S.D. | Obs | Mean | S.D. | Mean Diff | |
| Panel A: Unbalance Sample | | | | | | | | | | | |
| AR/total sales | 18566 | 0.255 | 0.321 | 10207 | 0.216 | 0.275 | 8359 | 0.303 | 0.364 | -0.088 | *** |
| AP/total sales | 18567 | 0.156 | 0.141 | 10207 | 0.148 | 0.124 | 8360 | 0.165 | 0.159 | -0.017 | *** |
| Cash Reserves | 18826 | 0.187 | 0.140 | 10299 | 0.175 | 0.125 | 8527 | 0.202 | 0.154 | -0.027 | *** |
| Size | 18826 | 21.437 | 1.168 | 10299 | 21.759 | 1.203 | 8527 | 21.049 | 0.996 | 0.709 | *** |
| Log(1+Age) | 18824 | 2.349 | 0.523 | 10294 | 2.336 | 0.533 | 8530 | 2.365 | 0.511 | -0.028 | *** |
| FI&IP/assets | 18826 | 0.286 | 0.167 | 10299 | 0.310 | 0.174 | 8527 | 0.258 | 0.154 | 0.051 | *** |
| Net Profit Margin | 18568 | 0.049 | 0.226 | 10208 | 0.060 | 0.171 | 8360 | 0.036 | 0.277 | 0.025 | *** |
| Total Sales growth | 17292 | 0.207 | 0.499 | 9735 | 0.205 | 0.445 | 7557 | 0.210 | 0.560 | -0.005 | |
| Net worth/assets | 18826 | 0.519 | 0.239 | 10299 | 0.517 | 0.202 | 8527 | 0.522 | 0.278 | -0.005 | |
| Total debt/assets | 18755 | 0.199 | 0.155 | 10255 | 0.199 | 0.149 | 8500 | 0.199 | 0.162 | 0.000 | |
| Tobin Q | 18583 | 2.450 | 1.682 | 10236 | 2.191 | 1.396 | 8347 | 2.768 | 1.930 | -0.577 | *** |
| Panel B: Balance Sample | | | | | | | | | | | |
| AR/total sales | 10066 | 0.302 | 0.454 | 6437 | 0.240 | 0.349 | 3629 | 0.411 | 0.581 | -0.171 | *** |
| AP/total sales | 10067 | 0.166 | 0.186 | 6437 | 0.148 | 0.139 | 3630 | 0.198 | 0.245 | -0.051 | *** |
| Cash Reserves | 10197 | 0.154 | 0.112 | 6495 | 0.159 | 0.109 | 3702 | 0.145 | 0.116 | 0.014 | *** |
| Size | 10197 | 21.377 | 1.173 | 6495 | 21.681 | 1.110 | 3702 | 20.845 | 1.089 | 0.836 | *** |
| Log(1+Age) | 10200 | 2.469 | 0.512 | 6495 | 2.426 | 0.524 | 3705 | 2.545 | 0.480 | -0.118 | *** |
| FI&IP/assets | 10197 | 0.299 | 0.168 | 6495 | 0.310 | 0.170 | 3702 | 0.279 | 0.163 | 0.031 | *** |
| Net Profit Margin | 10067 | 0.016 | 0.347 | 6437 | 0.048 | 0.223 | 3630 | -0.039 | 0.491 | 0.087 | *** |
| Total Sales growth | 9984 | 0.223 | 0.689 | 6383 | 0.215 | 0.580 | 3601 | 0.237 | 0.848 | -0.022 | |
| Net worth/assets | 10197 | 0.463 | 0.294 | 6495 | 0.501 | 0.212 | 3702 | 0.398 | 0.391 | 0.102 | *** |
| Total debt/assets | 10168 | 0.225 | 0.164 | 6468 | 0.209 | 0.151 | 3700 | 0.252 | 0.182 | -0.043 | *** |
| Tobin Q | 10124 | 2.510 | 1.899 | 6484 | 2.215 | 1.477 | 3640 | 3.037 | 2.390 | -0.822 | *** |
| Panel C: Pair Sample | | | | | | | | | | | |
| Weight | 3449 | 0.135 | 0.165 | 1901 | 0.135 | 0.164 | 1548 | 0.135 | 0.166 | 0.000 | |
| Interfirm | 3450 | 0.171 | 0.377 | 1901 | 0.211 | 0.408 | 1549 | 0.122 | 0.327 | 0.089 | *** |

