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Internal Capital Markets in Business Groups and the Propagation of Credit Supply Shocks

by Yu Shi, Robert Townsend, and Wu Zhu

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I N T E R N A T I O N A L M O N E T A R Y F U N D

IMF Working Paper

Research Department

**Internal Capital Markets in Business Groups and the
Propagation of Credit Supply Shocks¹**

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Abstract

Using business registry data from China, we show that internal capital markets in business groups can propagate corporate shareholders' credit supply shocks to their subsidiaries. An average of 16.7% local bank credit growth where corporate shareholders are located would increase subsidiaries investment by 1% of their tangible fixed asset value, which accounts for 71% (7%) of the median (average) investment rate among these firms. We argue that equity exchanges is one channel through which corporate shareholders transmit bank credit supply shocks to the subsidiaries and provide empirical evidence to support the channel.

JEL Classification Numbers: G2, G3, O17, L23

Keywords: Internal capital markets, business groups, bank lending, China

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1 Introduction

When financial markets are less developed, external financing remains challenging. Non-financial firms rely on internal capital markets to allocate capital and maximize profits. In many countries, such as Japan (Hoshi, Kashyap, and Scharfstein, 1991), South Korea (Almeida, Kim, and Kim, 2015), and Italy (Santioni, Schiantarelli, and Strahan, 2017), internal capital markets are prevalent within business groups: a group of legally independent firms under common ownership (Almeida et al., 2015). However, the literature so far has mostly documented subsidiary firms with a common shareholder hedging risks with each other. Little attention has been paid to the transmission of shocks from the corporate shareholder to their subsidiaries.

In this paper, we show that internal capital markets in business groups can propagate corporate shareholders' credit supply shocks to their subsidiaries, using rich firm-level data from China. We focus on the credit supply shocks from the banking sector, as banks are still dominating the financial market in China. Controlling for local credit market and macroeconomic conditions, an average 16.7% bank credit growth exposed to corporate shareholders increases subsidiaries investment additionally by 1% of their tangible fixed asset value. The estimate is reasonably large compared to a median value of subsidiary investment rate: 1.4%. We also argue in this paper that equity exchanges between shareholders and subsidiaries is one potential channel of credit transmission and provide evidence to support this channel.

Our findings shed new lights on the macroeconomic importance of internal capital markets within business groups and the bank lending channel. First, the business registry data covers the universe of firms in China. Compared to other papers studying only the listed firms, we document that business groups populate the entire economy. Second, subsidiary firms in business groups tend to be smaller, younger, and more financially constrained compared to their corporate shareholders (table 1). On the other hand, bank credit favors larger, older, and more connected firms over the smaller and younger ones (Gilchrist and Zakrajšek, 1998; Borensztein and Lee, 2002). A positive bank lending shock thus could have a more significant aggregate impact if large corporate shareholders would pass the shock to their smaller subsidiaries through the internal capital markets. For the rest of the paper, "holding firms", "shareholders" and "parent companies" all refer to the corporate shareholders in business groups.

We begin by documenting that a significant fraction of Chinese firms are in business groups. Our business registry data, unlike public firm disclosure data, identifies business

groups among all registered firms in China (Bai, Hsieh, Song, and Wang, 2018). As of 2017, 16% out of the universe of over 35 million firms were part of business groups. In our merged sample, these firms in business groups contribute to 60% of output, 70% of total fixed asset, and 60% of employment. The average value of total assets for shareholders, subsidiaries, and out-of-business-group firms, are 712 million, 512 million, and 134 million RMB respectively. Within business groups, the subsidiary firms on average out-perform the shareholders in terms of total factor productivity (TFP) and return on assets (ROA), but they have less access to bank credit (table 1).

Next, we provide causal evidence that bank credit supply shocks to a corporate shareholder benefit its subsidiary firms. Our identification relies on the geographical diversification of the business-group network and the regional segmentation of the Chinese banking sector. According to our business registry data, 17.5% of the shareholding relationships have the shareholder and the subsidiary located in two different municipal cities. The network spans the entire country without following a particular pattern. The regional segmentation of the banking sector is a result of the localized business model of Chinese banks and inefficiency in the inter-bank market. Local bank branches have substantial decision-making power, and thus even large commercial banks conduct business on a local basis (Huang, Pagano, and Panizza, 2019). Regulation of the 75% ceiling in loan-to-deposit ratio and limited competition on the repo market also prevent the inter-bank market from smoothing funding gaps across the country (Acharya, Qian, and Yang, 2016; Ruan 2017; Chen, Ren, and Zha, 2018).

We implement our identification strategy using variation in local bank credit growth and corporate balance sheet data of the subsidiary firms (2000 - 2008). Taking the existing network of business groups as given, we compare similar subsidiary firms located in the same city but having shareholders in different other cities that experienced different levels of bank credit growth. Provided that idiosyncratic shocks to bank credit are uncorrelated across cities, we verify the transmission of these shocks along the business-group network if subsidiary firms responded more when their shareholders in other cities experienced a larger bank credit growth. We also include firms that are not in any business groups in our control group so as to estimate local average trends and fixed effects.

Since we use bank credit growth to proxy for credit supply shocks, the main identification challenge comes from the possibly correlated credit demand across cities. To mitigate the concern, we construct a Bartik-type instrument for local bank credit supply shocks. We track the expansion of commercial banks all over the country, which

should be correlated with bank business decisions but uncorrelated with local credit demand of individual cities. A commercial bank that expanded fast in China is considered as being more ambitious in providing new credits to firms. If this bank had also controlled a significant fraction of the credit market in a city, we consider the city as experienced a more substantial bank credit supply shock. The estimates using this Bartik-type instrument support our hypothesis that corporate shareholders would pass along a positive credit supply shock from banks to their subsidiaries.

Another challenge is that other networks may overlap with the business-group network. To deal with this challenge, we control for other networks in additional robustness tests. We include in estimates of upstream supply shocks and downstream demand shocks as proxies for supply chain linkages, trade credit measures (account payable and receivable) as proxy for credit from trading partners, shareholder industry cross subsidiary industry fixed effects and shareholder city cross subsidiary city fixed effects to control for any geographical overlay of industries, and a common shareholder dummy to control for the tunneling effects.

How would internal capital markets within business groups facilitate the transmission of credit supply shocks from shareholders to subsidiaries? We provide new empirical evidence and argue that the equity transfers among shareholders and subsidiaries could be an effective channel¹. Subsidiaries transfer or issue new equity stakes to holding firms in exchange for more cash. We establish this channel using the same identification strategy but replacing the left-hand side with total equity shares held by corporate shareholders. We find that for an average subsidiary firm, total equity shares held by corporate shareholders increases following a positive credit supply shock to these shareholders. The equity transfer channel is also discussed in Almeida et al. (2015), who find that cross-firm equity investments are frequently used by *chaebol* (business groups in Korea) to transfer cash from low-growth to high-growth member firms.

The effectiveness of internal capital markets in propagating credit supply shocks depend on two elements: the subsidiary firms' financial constraints and their investment opportunities. We construct various proxies for firm financial constraint and investment opportunities following Manova, Wei, and Zhang (2015) and Giroud and Mueller (2015). Our findings indicate that subsidiary firms with larger long-term financial constraints (high external finance dependence) tend to invest more following a credit supply shock to their shareholders, while the short-term liquidity constraints

¹Another possible channel is inter-business-group loans, but due to data limitations, we are not able to test this channel in this paper.

matter less. Among the group of financially constrained subsidiaries, the ones with good investment opportunities also invest more following a credit supply shock to their shareholders.