## Table 3.2: Baseline Regression: Determinants of Trade Credit

This table presents firm-year unbalance and balance data from year 1999 to 2013. The balance data require all firms have financial characteristics starting from 1999 to 2013. The dependent variables are accounts receivable, accounts payable scaled over total sales. Non-SOE Dummy is an indicator equals to one if supplier firms is non-SOE. All specifications control for firms' characteristics, which include size, age, tangibility, net profit margin sales growth, net worth, total debt and Tobin's q. All specifications include industry and year fixed effect. The standard errors are clustered at firm and year level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | Unbalance Sample | | | | Balance Sample | | | |
|---|---|---|---|---|---|---|---|---|
| | (1)AR | (2)AR | (3)AP | (4)AP | (5)AR | (6)AR | (7)AP | (8)AP |
| non-SOE | 0.063*** | 0.087*** | 0.012*** | 0.019** | 0.074*** | 0.141*** | 0.015* | 0.028* |
| | (0.011) | (0.020) | (0.005) | (0.008) | (0.018) | (0.033) | (0.008) | (0.016) |
| Liquidity | -0.521*** | -0.450*** | -0.143*** | -0.124*** | -0.776*** | -0.601*** | -0.208*** | -0.174*** |
| | (0.103) | (0.093) | (0.022) | (0.024) | (0.156) | (0.146) | (0.037) | (0.035) |
| Liquidity* | | -0.141** | | -0.038 | | -0.455*** | | -0.089 |
| non-SOE | | (0.068) | | (0.027) | | (0.132) | | (0.073) |
| Size | -0.034*** | -0.034*** | -0.010*** | -0.010*** | -0.044*** | -0.044*** | -0.017*** | -0.017*** |
| | (0.006) | (0.006) | (0.002) | (0.002) | (0.010) | (0.010) | (0.004) | (0.004) |
| Log(1+Age) | -0.012 | -0.012 | -0.017*** | -0.017*** | 0.023 | 0.026 | -0.012 | -0.011 |
| | (0.012) | (0.012) | (0.005) | (0.005) | (0.026) | (0.025) | (0.010) | (0.009) |
| FI&IP over | -0.521*** | -0.517*** | -0.068*** | -0.067*** | -0.698*** | -0.689*** | -0.081*** | -0.079*** |
| assets | (0.082) | (0.081) | (0.016) | (0.016) | (0.117) | (0.116) | (0.025) | (0.025) |
| Net profit | -0.295*** | -0.293*** | -0.106*** | -0.106*** | -0.321*** | -0.315*** | -0.116*** | -0.115*** |
| margin | (0.056) | (0.055) | (0.015) | (0.015) | (0.059) | (0.059) | (0.018) | (0.018) |
| Sales growth | -0.060*** | -0.060*** | -0.017*** | -0.017*** | -0.052*** | -0.053*** | -0.010** | -0.010** |
| | (0.014) | (0.014) | (0.004) | (0.004) | (0.015) | (0.015) | (0.004) | (0.004) |
| Net worth | 0.064* | 0.069* | -0.284*** | -0.283*** | 0.055 | 0.065 | -0.253*** | -0.251*** |
| over assets | (0.038) | (0.038) | (0.022) | (0.022) | (0.064) | (0.063) | (0.037) | (0.036) |
| Total debt | 0.159*** | 0.166*** | -0.220*** | -0.218*** | 0.221*** | 0.238*** | -0.190*** | -0.186*** |
| over assets | (0.052) | (0.053) | (0.025) | (0.025) | (0.068) | (0.067) | (0.037) | (0.037) |
| Tobin's q | 0.001 | 0.001 | 0.001 | 0.001 | -0.002 | -0.002 | -0.001 | -0.001 |
| | (0.003) | (0.003) | (0.002) | (0.002) | (0.007) | (0.006) | (0.002) | (0.002) |
| Constant | 1.638*** | 1.621*** | 0.730*** | 0.726*** | 1.756*** | 1.715*** | 0.817*** | 0.809*** |
| | (0.143) | (0.138) | (0.058) | (0.057) | (0.262) | (0.251) | (0.102) | (0.100) |
| Industry Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 17139 | 17139 | 17140 | 17140 | 9883 | 9883 | 9884 | 9884 |
| Adj R-squared | 0.386 | 0.386 | 0.305 | 0.305 | 0.373 | 0.375 | 0.297 | 0.297 |