Related Literature

This paper relates most closely to internal capital market literature. There has been a large literature focusing on the capital or labor reallocation across sectors or segments within under common shareholder (Hoshi, Kashyap, and Scharfstein, 1991; Shin and Stulz, 1998; Ozbas and Scharfstein, 2009; Giroud and Mueller, 2015; Almeida, Kim, and Kim, 2015; Santioni, Schiantarelli, and Strahan, 2017). In contrast, we show that the internal capital market is not only effective in hedging risks across firms, but also important in transmitting credit supply shocks from the banking sector to the entire corporate sector. Cetorelli and Goldberg (2012) argue that internal capital markets within US banks play an important role in propagating shocks across countries, but they do not discuss non-financial firms.

Our paper also complements the literature studying the cross-holding network. In the corporate finance literature, people find that the cross-holding relationships can distort the mergers and acquisition decisions by inflating the market value of targeted companies (Fedenia, Hodder, and Triantis, 1994), or cause the conflicts between controlling rights and cash-flow rights which leads to the “tunneling effect” (Porta and Shleifer, 1999; Claessens, Djankov, and Lang, 2000; Gopalan, Nanda, and Seru, 2007; Jiang, Lee, and Yue, 2010; Gul, Kim, and Qiu, 2010). We show that the cross-holding network can also benefit the economy when holding firms pass along credit shocks from the banking sector to the subsidiary firms.

This paper further emphasizes the importance of the bank-lending channel, which is an important vehicle for monetary policy to have significant impacts on the real economy. Previous studies often focus on testing the direct effect of the bank-lending channel by exploring exogenous variations in bank credit supply (Bernanke, 1983; Peek and Rosengren, 2001; Morgan, Rime, and Strahan, 2004; Ashcraft, 2005; Paravisini, 2008; Chava and Purananadam, 2008; Khwaja and Mian, 2008; Loutskina and Strahan, 2009). We show that the bank-lending channel could affect firms that are indirectly connected to the banking sector through their holding companies. Therefore, the bank-lending channel can have larger and wider impacts in the non-financial sectors.

Finally, this paper fits broadly into the literature studying financial linkages. In-

terlinked financial activities can expose the financial sector into larger systemic risks and raise challenges on financial stability (Allen and Gale, 2000; Eisenberg and Noe, 2001; Gai, Haldane, and Kapadia, 2011; Elliott, Golub, and Jackson, 2014; Acemoglu, Ozdaglar, and Tahbaz-Salehi, 2015). In our paper, we emphasize the importance of monitoring firm-to-firm investment in equity shares by showing the existence of a large cross-holding network and its effect in linking the financial sector to the real economy.

The rest of this paper is organized as follows: in section 2, we discuss the theoretical framework of this paper and develop hypotheses for the empirical analyses. Section 3 describes our identification strategy and provide a detailed overview of our innovative data sets. In section 4, we discuss our empirical findings. Finally section 5 concludes the paper.

2 Hypotheses Development

In this section, we discuss the theoretical framework describing how firms in a business group would react to credit supply shocks from the banking sector. Two assumptions are necessary to capture the transmission of credit supply shocks within business groups. The first assumption is that each individual firm within business groups face a binding credit constraint. This assumption is necessary to generate a positive response to bank credit supply shocks and it can be rationalized with various micro-foundations, including but not limit to limited pledgeability, weak legal and regulatory environment outside of firms. The second assumption is that shareholder has both the ability and the incentive to transfer capital to subsidiaries for more profits. Both Stein (1997) and Gertner, Scharfstein, and Stein (1994) emphasize the role that control rights play in making headquarters an effective intermediary. The incentive to transfer capital to subsidiaries could be generated when subsidiaries have better investment opportunities but cannot be fulfilled through external financing. One example could be when shareholders and subsidiaries locate in different cities and face different credit supply shocks, as is the case in our empirical analysis. It could also happen when banks are more willing to lend to shareholders, given that they are older firms with more assets compared to subsidiaries. The two assumptions ensure efficient capital reallocation within business groups.

A key distinction between our study and the existing ones on internal capital markets is that we focus on corporate shareholders intermediating credit from banks to

subsidiaries. The corporate shareholders are also firms producing with capital and labor, so when they face a positive credit supply shock from the banking sector, their marginal return on capital decline and they have more incentive to invest in their subsidiaries with still-high marginal return on capital. Upon receiving capital from shareholders, financially-constrained subsidiaries increase their investment to generate greater profits. Our first hypothesis is thus:

- When shareholders experience a positive local credit shock, their subsidiaries increase their capital expenditure more relative to stand-alone firms or subsidiaries with no credit growth shocks to their shareholders.

The winner-picking feature in this theoretical framework implies that subsidiaries have different likelihood of receiving capital transfers from their shareholders depending on their marginal return on capital. A high marginal return on capital is the result of a large gap between firm's financing capacity and its desired investment, which can come from either a high firm productivity or a tight firm financial constraint. This rationale thus gives us two additional testable hypotheses:

- When shareholders experience a positive local credit shock, subsidiaries with greater investment opportunities increase their capital expenditure more compared to subsidiaries with fewer investment opportunities.
- When shareholders experience a positive local credit shock, subsidiaries with tighter financial constraints increase their capital expenditure more compared to subsidiaries with looser financial constraints.

The credit transfer between shareholders and subsidiaries can be done through the transfer of subsidiaries' equity shares. In our data set, we observe the equity shareholdings of all shareholders, including both corporate and individual shareholders. Shareholders purchase equity from individual shareholders or through new issuance when transferring credit to subsidiaries, both of which lead to higher equity shareholdings of corporate shareholders. We thus hypothesize the following:

- When shareholders experience a positive local credit shock, the individual shareholders of their subsidiaries hold less equity shares to facilitate capital transfers to subsidiaries compared to stand-alone firms or subsidiaries with no credit growth shocks to their shareholders.

The actual amount of credit transfer through exchanges of equity shares should depend on the marginal return on capital of the subsidiaries. However, given that our sample contain mostly private firms without market valuation, we cannot compute the amount of credit transferred from shareholders to subsidiaries following a bank credit supply shock.

3 Empirical Strategy and Data

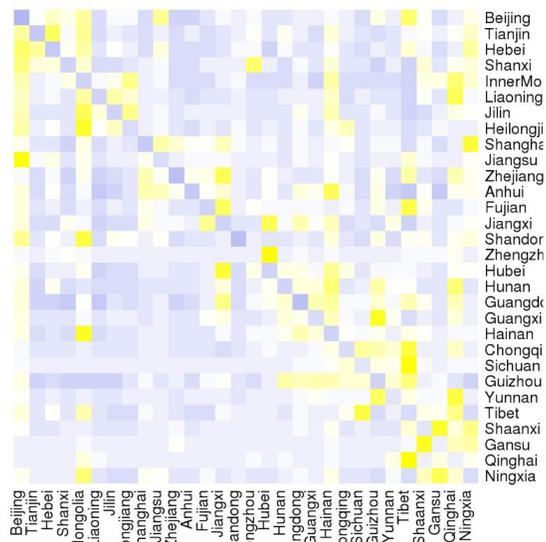
In this section, we provide an overview of our unique data set and our empirical strategies for testing the theoretical hypotheses.