## Table 3.3: Determinants of Trade Credit: Factor Analysis

This table presents firm-year unbalance and balance data from year 1999 to 2013. The balance data require all firms have financial characteristics starting from 1999 to 2013. The dependent variables are accounts receivable, accounts payable scaled over total sales. Non-SOE Dummy is an indicator equals to one if supplier firms is non-SOE. High Sales Growth is a dummy equals to one if firm's sales growth above median by each year. High GDP Growth is a dummy equals to one if firm's geographic province's GDP is above median by each year. All specifications include industry and year fixed effect. The standard errors are clustered at firm and year level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | Unbalance Sample | | | | Balance Sample | | | |
|---|---|---|---|---|---|---|---|---|
| | (1)AR | (2)AR | (3)AP | (4)AP | (5)AR | (6)AR | (7)AP | (8)AP |
| non-SOE | 0.105*** | 0.094*** | 0.023** | 0.017** | 0.161*** | 0.146*** | 0.031 | 0.018 |
| | (0.025) | (0.022) | (0.010) | (0.008) | (0.039) | (0.036) | (0.020) | (0.016) |
| Liquidity | -0.432*** | -0.448*** | -0.126*** | -0.124*** | -0.549*** | -0.602*** | -0.164*** | -0.173*** |
| | (0.090) | (0.093) | (0.026) | (0.024) | (0.139) | (0.146) | (0.035) | (0.035) |
| Liquidity* | -0.162** | -0.144** | -0.055 | -0.037 | -0.390*** | -0.453*** | -0.080 | -0.090 |
| non-SOE | (0.072) | (0.069) | (0.034) | (0.027) | (0.127) | (0.132) | (0.077) | (0.073) |
| High Sales | -0.033*** | | -0.020*** | | -0.046*** | | -0.025*** | |
| Growth | (0.010) | | (0.004) | | (0.014) | | (0.005) | |
| High Sales | -0.029** | | -0.003 | | -0.058*** | | -0.007 | |
| Growth | | | | | | | | |
| *non-SOE | (0.012) | | (0.005) | | (0.022) | | (0.011) | |
| High GDP | | -0.008 | | 0.003 | | -0.009 | | 0.002 |
| Growth | | (0.009) | | (0.003) | | (0.012) | | (0.005) |
| High GDP | | -0.013 | | 0.002 | | -0.008 | | 0.019** |
| Growth | | | | | | | | |
| *non-SOE | | (0.014) | | (0.004) | | (0.026) | | (0.008) |
| Size | -0.029*** | -0.034*** | -0.008*** | -0.010*** | -0.036*** | -0.044*** | -0.014*** | -0.017*** |
| | (0.006) | (0.006) | (0.002) | (0.002) | (0.010) | (0.010) | (0.004) | (0.004) |
| Log(1+Age) | -0.021* | -0.011 | -0.020*** | -0.017*** | 0.013 | 0.025 | -0.018* | -0.010 |
| | (0.012) | (0.012) | (0.005) | (0.005) | (0.026) | (0.025) | (0.011) | (0.010) |
| PPE over | -0.497*** | -0.515*** | -0.068*** | -0.067*** | -0.659*** | -0.687*** | -0.076*** | -0.080*** |
| assets | (0.081) | (0.080) | (0.017) | (0.016) | (0.117) | (0.115) | (0.026) | (0.024) |
| Net profit | -0.297*** | -0.293*** | -0.104*** | -0.106*** | -0.320*** | -0.315*** | -0.114*** | -0.114*** |
| margin | (0.053) | (0.055) | (0.016) | (0.015) | (0.058) | (0.059) | (0.018) | (0.018) |
| Sales growth | -0.047*** | -0.060*** | -0.014*** | -0.017*** | -0.042*** | -0.053*** | -0.007* | -0.010** |
| | (0.011) | (0.014) | (0.004) | (0.004) | (0.012) | (0.015) | (0.004) | (0.004) |
| Net worth | 0.058 | 0.068* | -0.283*** | -0.282*** | 0.057 | 0.064 | -0.248*** | -0.252*** |