3.1 Identification Strategy

Our identification strategy is to exploit the geographical dispersion of business groups in China. As discussed in section 1, business groups in China locate everywhere in the country. Figure 1 below presents the heatmap showing the shareholder-subsidiary linkages across provinces², validating the diversification of business groups across China. Taking the existing network of business groups as given, we compare similar subsidiary firms located in the same city with shareholders experienced different credit supply shocks in other cities. Provided that the credit supply shocks are uncorrelated across cities, we identify the transmission of these shocks by studying the response of subsidiary firms to credit supply shocks exposed to their shareholders. To illustrate, suppose that there exist two textile firms in Guangzhou with similar scale and the same exporting status which are owned by two separate shareholding companies in Beijing and Chengdu. In 2009, credit supply in Chengdu grew by 62 percent due to the four-trillion RMB stimulus. Around the same time, Beijing also experienced a credit boom with a credit growth of 24 percent. The difference in the investment rate of the two textile firms are then used to identify the pass-through of credit supply shocks from the shareholders in Beijing and Chengdu to the two subsidiaries in Guangzhou. We add city cross year fixed effects to control for any local credit market and macroeconomic conditions. We also include firms that are not in any business groups in our control group so as to estimate local average trends and fixed effects.

²Provinces with higher intensity of shareholder-subsidiary linkages are marked as yellow; and the ones with lower intensity of the linkages are marked as blue.

Figure 1: The Geographical Diversification of Business Groups



The key challenge of our identification strategy is that the shareholders' credit supply shocks may coincide with subsidiaries' investment opportunities. We establish the validity of our results with two arguments: first, our measurement of local credit supply shocks may depend on local credit demand, but not credit demand in other cities; second, the shareholding relationships between shareholders and subsidiaries does not fully overlap with other business relationships across cities.

The first argument is supported by the large literature documenting the geographical segmentation of the Chinese financial system and its distortionary effects on capital allocation. The geographical segmentation is a result of both institutional and regulatory restrictions. From the institutional perspective, both local financial institutions and large policy and commercial banks tend to operate within cities (Dobson and Kashyap, 2006; Roach, 2006). The inter-bank market is dominated by the four largest Chinese banks, which makes it harder for smaller banks to smooth local funding gaps. Several regulations also limit financial institutions to conducting businesses at the national level. First, there has been a loan-to-deposit ratio requirement until 2015: Chinese banks could not lend more than 75% of their deposits. Second, interest rate ceilings were present on both deposits and loans (Huang et al., 2019).

While our identification suffices as long as city-level credit growth depends only on

local supply and demand, we construct an instrument orthogonal to local credit demand to further mitigate the concern. Our Bartik-type instrument exploits the opening of new local bank branches across cities. A commercial bank that expanded fast in China is regarded as being more ambitious in providing new credits to firms. If the bank had controlled a large fraction of the credit market in a city, we consider the city as experienced a larger credit supply shock. The estimates using this Bartik-type instrument support our hypothesis that corporate shareholders would pass through a positive credit supply shock to their subsidiaries.

For the second argument, we show that the shareholding relationships still have a significant effect after controlling for other types of business networks in the robustness tests. We include in estimates for upstream supply shocks and downstream demand shocks as proxies for the supply chain linkages, trade credit measures (account payable and receivable) as proxies for credit from trading partners, shareholder industry cross subsidiary industry fixed effects and shareholder city cross subsidiary city fixed effects to control for any geographical overlay of industries, and a common shareholder dummy to control for the tunneling effects³.

3.2 Firm-level Data and Key Variables

We obtain firm-to-firm equity holding relationships and the network of business groups from the State Administration of Industry and Commerce (hereafter SAIC) Database.

The SAIC provides a complete record of the original shareholders and their capital contributions for all registered enterprises in China, as well as each update of the shareholding structure⁴ from 1950 to 2017⁵. It also contains other information including the company name, the legal person, the start-up capital, the domicile of the enterprise (location), the business scope, and the year of establishment. We construct firm-to-firm equity holding relationships based on the SAIC and track the business group network over time. This network of business groups expanded rapidly from having only 1.8 million companies in 2000 to including more than 5 million companies in networks in 2017. Our network in the baseline is purely based on the equity holding relationship

³Specifically, we attempt to control the tunneling effect through any additional common shareholders of subsidiaries and their shareholders.

⁴Including any updates or changes in shareholder capital contribution, shareholding status, and their holding shares.

⁵By 2017, there have been approximately 40 million registered enterprises in the SAIC, among which 28 million are private entities.

and we do not distinguish between major and minor shareholders.

To construct measures of firm investment and financing activities, we use the corporate balance sheet information from the Annual Survey of Chinese Industrial Enterprises (ASCIE) data. The ASCIE is an annual survey conducted by the Chinese National Bureau of Statistics since 1995. It covers all state-owned enterprises (SOEs) regardless of their business scope, and private firms in manufacturing, mining and energy sectors with an annual revenue over 5 million RMB. After 2011, the cutoff was lifted to 20 million RMB. We delete all observations after 2010⁶ to avoid the selection bias from the change in the sampling criteria. We also drop the observations before 2000 due to the concern on data quality in the early years of the survey and observations in 2009 due to data availability concern. Finally, we remove the outliers following Brandt, Van Biesebroeck, and Zhang (2014), which leaves us with an unbalanced sample of 688,560 firms and 2,602,126 observations spanning 9 years (2000 - 2008)⁷. Roughly 95% of the firms appear in the sample for at least two years⁸.

We merge SAIC and ASCIE data sets using the legal name of each firm, the name of legal representative, the domicile of the firm, and the year of establishment⁹. We are able to match 547,411 out of the 658,678 firms in ASCIE to the SAIC database, which accounts for 83 percent of our sample. After merging the SAIC database with ASCIE, we are left with a total of 138,453 holding firms¹⁰ and 151,604 subsidiaries¹¹.

In our empirical analysis, the firm-level outcome variables of subsidiaries include investment, R&D expenditure, profit margin, leverage ratio, and the book value of total debt. Investment is constructed as the net formation of tangible fixed asset, normalized by the one-year lagged value of total tangible fixed asset. The real value of total tangible fixed asset is recovered from the nominal tangible fixed asset using the

⁶The data for 2004 and 2008 are from the national industrial census. We match the census data with the annual survey using firm ID, firm name, legal person, address at six digital county level, phone, zip, 4 digital industrial code, founding year suggested by Brandt, Van Biesebroeck, and Zhang (2014).

⁷The total number of observations in our results is smaller because firm fixed effects absorbed firms only appeared once in the data set; and certain variables are missing for some firms in certain years.

⁸The average number of observations that one firm contributes to is 5.7 and the corresponding standard deviation is 2.8.

⁹According to the corporate law in China, each registered enterprise has a unique legal representative, who has the full responsibility in dealing with the enterprise's legal issues.

¹⁰They are roughly 20 percent of our ASCIE sample and 43 percent of the whole sample of holding firms in the SAIC database.

¹¹These firms account for 18 percent of our ASCIE sample and 26 percent of the whole sample of subsidiary firms in the SAIC.

procedure and the code provided by Brandt et al. (2014). R&D expenditure is directly reported by firms as an item in their operating costs. We consider R&D expenditure as mostly capital expenditure, thus it is also normalized using the one-year lagged total asset value. Firm-level profit margin is the ratio of operating profit divided by operating revenue; the book value of debt includes long locate in-term and short-term bank loans and corporate bonds; and finally, leverage ratio is constructed as the ratio of total book value of debt divided by the total book value of liabilities and equity.

We also measure the equity transfers between shareholders and subsidiaries. Our data set, unfortunately, does not allow us to directly observe the equity trading between firms. We test for the equity transfer channel using total fraction of equity shares (0 to 100) held by the corporate shareholders of a given subsidiary company. When the company sells its equity in exchange for capital injection, the total equity shares held by the corporate shareholders of the firm would increase with or without new stock issuance.