| over assets | (0.036) | (0.038) | (0.022) | (0.022) | (0.061) | (0.063) | (0.036) | (0.036) |
| Total debt | 0.159*** | 0.165*** | -0.214*** | -0.217*** | 0.239*** | 0.236*** | -0.180*** | -0.185*** |
| over assets | (0.052) | (0.053) | (0.026) | (0.025) | (0.068) | (0.067) | (0.037) | (0.037) |
| Tobin's q | 0.002 | 0.001 | 0.001 | 0.001 | 0.000 | -0.002 | 0.000 | -0.001 |
| | (0.003) | (0.003) | (0.002) | (0.002) | (0.006) | (0.006) | (0.002) | (0.002) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Constant | 1.510*** | 1.629*** | 0.689*** | 0.723*** | 1.570*** | 1.722*** | 0.786*** | 0.809*** |
| | (0.137) | (0.137) | (0.059) | (0.058) | (0.271) | (0.248) | (0.104) | (0.100) |
| Industry Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 15285 | 17124 | 15286 | 17125 | 9190 | 9868 | 9191 | 9869 |
| Adj R-squared | 0.391 | 0.387 | 0.316 | 0.305 | 0.383 | 0.375 | 0.308 | 0.298 |

## Table 3.4: Determinants of Account Receivable during Crisis

This table presents firm-year unbalance data from year 1999 to 2013. The dependent variable is accounts receivable over total sales. Non-SOE Dummy is an indicator equals to one if supplier firms is non-SOE. Crisis is an indicator that equals to one from year 2008 to 2009. All specifications control for firms' characteristics, which include size, age, tangibility, net profit margin sales growth, net worth, total debt and Tobin's q. All specifications include industry fixed effect. The standard errors are clustered at firm level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Non-SOE | 0.036*** | 0.036*** | 0.044*** | 0.072*** | 0.045*** | 0.073*** | 0.081*** | 0.081*** |
| | (0.009) | (0.009) | (0.010) | (0.017) | (0.010) | (0.017) | (0.017) | (0.017) |
| Liquidity | -0.610*** | -0.649*** | -0.611*** | -0.503*** | -0.651*** | -0.543*** | -0.504*** | -0.545*** |
| | (0.040) | (0.041) | (0.040) | (0.043) | (0.041) | (0.044) | (0.043) | (0.044) |
| Crisis | -0.102*** | -0.150*** | -0.077*** | -0.102*** | -0.126*** | -0.150*** | -0.078*** | -0.126*** |
| | (0.005) | (0.009) | (0.005) | (0.005) | (0.009) | (0.009) | (0.005) | (0.009) |
| Crisis* | | 0.278*** | | | 0.286*** | 0.276*** | | 0.284*** |
| Liquidity | | (0.038) | | | (0.038) | (0.038) | | (0.038) |
| Crisis* | | | -0.057*** | | -0.060*** | | -0.057*** | -0.060*** |
| Non-SOE | | | (0.010) | | (0.010) | | (0.010) | (0.010) |
| Liquidity* | | | | -0.208*** | | -0.207*** | -0.208*** | -0.207*** |
| Non-SOE | | | | (0.058) | | (0.058) | (0.058) | (0.058) |
| Size | -0.102*** | -0.150*** | -0.077*** | -0.102*** | -0.126*** | -0.150*** | -0.078*** | -0.126*** |
| | (0.005) | (0.009) | (0.005) | (0.005) | (0.009) | (0.009) | (0.005) | (0.009) |
| Log(1+Age) | -0.056*** | -0.056*** | -0.057*** | -0.056*** | -0.057*** | -0.056*** | -0.056*** | -0.056*** |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| FI&IP over | -0.114*** | -0.114*** | -0.115*** | -0.113*** | -0.114*** | -0.112*** | -0.114*** | -0.113*** |