3.3 Local Credit Supply Shocks and Economic Condition

Our main source of city-level economic variables and credit growth is the province and city year books from the China Data Center (CDC), which cover 312 prefecture-level cities from 2000 to 2016.

For local credit supply shocks, we construct two measures as proxies. Note that our identification strategy allows the measured city-level credit supply shocks to depend on local credit demand, as long as they are orthogonal to the investment opportunities of subsidiary firms located in other cities. Therefore in the baseline specification, we use the growth rate of the outstanding amount of loans in each city as the proxy of city-level credit supply shocks. The outstanding amount of loans in nominal terms is directly obtained from city year books. For subsidiary firms with multiple shareholders, we compute the average growth rate of local outstanding amount of loans weighted by city-level loan volume at a one-year lag (see section 4.1 for details).

In an alternative specification, we construct a Bartik-type instrument to isolate the local credit demand shocks from the local credit supply shocks. Our instrument shares the spirit in Gao, Ru, Townsend, and Yang (2018) to exploit the opening of new local bank branches. A bank that expands fast at the nationwide is considered to have been providing more credits to firms and the expansion should be less relevant to credit demand in individual cities. The national-level credit demand shocks are controlled

with year fixed effects. We obtain bank branch information from the bank branch registry database provided by the China Banking Regulatory Commission (hereafter CBRC). The data set documents the name, location (specific to street names), date of establishment and/or cancellation for each bank branch in China. section 4.2 discusses in detail the construction of the instrumental variable.

4 Empirical Analysis

Using the shareholders information from the SAIC, we back out the network of business groups among non-financial firms. As of 2017, out of all 36 million firms in China, there are roughly 5.5 million pairs of shareholder-subsidary linkages. An overall of 2.55 million firms perform as holding firms, and 3.79 million firms are subsidiaries of other non-financial firms. On average, each corporate shareholder has 1.5 subsidiary firms and holds 63.8% of the equity shares of each subsidiary firm.

Despite that there is only a small share of firms (roughly 15.6%) that are associated with any business groups, these firms make a major economic contribution: 80% of the registered capital, 60% of the output, 70% of the total fixed asset, and 60% of the employment in our merged sample are from firms within business groups. Table 1 provides a detailed comparison between the out-of-business-group firms and the within-business-group firms, based on firm characteristics from the SAIC and the ASCIE. We further divide the within-business-group firms into the group of subsidiary firms and the group of corporate shareholders to compare their differences. Overall, firms that are part of the business groups tend to be older and much larger than the stand-alone ones. Compared to the corporate shareholders, the subsidiary firms have better performance (in terms of TFP and ROA), but they borrow less from the banking sector (lower leverage ratio).

Table 1: Firm-level Summary Statistics

	Mean	Median	S.D.	25th	75th	No. of Obs.	Data Source
<i>Out-of-business-group Firms:</i>							
Log(Firm Age)	1.868	1.946	0.818	1.386	2.398	1.722e+06	ASCIE
Log(Total Asset Value)	9.413	9.288	1.204	8.587	10.12	1.621e+06	ASCIE
<i>Subsidiary Firms:</i>							
Log(Firm Age)	2.160	2.197	0.836	1.609	2.639	620,208	ASCIE
Log(Total Asset Value)	10.43	10.31	1.481	9.378	11.39	599,636	ASCIE
Leverage Ratio	0.572	0.571	0.296	0.358	0.767	620,252	ASCIE
ROA	0.0460	0.0175	0.120	-0.193	0.842	599,636	ASCIE
TFP	0.00495	0.0553	0.483	-0.205	0.298	397,298	ASCIE
Investment	0.146	0.014	0.301	0	0.140	395,638	ASCIE
R&D	0.177	0	0.743	0	0	305,745	ASCIE
<i>Corporate Shareholders:</i>							
Log(Firm Age)	2.451	2.398	0.889	1.792	3.091	409,878	ASCIE
Log(Total Asset Value)	10.83	10.73	1.553	9.691	11.89	399,288	ASCIE
Leverage Ratio	0.618	0.620	0.277	0.432	0.794	409,955	ASCIE
ROA	0.0426	0.0165	0.107	0	0.199	399,288	ASCIE
TFP	-0.0071	0.0558	0.521	-0.228	0.315	267,056	ASCIE
Investment	0.159	0.015	0.317	0	0.161	275,070	ASCIE
R&D	0.261	0	0.876	0	0	214,948	ASCIE

Notes: This table summarizes a partial list of variables used in the empirical exercises. For a complete summary, please see the appendix for more details. The data sources are the Annual Survey of Chinese Industrial Enterprises by the Chinese National Bureau of Statistics, CompuStat, and the SAIC database. Firm age is measured as the number of years since establishment. The construction of leverage ratio, investment, and R&D is described in section 3.2; the construction ROA and firm-year TFP is discussed in section 4.4.

Table 2 summarizes the equity shareholding conditions and local credit growth in shareholders' cities for the group of subsidiary firms.

Table 2: Equity Holding and Credit Growth Statistics

	Mean	Median	SD	Min	Max	No. of Obs.	Data Source
<i>Subsidiary Firms:</i>							
Avg. Credit Growth in Holding Firms' Cities	0.166	0.154	0.173	-0.217	0.606	428,735	ASCIE, CDC
Log (Equity Held by Corporate Shareholders)	6.211	8.007	4.413	0.001	12.19	574,748	ASCIE, SAIC
Equity Shares Held by Corporate Shareholders (%)	57.9	84.3	45.2	0	100	562,682	ASCIE

Notes: This table summarizes additional variables on the equity shareholding and credit growth for the subsidiary firms. Section 3.2 provides a detailed discussion on the measurement of equity shareholdings. The construction of credit growth is available in section 4.1.

4.1 Baseline Specification and Results

Our baseline specification (1) is designed to study if subsidiary firms respond to credit supply shocks to its parent companies located in other cities:

$$Y_{it} = \alpha_{ct} + \theta_i + \gamma \text{CreditGrowth}_{pt} + \kappa' X_{it} + \epsilon_{it}, \quad (1)$$

We define the average local credit growth that is exposed to shareholders as follows:

$$\text{CreditGrowth}_{pt} = \log\left(\sum_{j \in H_{i0}, c(j) \neq c} \text{LoanVolume}_{c(j),t}\right) - \log\left(\sum_{j \in H_{i0}, c(j) \neq c} \text{LoanVolume}_{c(j),t-1}\right) \quad (2)$$

where H_{i0} is the set of firms holding equity shares of firm i at the beginning of the sample period¹², and $c(j)$ is the home city of j . c is the home city of subsidiary i . $\text{LoanVolume}_{c(j),t}$ is the total value of the outstanding loans in city $c(j)$ at the end

¹²We use the network in the beginning of the sample period to avoid the concern of an endogenous business-group network.

of year t . We include in firm fixed effect θ_i to control for firm heterogeneity, and city cross year fixed effect α_{ct} to capture any local credit market and macroeconomic shocks. Other controls, X_{it} , include firm ownership and age fixed effects, one-year lagged firm size dummy, one-year lagged debt-to-asset ratio, and two-digit industry cross year fixed effect.

We use the baseline specification to study the effect of shareholders' local credit supply shocks on subsidiaries. The left-hand-side variables of interests include investment, R&D expenditure, profit margin, leverage ratio, and the growth rate of total debt outstanding. A positive γ_1 implies that when shareholders experience a positive local credit growth, subsidiaries located in other cities increase their investment or other relevant measures in response.