| assets | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) |
| Net profit | -0.536*** | -0.535*** | -0.534*** | -0.530*** | -0.533*** | -0.529*** | -0.528*** | -0.527*** |
| margin | (0.035) | (0.035) | (0.035) | (0.035) | (0.035) | (0.035) | (0.035) | (0.035) |
| Sales growth | -0.290*** | -0.291*** | -0.290*** | -0.287*** | -0.291*** | -0.288*** | -0.287*** | -0.288*** |
| | (0.025) | (0.025) | (0.025) | (0.025) | (0.025) | (0.025) | (0.025) | (0.025) |
| Net worth | -0.061*** | -0.061*** | -0.061*** | -0.061*** | -0.061*** | -0.061*** | -0.061*** | -0.061*** |
| over assets | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) |
| Total debt | 0.094*** | 0.094*** | 0.092*** | 0.102*** | 0.093*** | 0.102*** | 0.100*** | 0.101*** |
| over assets | (0.028) | (0.028) | (0.028) | (0.028) | (0.028) | (0.028) | (0.028) | (0.028) |
| Tobin's q | 0.268*** | 0.268*** | 0.266*** | 0.277*** | 0.267*** | 0.278*** | 0.276*** | 0.276*** |
| | (0.039) | (0.039) | (0.039) | (0.038) | (0.039) | (0.038) | (0.038) | (0.038) |
| Constant | 1.922*** | 1.925*** | 1.928*** | 1.884*** | 1.931*** | 1.887*** | 1.890*** | 1.893*** |
| | (0.107) | (0.107) | (0.107) | (0.105) | (0.107) | (0.105) | (0.105) | (0.105) |
| Industry Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 17139 | 17139 | 17139 | 17139 | 17139 | 17139 | 17139 | 17139 |
| R-squared | 0.329 | 0.33 | 0.33 | 0.33 | 0.331 | 0.332 | 0.331 | 0.333 |

## Table 3.5: Determinants of Account Receivable during Crisis: Robustness

This table presents firm-year balanced data from year 1999 to 2013. The dependent variable is accounts receivable over total sales. Non-SOE Dummy is an indicator equals to one if supplier firms is non-SOE. Crisis is an indicator that equals to one from year 2008 to 2009. All specifications control for firms' characteristics, which include size, age, tangibility, net profit margin sales growth, net worth, total debt and Tobin's q. All specifications include industry fixed effect. The standard errors are clustered at firm level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| non-SOE | 0.076*** | 0.076*** | 0.091*** | 0.146*** | 0.090*** | 0.147*** | 0.161*** | 0.160*** |
| | (0.018) | (0.018) | (0.019) | (0.031) | (0.019) | (0.031) | (0.032) | (0.032) |
| Liquidity | -0.801*** | -0.874*** | -0.804*** | -0.618*** | -0.871*** | -0.691*** | -0.622*** | -0.689*** |
| | (0.071) | (0.074) | (0.071) | (0.071) | (0.074) | (0.073) | (0.070) | (0.073) |
| Crisis | -0.116*** | -0.198*** | -0.074*** | -0.117*** | -0.154*** | -0.200*** | -0.075*** | -0.155*** |
| | (0.009) | (0.019) | (0.008) | (0.009) | (0.017) | (0.019) | (0.008) | (0.017) |
| Crisis* | | 0.538*** | | | 0.497*** | 0.539*** | | 0.498*** |
| Liquidity | | (0.084) | | | (0.080) | (0.084) | | (0.081) |
| Crisis* | | | -0.118*** | | -0.108*** | | -0.118*** | -0.108*** |
| non-SOE | | | (0.022) | | (0.021) | | (0.022) | (0.021) |
| Liquidity* | | | | -0.472*** | | -0.473*** | -0.471*** | -0.472*** |