Table 3 reports our baseline results. Column (1) indicates that controlling for local credit market dynamics, an average 16.7% annual total credit growth in shareholders' cities would lead to subsidiaries spending an additional 1% of their fixed asset value on investment. This additional 1% accounts for 71% of the median investment rate and 7% of the average investment rate of all subsidiary firms.

Table 3: The Baseline Results

	(1)	(2)	(3)	(4)	(5)
	Investment	R&D	Profit Margin	Leverage Ratio	Debt Growth
Avg. Credit Growth in Holding Firms' Cities	0.0619***	0.0144	-0.0061*	0.0366	0.872
	(0.014)	(0.012)	(0.003)	(0.023)	(0.841)
Number of Observations	1,379,261	1,015,249	1,535,540	1,528,291	1,516,490
City \times Year FE	YES	YES	YES	YES	YES
2-digit Industry \times Year FE	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Firm-level Controls	YES	YES	YES	YES	YES

Notes: This table presents how holding firms pass credit supply shocks to subsidiary firms. Holding firms' cities credit growth is computed as the weighted average of the growth rate of total bank loans. Column (1) to column (5) reports the baseline estimates of the effect of credit growth shocks to parent companies on subsidiary firms' investment, R&D expenditure, profit-to-sales ratio, leverage ratio, and the growth rate of external debt. Firm-level controls include firm size, ownership, and age fixed effects; one-year lagged debt-to-asset ratio, and one-year lagged net profit margin. All specifications include city cross year fixed effects, 2-digit industry cross year fixed effects, and firm fixed effects. The standard error clustered at firm level are reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

In the baseline, we weight each shareholder by the size of the local credit market (equation 2) to avoid large impacts from extreme credit market fluctuations in small cities. Table 4 shows the effect of shareholders' local credit growth shock on subsidiary investment using different shareholder weights. Column (2) adjusts the baseline weights using the size of each parent company relative to the size of an average firm in their city (in terms of initial registered capital¹³), taking into account the relative importance of the shareholder in their local credit market. Column (3) and (4) ignore the differences in local credit markets but weight each shareholder by their relative cash-flow rights and by an equal weight, respectively. These estimates using alternative shareholder

¹³We do not use the value of total asset here because it is not provided in SAIC, and thus not available for firms below a certain scale.

weights are still positive and significant and statistically indifferent from our baseline estimate, indicating a positive outcome in subsidiary investment following credit supply shocks to shareholders.

Table 4: Alternative Shareholder Weights

	(1)	(2)	(3)	(4)
	Baseline	Size-adjusted Weights	Cash-flow Rights Weights	Simple Average
Avg. Credit Growth in Holding Firms' Cities	0.0619***	0.0710***	0.0755***	0.0570***
	(0.014)	(0.0167)	(0.021)	(0.0163)
Number of Observations	1,314,458	1,314,458	1,314,458	1,314,458
City \times Year FE	YES	YES	YES	YES
2-digit Industry \times Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Firm-level Controls	YES	YES	YES	YES

Notes: This table presents estimates of holding firms passing credit supply shocks to subsidiary firms using different shareholder weights. Holding firms' cities credit growth is computed as the average growth rate of total bank loans, weighted by the size of local credit market, the size of local credit market multiplied by firm total asset value relative to city average, shareholders' cashflow rights, and an equal weight in column (1) to column (4). Firm-level controls include firm size, ownership, and age fixed effects; one-year lagged debt-to-asset ratio, and one-year lagged net profit margin. All specifications include city cross year fixed effects, 2-digit industry cross year fixed effects, and firm fixed effects. The standard error clustered at firm level are reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

Besides investment, we also study the impact on subsidiary firms' R&D expenditure, profit margin, leverage, and the total amount of outstanding debt. Subsidiary firms' average profit margin declines slightly following a positive credit supply shock to their parent companies. This could be explained by a similar rationale in Caballero and Hammour (1994): when the external condition improves¹⁴, subsidiary firms tend to

¹⁴This explanation would have effects either when parent companies pose a positive demand shock to subsidiary firms or when they lower the cost of finance of subsidiary firms. We distinguish the specific mechanism in section 4.4.

slowdown the destruction of outdated projects and thus results in a lower profit margin on average.

Other variables of our interests were not affected by the credit market conditions in holding firms' cities. R&D expenditure on average are not as sensitive to external financing conditions as investments (table 3 column (3)) and subsidiary firms' bank financing are not affected by shocks to their parent companies (table 3 column (4) and (5)). Compared to capital investment, R&D is smoother over time and more likely to create intangible assets, and thus is more dependent on internal financing (Hall and Lerner, 2010). In our sample, less than 10% of the firms have ever actively been involved in R&D activities. It is then not surprising that credit supply shocks to parent companies on average have insignificant impacts on the R&D expenditures of subsidiary firms. Column (4) and (5) of table 3 indicate that subsidiary firm's bank financing condition is not affected by shocks to their parent companies in other cities. This outcome implies that the significant impact on investment in column (1) of table 3 is not driven by subsidiary firms having a more relaxed borrowing constraint in the banking sector.

The baseline specification controls for city cross year fixed effects and 2-digit industry cross year fixed effects, which already eliminates any local economic shocks to the subsidiary firms and takes into account industry-specific patterns of development. The remaining critical challenge to our identification is that subsidiaries and shareholders may not be paired randomly across cities: two cities with more synergies may have more firms investing in each other. In such case, parent companies' and the subsidiary firms' cities may have positively correlated local credit demand. If such a correlation is due to similar industry layouts in these cities, our 2-digit industry cross year fixed effects can deal with it. For other possibilities, we construct a Bartik-type instrument and estimate the effect using an instrumental variable approach. Section 4.2 discusses in more details the instrument for local credit supply shocks and the estimation results. Another concern is that other types of networks, such as the production network, could also overlap with the business-group network. It is more of a challenge to interpreting the estimates in Table 3 rather than to the identification itself. To deal with this concern, we add other types of networks in our baseline specification and discuss the estimation in section 4.3. For the rest of the empirical analysis, we focus only on the investment of subsidiary firms.

4.2 Instrument for Local Credit Supply

In this section, we deal with the first challenge - the possibly correlated credit demand across cities - using an instrumental variables approach. As discussed in section 3.1, our baseline specification is valid as long as local bank credit growth does not depend on credit demand in other cities. To further mitigate the identification challenge, we construct a Bartik (shift-share) instrument Z_{pt} for local credit growth $CreditGrowth_{pt}$ using bank branch information from CBRC:

$$Z_{pt} = \sum_{j \in H_{i_0}, c(j) \neq c} \frac{\sum_b B_{b,c(j),t-3}}{\sum_{c(j) \neq c} \sum_b B_{b,c(j),t-3}} gBranch_{c(j),t},$$

where $B_{b,c,t}$ is the total number of branches of bank b in city c at time t , H_{i_0} is the set of firms holding equity shares of firm i at the beginning of the sample period, and $c(j)$ is the home city of j . $gBranch_{c(j),t}$ is the projected growth rate of the total number of bank branches in city $c(j)$ at time t (defined below), and $\frac{\sum_b B_{b,c(j),t-3}}{\sum_{c(j)} \sum_b B_{b,c(j),t-3}}$ is the weight of city $c(j)$ among all parent companies' cities, which is the number of bank branches in city $c(j)$ relative to the total number of branches in all parent companies' cities. $gBranch_{c(j),t}$ is defined as:

$$gBranch_{c(j),t} = \sum_b \frac{B_{b,c(j),t-3}}{\sum_b B_{b,c(j),t-3}} \cdot \frac{\sum_{c' \neq c(j)} (B_{b,c',t} - B_{b,c',t-1})}{\sum_{c' \neq c(j)} B_{b,c',t-1}}.$$

We use time $t - 3$ to compute the share of bank branches to mitigate the concern of endogenous initial conditions. Branches of policy banks and trusts are excluded to ensure the relevance of the instrument. Finally, we drop cities that only have one bank branch, which leaves us with a sample of 249,785 firm-year observations. The first-stage and second-stage results are summarized in Table 5:

Table 5: The Instrumental Variables Approach

	(1)	(2)	(3)	(4)
	First Stage	Second Stage		
	Avg. Credit Growth of Hol. Firms' Cities	Investment	Leverage Ratio	Debt Growth
Branch Bartik IV	1.643*** (0.019)			
F-Value	1.2e+04			
Avg. Credit Growth in Hol. Firms' Cities		0.258** (0.102)	-0.017 (0.015)	0.017 (0.053)
Number of Observations	249,785	249,785	285,555	284,536
City \times Year FE	YES	YES	YES	YES
2-digit Industry \times Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Firm-level Controls	YES	YES	YES	YES

Notes: This table presents the results of the instrumental variables approach. Column (1) reports the first-stage outcome that the Bartik IV constructed based on bank branch formation can significantly predict local credit growth. Column (2) to column (4) reports the IV estimates of the effect of credit supply shocks to parent companies on subsidiary firms' investment, leverage ratio, and the growth rate of external debt. Firm-level controls include firm size, ownership, and age fixed effects; one-year lagged debt-to-asset ratio, and one-year lagged net profit margin. All specifications include city cross year fixed effects, 2-digit industry cross year fixed effects, and firm fixed effects. The standard error clustered at firm level are reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

The estimated effect of credit supply shocks to the shareholders on subsidiary firms is four times larger compared to the baseline estimates. For an average 16.7% annual growth of total credit in shareholders' cities, a subsidiary firm is expected to invest 4.3% more of their fixed asset value, which is 29% of the average investment rate among all subsidiary firms. There are two possible explanations for the OLS estimate to be downward biased: first, local credit growth of shareholders' cities is a noisy measure of the credit supply shocks, which creates an attenuation bias; second, credit demand in share-

holders' cities and subsidiaries' cities could be either positively or negatively correlated. Column (3) and (4) of table 5 again imply that subsidiary firms' bank financing condition is not affected by the positive credit supply shocks to their shareholders. So the positive and significant impact on subsidiaries' investment is not driven by subsidiary firms having a more relaxed borrowing constraint following the credit supply shocks.

4.3 Other Robustness Tests

Another challenge to our identification strategy is that the connections between shareholders and subsidiaries may overlap with other networks across cities. Even if we establish the causality between credit supply shocks to shareholders and investment of subsidiaries, it may be the result of other business linkages. Therefore in this section, we rule out other explanations by controlling for various possible networks in our robustness tests.

Supply chain linkages and trade credit Clayton and Jorgensen (1999) argue that shareholder-subsidiary relationships are often found between firms along the same supply chain. Therefore, a significant γ may not necessarily imply that holding firms pass along the credit supply shocks to their subsidiary firms, but could be the result of holding firms passing a supply-side shock (a decrease in the cost of capital) or a demand-side shock (an increase in production scale) to the upstream or the downstream. Another reason that the supply chain linkages matter is that firms sometimes rely on trade credit for external financing. If the shareholders and subsidiaries are also trading partners, they can finance each other through trade credit instead of equity transfers.

To control for demand and supply shocks along the supply chain, we compute for each firm the weighted average of upstream and downstream output growth using the approach in Acemoglu, Akcigit, and Kerr (2016) and 2002 China Input-Output Table (3-digit industry level). For the trade credit channel, we add firm account payable and receivables (normalized by the one-year lagged total asset value) as measures of trade credit. Column (1) and (2) in table 6 indicates that controlling for supply chain linkages, local bank credit growth affecting the holding firms still has a positive and significant impact on the subsidiary firms. Compared to the baseline estimate in column (1) of Table 3, the effect is slightly smaller but statistically indifferent. Therefore, supply chain linkages and trade credit are not sufficient to explain our baseline findings.

Geographical network Acemoglu et al. (2016) point out that the geographic overlay of industries (i.e. how industries co-locate in various local labor markets) is also an important type of business network because any industry-to-industry effects can show up in firm-level analysis relying on cross-region variation. They control for the geographic overlay between different industries based on the industry composition in each region. We use a more general approach to directly control for shareholder industry cross subsidiary industry fixed effects and shareholder city cross subsidiary city fixed effects, to take into account any possible industry-to-industry or city-to-city spillover effects.

Column (3) and (4) in table 6 summarizes the results of the robustness test for the geographical network channel.

Table 6: Robustness Tests

	(1)	(2)	(3)	(4)	(5)
	Investment				
Avg. Credit Growth in Holding Firms' Cities	0.0571*** (0.0143)	0.0624*** (0.0143)	0.0413*** (0.0157)	0.0480*** (0.0144)	0.0625*** (0.0144)
Log (Demand from downstream)	0.00213 (0.00212)				
Log (Supply from upstream)	0.00213 (0.00211)				
Account Payable		-0.0992*** (0.00679)			
Account Receivable		-0.986*** (0.0135)			
Number of Observations	1,306,201	1,299,605	1,233,051	1,306,169	1,306,201
Shareholder Ind. × Subsidiary Ind. FE	NO	NO	YES	NO	NO
Shareholder city × Subsidiary city FE	NO	NO	NO	YES	NO
Common Shareholder Dummy	NO	NO	NO	NO	YES
City × Year FE	YES	YES	YES	YES	YES
2-digit Industry × Year FE	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Firm-level Controls	YES	YES	YES	YES	YES

Notes: This table presents additional robustness tests on how holding firms pass credit supply shocks to subsidiary firms. Column (1) and column (2) control for supply and demand shocks along the supply chain and trade credit (normalized by one-year lagged total assets), respectively. Column (3) and (4) include shareholder industry cross subsidiary industry fixed effects and shareholder city cross subsidiary city fixed effects, respectively, to control any industry-to-industry or city-to-city spillover effects. Firm-level controls include firm size, ownership, and age fixed effects; one-year lagged debt-to-asset ratio, and one-year lagged net profit margin. All specifications include city cross year fixed effects, 2-digit industry cross year fixed effects, and firm fixed effects. The standard error clustered at firm level are reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

4.4 The Equity Transfer Channel

In the last section of the empirical analysis, we argue that a significant channel for reallocating capital from shareholders to subsidiaries following a positive credit supply shock to the shareholders is through equity investments. For example, a holding firm can purchase additional equity stakes of its subsidiaries as way to pass along cash to subsidiaries (Almeida et al., 2015). Compared to commercial banks, the holding firms are typically more inclined to finance subsidiaries due to an information advantage or additional shareholder benefits (Stein, 1997). When facing good investment opportunities or positive credit market shocks, holding firms would increase external borrowing and finance subsidiaries through the internal capital markets (Shin and Zhao, 2013; Manova et al., 2015).

To show that holding firms reallocate capital to subsidiaries through equity transfers, we repeat the baseline and IV analyses but replacing the left-hand side variable with the total equity shares held by corporate shareholders. Intuitively, subsidiaries transfer or issue new equity stakes to holding firms in exchange for more cash. Therefore, the coefficient of our interest is expected to positive and significant, indicating that the total equity shares held by corporate shareholders increases following a positive credit supply shock to the shareholders. The results of the analyses are summarized in table 7. 0.5% additional equity shares are sold by the subsidiaries to their shareholders following an average 16.7% credit growth in shareholders' cities, which is worth of 2.5 millions RMB based on the average book value of subsidiary firms in our sample.