| non-SOE | | | | (0.132) | | (0.132) | (0.131) | (0.131) |
| Size | -0.067*** | -0.067*** | -0.068*** | -0.067*** | -0.068*** | -0.067*** | -0.068*** | -0.068*** |
| | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) |
| Log(1+Age) | -0.168*** | -0.168*** | -0.168*** | -0.164*** | -0.168*** | -0.165*** | -0.165*** | -0.165*** |
| | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) |
| FI&IP over | -0.715*** | -0.714*** | -0.713*** | -0.706*** | -0.712*** | -0.705*** | -0.704*** | -0.703*** |
| assets | (0.064) | (0.064) | (0.064) | (0.063) | (0.063) | (0.063) | (0.063) | (0.063) |
| Net profit | -0.319*** | -0.320*** | -0.319*** | -0.313*** | -0.319*** | -0.313*** | -0.313*** | -0.313*** |
| margin | (0.036) | (0.036) | (0.036) | (0.036) | (0.036) | (0.036) | (0.036) | (0.036) |
| Sales growth | -0.054*** | -0.053*** | -0.054*** | -0.054*** | -0.054*** | -0.053*** | -0.054*** | -0.054*** |
| | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) |
| Net worth | 0.105** | 0.106** | 0.103** | 0.115** | 0.104** | 0.116** | 0.113** | 0.114** |
| over assets | (0.050) | (0.049) | (0.050) | (0.048) | (0.049) | (0.048) | (0.048) | (0.048) |
| Total debt | 0.337*** | 0.338*** | 0.329*** | 0.354*** | 0.331*** | 0.356*** | 0.347*** | 0.349*** |
| over assets | (0.065) | (0.065) | (0.065) | (0.063) | (0.064) | (0.063) | (0.063) | (0.062) |
| Tobin's q | -0.002 | -0.002 | -0.002 | -0.002 | -0.002 | -0.001 | -0.001 | -0.001 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| Constant | 2.382*** | 2.392*** | 2.390*** | 2.326*** | 2.398*** | 2.336*** | 2.334*** | 2.342*** |
| | (0.197) | (0.196) | (0.196) | (0.191) | (0.196) | (0.191) | (0.191) | (0.191) |
| Industry Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 9883 | 9883 | 9883 | 9883 | 9883 | 9883 | 9883 | 9883 |
| R-squared | 0.336 | 0.338 | 0.338 | 0.339 | 0.34 | 0.341 | 0.341 | 0.343 |

**Table 3.6: Determinants of Account Payable during Crisis**

This table presents firm-year unbalance data from year 1999 to 2013. The dependent variable is accounts payable over total sales. Non-SOE Dummy is an indicator equals to one if supplier firms is non-SOE. Crisis is an indicator that equals to one from year 2008 to 2009. All specifications control for firms' characteristics, which include size, age, tangibility, net profit margin sales growth, net worth, total debt and Tobin's q. All specifications include industry fixed effect. The standard errors are clustered at firm level. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| non-SOE | 0.014*** | 0.014*** | 0.015*** | 0.020** | 0.015*** | 0.020** | 0.021** | 0.021** |
| | (0.005) | (0.005) | (0.005) | (0.008) | (0.005) | (0.008) | (0.008) | (0.008) |
| Liquidity | -0.143*** | -0.142*** | -0.143*** | -0.126*** | -0.143*** | -0.125*** | -0.126*** | -0.126*** |
| | (0.020) | (0.020) | (0.020) | (0.021) | (0.020) | (0.022) | (0.021) | (0.022) |
| Crisis | -0.011*** | -0.010* | -0.009*** | -0.011*** | -0.008 | -0.010* | -0.009*** | -0.008 |