Table 7: Equity Transfer in Response to Credit Supply Shocks

	(1)	(2)
	OLS	IV
	Equity Shares Held by Corporate Shareholders (%)	
Avg. Credit Growth in Holding Firms' Cities	3.380*** (0.084)	10.070*** (0.127)
Number of Observations	748,829	379,261
City \times Year FE	YES	YES
2-digit Industry \times Year FE	YES	YES
Firm FE	YES	YES
Firm-level Controls	YES	YES

Notes: This table presents how holding firms exchange equity shares with subsidiary firms following a positive credit supply shock. Holding firms' cities credit growth is computed as the weighted average of the growth rate of total bank loans. Column (1) and column (2) reports the OLS and IV estimates, respectively. Firm-level controls include firm size, ownership, and age fixed effects; one-year lagged debt-to-asset ratio, and one-year lagged net profit margin. All specifications include city cross year fixed effects, 2-digit industry cross year fixed effects, and firm fixed effects. The standard error clustered at firm level are reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

A direct implication based on the internal capital market theory (Stein, 1997) is that we should expect a larger effect from shareholders who benefit more from subsidiaries' successes or shareholders who themselves are less financially constrained. To test for such implication, we compare the effects of credit supply shocks to SOE and non-SOE shareholders, as well as controlling and non-controlling shareholders. Table 8 shows that under different weights, a positive credit supply shock to non-SOE shareholders lead to a positive response in subsidiary investment, while the same credit supply shocks to SOE shareholders have insignificant impacts. Similarly, table 9 implies that a positive credit shock to controlling shareholders increases the investment of subsidiary firms; while the same shock to non-controlling shareholders generates a positive yet insignificant effect.

Table 8: SOE versus Non-SOE Shareholders

	(1)	(2)	(3)	(4)
	Baseline	Size-adjusted Weights	Cash-flow Rights Weights	Simple Average
Avg. Credit Growth in SOE Holding Firms' Cities	-0.0638 (0.0532)	-0.0119 (0.0741)	-0.0870 (0.0768)	-0.0602 (0.0650)
Avg. Credit Growth in Non-SOE Holding Firms' Cities	0.0664*** (0.0191)	0.108*** (0.0238)	0.0918*** (0.0255)	0.0739*** (0.020)
Number of Observations	1,314,458	1,314,458	1,314,458	1,314,458
City \times Year FE	YES	YES	YES	YES
2-digit Industry \times Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Firm-level Controls	YES	YES	YES	YES

Notes: This table compares SOE and non-SOE holding firms in passing credit supply shocks to subsidiary firms using different shareholder weights. Holding firms' cities credit growth is computed as the average growth rate of total bank loans, weighted by the size of local credit market, the size of local credit market multiplied by firm total asset value relative to city average, shareholders' cashflow rights, and an equal weight in column (1) to column (4). Firm-level controls include firm size, ownership, and age fixed effects; one-year lagged debt-to-asset ratio, and one-year lagged net profit margin. All specifications include city cross year fixed effects, 2-digit industry cross year fixed effects, and firm fixed effects. The standard error clustered at firm level are reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

Table 9: Controlling versus Non-controlling Shareholders

	(1)	(2)	(3)	(4)
	Baseline	Size-adjusted Weights	Cash-flow Rights Weights	Simple Average
Avg. Credit Growth in Controlling Holding Firms' Cities	0.0917***	0.0800***	0.0791***	0.0923***
	(0.0248)	(0.0246)	(0.0227)	(0.0248)
Avg. Credit Growth in Non-controlling Holding Firms' Cities	0.0329	0.0855	-0.0635	0.0331
	(0.0414)	(0.0557)	(0.0585)	(0.0406)
Number of Observations	1,314,458	1,314,458	1,314,458	1,314,458
City \times Year FE	YES	YES	YES	YES
2-digit Industry \times Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Firm-level Controls	YES	YES	YES	YES

Notes: This table compares controlling and non-controlling holding firms in passing credit supply shocks to subsidiary firms using different shareholder weights. Holding firms' cities credit growth is computed as the average growth rate of total bank loans, weighted by the size of local credit market, the size of local credit market multiplied by firm total asset value relative to city average, shareholders' cashflow rights, and an equal weight in column (1) to column (4). Firm-level controls include firm size, ownership, and age fixed effects; one-year lagged debt-to-asset ratio, and one-year lagged net profit margin. All specifications include city cross year fixed effects, 2-digit industry cross year fixed effects, and firm fixed effects. The standard error clustered at firm level are reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

Another important feature of the internal capital market is that its significance depends on subsidiary firms' financial constraints as well as their investment opportunities (hypothesis 2 and 3 in section §2).

To establish the importance of firm financial constraint, we construct four measures of industry-level financial vulnerability following Manova et al. (2015): the external finance dependence (the Rajan-Zingales measure), the inventory ratio, the tangible

asset ratio and the trade credit ratio. Conceptually, the four measures capture different types of financial vulnerabilities. The external finance dependence is measured as the share of capital expenditure that is not financed by the cash flows in operations, which relates more to long-term investments. The inventory ratio, calculated as the ratio of inventory value over total sales, signals the needs for working capital due to variable cost in the production process. The tangible asset ratio indicates the collateral value of the industry, which is defined as the ratio of fixed asset¹⁵ value to total book value. Finally, the trade credit ratio, computed as the ratio of the change in accounts payable to the change in total assets, is the proxy for average firm access to credit from trading partners.

We extend the baseline specification (1) to study the impacts of firm financial vulnerability on the pass-through of credit supply shocks from shareholders to subsidiaries:

$$Y_{it} = \alpha_{ct} + \theta_i + \gamma_0 \text{CreditGrowth}_{pt} + \gamma_1 \text{CreditGrowth}_{pt} \times \text{FinVul}_s + \kappa' X_{it} + \epsilon_{it}, \quad (3)$$

where FinVul_s equals to 1 if the financial vulnerability measure of industry s ($i \in s$) is above median, and 0 otherwise. We construct the four non-time varying measures at the industry level using CompuStat data for US public firms to avoid endogeneity concerns.

Table 10 summarizes the results. We only include in private firms in our analysis considering that SOEs face atypical constraints on the credit market. Column (1) in the table implies that following an average 16.7% annual growth of total credit in shareholders' cities, subsidiaries in industries with an above-median external finance dependence invest 1.9% more of their fixed asset value compared to subsidiaries in industries with a below-median external finance dependence. The two short-term financial vulnerability measures, the inventory ratio and the trade credit ratio, appear to have insignificant effects on the pass-through of credit supply shocks from shareholders to subsidiary firms (column (2) and column (4) in table 10). The ability to collateralize has limited impact as well (column (3)), complementing our baseline finding (column (4) and (5) of table 3) that the subsidiary firms' bank financing condition is not affected by shocks to their parent companies in other cities.

¹⁵Fixed asset value refers to the value of plant, property and equipment on the balance sheet.

Table 10: Financial Vulnerabilities and the Pass-through of Credit Supply Shocks

	(1)	(2)	(3)	(4)
	Investment			
Avg. Credit Growth in Holding Firms' Cities	0.0463 (0.0371)	0.110*** (0.0316)	0.0994*** (0.0351)	0.107*** (0.0310)
Avg. Credit Growth in Hol. Firms' Cities × High External Finance Dependence	0.116** (0.0493)			
High Inventory Ratio		-0.0149 (0.0542)		
High Tangible Asset Ratio			0.0141 (0.0523)	
High Trade Credit Ratio				-0.00737 (0.0567)
Number of Observations	753,316	753,316	753,316	753,316
City × Year FE	YES	YES	YES	YES
2-digit Industry × Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Firm-level Controls	YES	YES	YES	YES

Notes: This table presents how holding firms pass credit supply shocks to subsidiary firms. Holding firms' cities credit growth is computed as the weighted average of the growth rate of total bank loans. "High" indicates that the financial vulnerability measure of the sector is above median. Column (1) to column (4) reports the effect of credit growth shocks to parent companies on subsidiary firms' investment, conditional on external finance dependence, inventory ratio, tangible asset ratio, and trade credit ratio, respectively. Firm-level controls include firm size, ownership, and age fixed effects; one-year lagged debt-to-asset ratio, one-year lagged net profit margin, and one-year lagged financial vulnerability measures. All specifications include city cross year fixed effects, 2-digit industry cross year fixed effects, and firm fixed effects. The standard error clustered at firm level are reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

For subsidiary firm investment opportunities, we construct four proxies following Giroud and Muller (2015): return on asset (ROA), return on capital (ROC), sales growth, and estimated TFP. The ROA is calculated as the ratio of net profit to one-year lagged total asset value; the ROC is measured as the ratio of net profit to lagged total fixed capital stock, and the sales growth is computed as the annual growth rate of

total revenue. To estimate TFP, we follow the literature (Bertrand and Mullainathan, 2003; Syverson, 2004; Foster, Haltiwanger, and Syverson, 2008; Giroud and Mueller, 2015) to estimate the linear production function at the 2-digit industry level:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_m m_{it} + \beta_k k_{it} + \mu_{it}, \quad (4)$$

where l_{it} , m_{it} , k_{it} represent labor, intermediate input, and capital, respectively. The firm-year TFP estimates is obtained by computing the residual term $\hat{\mu}_{it}$, from production function (4). For robustness, we have also imposed an $AR(1)$ process on productivity μ_{it} and the same results hold.

Next we extend again the baseline specification (1) to study the impacts of firm investment opportunities on the pass-through of credit supply shocks from shareholders to subsidiaries::

$$Y_{it} = \alpha_{ct} + \theta_i + \gamma_0 CreditGrowth_{pt} + \gamma_1 CreditGrowth_{pt} \times InvOpp_{i,t-1} + \kappa' X_{it} + \epsilon_{it}, \quad (5)$$

where $InvOpp_{i,t-1}$ equals to 1 if the investment opportunity measure of firm i at time $t - 1$ is above median, and 0 otherwise.

Table 11 summarizes the results. As expected, the better-performing subsidiary firms make a significantly larger investment following the same credit supply shock to the parent companies.

Table 11: Investment Opportunities and the Pass-through of Credit Supply Shocks

	(1)	(2)	(3)	(4)
	Investment (high external financial dependence firms)			
Avg. Credit Growth in Holding Firms' Cities	0.111** (0.0466)	0.110*** (0.0428)	0.123** (0.0480)	0.0777* (0.0451)
Avg. Credit Growth in Hol. Firms' Cities × High ROA (t-1)	0.097*** (0.0470)			
High ROC (t-1)		0.089*** (0.0506)		
High TFP (t-1)			0.071*** (0.0466)	
High Sales Growth (t-1)				0.064*** (0.0467)
Number of Observations	376,189	376,189	371,944	265,616
City × Year FE	YES	YES	YES	YES
2-digit Industry × Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Firm-level Controls	YES	YES	YES	YES

Notes: This table presents how holding firms pass credit supply shocks to subsidiary firms depending on the investment opportunities of subsidiaries. We focus on the group of firms with above-median external finance dependence for more significance. Holding firms' cities credit growth is computed as the weighted average of the growth rate of total bank loans. "High" indicates that the investment opportunity measure of the firm is above median. Column (1) to column (4) reports the effect of credit growth shocks to parent companies on subsidiary firms' investment, conditional on one-year lagged ROA, ROC, TFP, and sales growth, respectively. Firm-level controls include firm size, ownership, and age fixed effects; one-year lagged debt-to-asset ratio, and one-year lagged investment opportunity measures. All specifications include city cross year fixed effects, 2-digit industry cross year fixed effects, and firm fixed effects. The standard error clustered at firm level are reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

Finally, we divide subsidiary firms into three groups to provide further support to the internal capital market theory: SOEs, domestic private companies, and foreign-invested companies. Compared to the domestic private firms, both SOE subsidiaries and foreign-invested companies should be less financially constrained due better access to non-bank capitals. Table 12 shows that only the domestic private subsidiary firms

positively respond to credit supply shocks to their shareholders, while SOEs and foreign-invested companies are largely unaffected.

Table 12: Heterogeneous Response of Subsidiaries

	(1)	(2)	(3)
	Domestic Private Firms	SOEs	Foreign-invested Companies
Avg. Credit Growth in Holding Firms' Cities	0.0946*** (0.0217)	0.00945 (0.0329)	0.00724 (0.0229)
Number of Observations	970,214	115,653	209,310
City \times Year FE	YES	YES	YES
2-digit Industry \times Year FE	YES	YES	YES
Firm FE	YES	YES	YES
Firm-level Controls	YES	YES	YES

Notes: This table presents how different subsidiary firms respond differently to holding firms' credit supply shocks. Holding firms' cities credit growth is computed as the weighted average of the growth rate of total bank loans. Column (1) to column (5) reports the baseline estimates of the effect of credit growth shocks to parent companies on subsidiary firms' investment for domestic private subsidiaries, SOE subsidiaries, and foreign-invested subsidiaries, respectively. Firm-level controls include firm size, ownership, and age fixed effects; one-year lagged debt-to-asset ratio, and one-year lagged net profit margin. All specifications include city cross year fixed effects, 2-digit industry cross year fixed effects, and firm fixed effects. The standard error clustered at firm level are reported in parentheses.

*** Significant at the 1 percent level

** Significant at the 5 percent level

* Significant at the 10 percent level

The Tunneling effect Last but not least, we make efforts to rule out the tunneling effect from the literature of cross-holding relationships. A large corporate finance literature (Porta and Shleifer, 1999; Claessens et al., 2000; Gopalan et al., 2007; Jiang et al., 2010; Gul et al., 2010) argue that in a cross-holding network, there exists conflicts of interest between voting rights and cash-flow rights. A controlling shareholder may divert the resources from one subsidiary firm with low cash-flow rights to another subsidiary with high cash-flow rights and benefit much more, which creates a distortion in internal investment decisions. The tunneling effect works against our argument if the holding firm and the subsidiary firm have the same controlling shareholder who may have incentive to divert the resources from the holding firm to the subsidiary firm.

To control for the tunneling effect, we create a common shareholder dummy between subsidiaries and their shareholders and add to specification (1). The regression result in column (5) of table 6 shows that the key coefficient of our interest is unchanged after controlling for the common shareholder dummy.

5 Conclusion

In this paper, we document a large network of business groups in which corporate firms hold equity stakes of each other. We show that this network of business groups not only connects different firms in the corporate sector, but also propagates the credit supply shocks from the banking sector more widely to the real economy. The propagation exists as corporate shareholders can transfer capital to subsidiaries through exchanges of subsidiaries' equity stakes. The effect of propagation is more significant when the subsidiaries face higher financial constraints or greater investment opportunities.

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