| | (0.002) | (0.005) | (0.003) | (0.002) | (0.005) | (0.005) | (0.003) | (0.005) |
| Crisis* | | -0.005 | | | -0.004 | -0.006 | | -0.005 |
| Liquidity | | (0.025) | | | (0.025) | (0.025) | | (0.025) |
| Crisis* | | | -0.006 | | -0.006 | | -0.006 | -0.006 |
| non-SOE | | | (0.005) | | (0.005) | | (0.005) | (0.005) |
| Liquidity* | | | | -0.033 | | -0.033 | -0.033 | -0.033 |
| non-SOE | | | | (0.029) | | (0.029) | (0.029) | (0.029) |
| Size | -0.008*** | -0.008*** | -0.008*** | -0.007*** | -0.008*** | -0.007*** | -0.008*** | -0.008*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| Log(1+Age) | -0.014*** | -0.014*** | -0.014*** | -0.014*** | -0.014*** | -0.014*** | -0.014*** | -0.014*** |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| FI&IP over | -0.073*** | -0.073*** | -0.073*** | -0.072*** | -0.073*** | -0.072*** | -0.072*** | -0.072*** |
| assets | (0.018) | (0.018) | (0.018) | (0.018) | (0.018) | (0.018) | (0.018) | (0.018) |
| Net profit | -0.106*** | -0.106*** | -0.106*** | -0.106*** | -0.106*** | -0.106*** | -0.105*** | -0.105*** |
| margin | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) | (0.012) |
| Sales growth | -0.019*** | -0.019*** | -0.019*** | -0.019*** | -0.019*** | -0.019*** | -0.019*** | -0.019*** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| Net worth | -0.280*** | -0.280*** | -0.280*** | -0.279*** | -0.280*** | -0.279*** | -0.279*** | -0.279*** |
| over assets | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) | (0.022) |
| Total debt | -0.224*** | -0.224*** | -0.224*** | -0.222*** | -0.224*** | -0.222*** | -0.223*** | -0.223*** |
| over assets | (0.024) | (0.024) | (0.024) | (0.024) | (0.024) | (0.024) | (0.024) | (0.024) |
| Tobin's q | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Constant | 0.588*** | 0.588*** | 0.588*** | 0.582*** | 0.588*** | 0.582*** | 0.582*** | 0.582*** |
| | (0.055) | (0.055) | (0.055) | (0.055) | (0.055) | (0.055) | (0.055) | (0.055) |
| Industry Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 17140 | 17140 | 17140 | 17140 | 17140 | 17140 | 17140 | 17140 |
| R-squared | 0.302 | 0.302 | 0.302 | 0.302 | 0.302 | 0.302 | 0.302 | 0.302 |

## Table 3.7: Determinants of Trade Credit Robustness for Supplier-Customer Relations

This table presents firm-year unbalance data from year 1999 to 2013. The dependent variables are accounts receivables and accounts payables over total sales. Each observation represents a supplier-customer pair. Non-SOE Dummy is an indicator equals to one if supplier (customer) firms is non-SOE. Crisis is an indicator that equals to one from year 2008 to 2009. All specifications control for firms' characteristics, which include size, age, tangibility, net profit margin sales growth, net worth, total debt and Tobin's q. All specifications include supplier-customer pair effect and standard errors are clustered at supplier-customer pair. ***, ** and * indicate significance level at the 1%, 5% and 10% level, respectively.

| | (1)AR | (2)AR | (3)AR | (4)AP | (5)AP | (6)AP |
|---|---|---|---|---|---|---|
| Crisis | | -0.055** | -0.075** | | -0.010 | -0.021 |
| | | (0.023) | (0.032) | | (0.008) | (0.013) |
| Crisis* | | | 0.152 | | | 0.085 |
| Cash Liq | | | (0.90) | | | (1.41) |
| Crisis* | | | -0.061 | | | -0.024 |
| non-SOE | | | | | | |
| | | | (-0.27) | | | (-0.34) |
| Cash Liq* | -0.166 | | -0.157 | 0.057 | | 0.067 |
| Supplier | | | | | | |
| non-SOE | (0.254) | | (0.243) | (0.076) | | (0.077) |
| Supplier variables | | | | | | |
| Cash Liq | -0.364 | -0.440*** | -0.378* | -0.124* | -0.090* | -0.140* |
| | (0.225) | (0.155) | (0.214) | (0.068) | (0.050) | (0.072) |
| Size | 0.090 | 0.087 | 0.087 | 0.058** | 0.058** | 0.058** |
| | (1.57) | (1.57) | (1.58) | (2.20) | (2.20) | (2.23) |
| Log(1+Age) | -0.484*** | -0.482*** | -0.479*** | -0.064** | -0.063** | -0.062** |
| | (-3.45) | (-3.46) | (-3.45) | (-2.10) | (-2.09) | (-2.06) |
| FI&IP over | -0.372** | -0.369** | -0.361** | -0.091 | -0.087 | -0.088 |
| assets | (-2.15) | (-2.14) | (-2.14) | (-1.35) | (-1.29) | (-1.32) |
| Net profit | -0.212 | -0.211 | -0.211 | -0.041 | -0.040 | -0.042 |
| margin | (-1.25) | (-1.26) | (-1.25) | (-0.78) | (-0.77) | (-0.80) |
| Sales growth | -0.036* | -0.041** | -0.042** | -0.007 | -0.007 | -0.008 |
| | (-1.75) | (-1.97) | (-2.00) | (-0.56) | (-0.60) | (-0.64) |
| Net worth | 0.127 | 0.113 | 0.120 | -0.171*** | -0.170*** | -0.173*** |
| over assets | (0.99) | (0.88) | (0.93) | (-2.79) | (-2.78) | (-2.83) |
| Total debt | 0.023 | 0.016 | 0.032 | -0.092* | -0.087 | -0.090* |
| over assets | (0.17) | (0.13) | (0.25) | (-1.67) | (-1.58) | (-1.65) |
| Tobin's q | 0.003 | 0.003 | 0.003 | 0.004 | 0.004 | 0.004 |
| | (0.39) | (0.33) | (0.34) | (1.10) | (1.04) | (1.13) |
| Customer variables | | | | | | |
| Weight | -0.182 | -0.188 | -0.189 | 0.010 | 0.009 | 0.008 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (-0.88) | (-0.92) | (-0.92) | (0.33) | (0.31) | (0.27) |
| Cash Liq | -0.217 | -0.111 | -0.135 | 0.021 | 0.028 | 0.036 |
| | (-1.05) | (-0.51) | (-0.63) | (0.38) | (0.48) | (0.60) |
| Size | 0.090 | 0.078 | 0.076 | 0.005 | 0.002 | 0.002 |
| | (1.35) | (1.19) | (1.17) | (0.20) | (0.10) | (0.08) |
| FI&IP over | -0.313 | -0.268 | -0.270 | 0.028 | 0.037 | 0.033 |
| assets | (-0.95) | (-0.81) | (-0.82) | (0.35) | (0.47) | (0.42) |
| Net profit | 0.070 | 0.048 | 0.043 | 0.042 | 0.037 | 0.036 |
| margin | (0.34) | (0.23) | (0.21) | (0.56) | (0.50) | (0.49) |
| Sales growth | -0.070* | -0.084** | -0.081** | -0.030* | -0.032* | -0.032* |
| | (-1.94) | (-2.29) | (-2.17) | (-1.83) | (-1.90) | (-1.83) |
| Net worth | 0.408** | 0.396** | 0.407** | 0.026 | 0.024 | 0.029 |
| over assets | (2.13) | (2.17) | (2.21) | (0.36) | (0.34) | (0.41) |
| Total debt | 0.118 | 0.134 | 0.125 | -0.041 | -0.040 | -0.042 |
| over assets | (0.58) | (0.67) | (0.63) | (-0.47) | (-0.47) | (-0.49) |
| Constant | -2.550* | -2.204* | -2.188* | -0.920** | -0.858** | -0.853** |
| | (-1.90) | (-1.69) | (-1.67) | (-2.32) | (-2.16) | (-2.17) |
| Pair Fixed Effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 2457 | 2457 | 2457 | 2457 | 2457 | 2457 |
| R-squared | 0.747 | 0.751 | 0.752 | 0.79 | 0.79 | 0.791 |