

# Tiered Intermediation in Business Groups<sup>\*</sup>

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## Abstract

Using business registry data from China, we show that internal capital markets in business groups can play the role of financial intermediary and propagate corporate shareholders' credit supply shocks to their subsidiaries. An average of 10% local bank credit growth where corporate shareholders are located would increase subsidiaries' investment by 0.6% of their tangible fixed asset value, which accounts for 42.5% (4.3%) of the median (average) investment rate among these firms. We argue that equity transfers is one channel through which corporate shareholders transmit bank credit supply shocks to the subsidiaries and provide empirical evidence to support the channel. This financial intermediation is tiered in that it only works from shareholders to subsidiaries, but not vice versa. In theory, we model the business group as a network with heterogeneous financial constraints, investment opportunities, and endogenized firm-to-firm equity financing to explain the channel and match the empirical evidence.

**JEL Classification:** G20, G30

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# 1 Introduction

The direct credit supply channel of financial intermediaries (the bank-lending channel) has been extensively explored as a critical channel linking financial shocks to the real economy (Bernanke [1983], Bernanke and Blinder [1988], Bernanke and Gertler [1995], Khwaja and Mian [2008], Ippolito et al. [2018], Greenstone et al. [2020]). The channel argues that banks usually play a significant role in credit intermediation in economies with less developed financial markets. By adjusting their lending behaviors, banks can pass on aggregate shocks, such as credit supply shocks or monetary policy changes, to the real economy. A missing element in this argument is that less developed external financial markets are often accompanied with more developed internal capital markets. Firms connected either through production or equity-holding linkages (for example, in the form of business groups) would reallocate resources within the network to cope with external financial shocks. Therefore, the impact of financial shocks on the real economy depends not only on the allocation of bank credits to firms, but also on the reallocation of credits within the non-financial corporate sector.

In this paper, we study the internal capital market within business groups and their implications for credit intermediation. A business group is a group of legally independent firms linked through equity ties (Khanna and Yafeh [2007]), and firms within the same business group can make independent financing and investment decisions. We argue both theoretically and empirically the significance of credit channeling from shareholders to subsidiaries within the same business group during an external credit boom. This finding has important implications for understanding the impact of bank lending on the real economy.

In theory, we first present a network model to discuss how internal capital markets within a business group would channel credit when different firms in the group are affected disproportionately by an external credit boom. Our model features a network where firms are connected via equity-holding linkages and have heterogeneous financial constraints and investment opportunities. To distinguish business groups from conglomerates, we assume that financing and investment decisions are decentralized at the firm level, instead of the whole group level, with the objective of maximizing the present value of its shareholders. Each firm can choose from two types of contracts to finance its investment: a bank loan subject to firm-specific borrowing constraints or a firm-to-firm equity transfer contract. Inter-company loans are not considered in our model for two reasons: 1) the regulatory requirement in China (the "General Rules of Loans" issued by the People's Bank of China in 1996) prohibits the issuance of inter-company loans between non-financial corporates; 2) data on inter-company loans is much more scattered compared to equity contracts due to the regulatory requirement. In a more general setup, firms can also opt for inter-company loans for financing. The use of inter-company loans, however, can be associated with additional complications including agency problems between shareholders and subsidiaries, tax differentials, and information asymmetry (Buettner and Wamser [2007], Jiang et al.

[2010], Huang [2019], Qian et al. [2020]). We leave this option out to better match the empirical setting of this paper.

Our model generates several critical testable implications. First, firms would prioritize bank loans over inter-company equity financing and borrow up to their borrowing constraints. This is consistent with the literature of bank lending channel and the pecking order theory. Second, credit transfer through equity contracts is tiered that only pre-existing shareholders would provide equity finance to subsidiaries in the same business group (the "tiered intermediation"). This is because we assume that investors break even from equity contracts, and thus only pre-existing shareholders would gain extra benefit from shareholders' returns. The same result would hold with other assumptions, for example when there is a fixed cost for starting a new equity-holding linkage or when shareholders have relative information advantage on the quality of subsidiaries' projects (see Section 2 for more details). Last but not least, more financially constrained and more productive subsidiaries are likely to get more funding from equity financing within the business group.

Next, we use a novel and comprehensive administrative data set from China to test the theoretical implications from our model. Our data set covers all firms registered in China and their corresponding equity ties. We show that following a positive credit supply shock to the banking sector, parent companies in business groups facilitate channeling bank credit to more financially constrained subsidiaries with higher implied return on capital, which amplifies the impact of a positive shock on the real economy. We further provide robust empirical evidence that the channeling of credit happens in the form of tiered intermediation. That is, within a business group, credit supply shocks can only be propagated from corporate shareholders to subsidiaries but not vice versa or between subsidiaries.

Our empirical analysis begins with documenting a significant fraction of Chinese firms residing in business groups. A business group typically consists of legally independent firms, possibly operating in different sectors and cities. We adopt a broader definition of shareholders in this paper, which includes both majority shareholders ( $> 50\%$  shares) and minority shareholders ( $\leq 50\%$  shares). Unlike public firm disclosure data, the business registry data identifies business groups among all registered firms in China (Allen et al. [2019a]). As of 2017, 16% of the universe of roughly 40 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 assets, and 60% of employment. Shareholders in the groups are much larger compared to subsidiaries or out-of-group firms: the average value of total assets for shareholders, subsidiaries, and out-of-group firms, are 712 million, 512 million, and 134 million RMB, respectively. We also verify that the subsidiary firms outperform the shareholders regarding total factor productivity (TFP) and return on assets (ROA) on average. Nevertheless, they have lower leverage ratios (table 1) and thus would need help from their shareholders.

Next, we provide causal evidence that a positive bank credit supply shock to a corporate shareholder benefits subsidiary firms unexposed to the shock. Our identifi-

cation relies on the geographical diversification of the business-group network and the regional segmentation of China’s banking system. According to the business registry data, 38% of the shareholder-subsidary pairs have the shareholder and subsidiary located in two different municipal cities. The network spans the entire country without following a particular pattern. The regional segmentation of the banking system results from the localized business model of Chinese banks and inefficiency in the interbank market. Local bank branches have substantial decision-making power, and even large commercial banks make lending decisions on a regional basis (Huang et al. 2020). Regulation of the 75% ceiling in loan-to-deposit ratio and limited competition on the repo market further prevent the inter-bank market from smoothing funding gaps across the country (Ruan 2017, Chen et al. 2018, Acharya et al. 2021).

Taking the existing network of business groups as given, we compare subsidiary firms located in the same city, industry, and similar firm characteristics but having their shareholders in other cities experiencing various levels of bank lending growth. Our results suggest that the more local bank credit growth the parent companies experience, the more investment their unaffected subsidiaries make. If subsidiaries’ idiosyncratic credit demand shocks are uncorrelated with credit growth in their parent companies’ cities, such evidence would suggest the transmission of bank credit supply shocks from parent companies to subsidiaries. Finally, we control for city-by-year and industry-by-year fixed effects to control for any city- or industry-specific time-varying factors in the baseline. Thus, the local credit demand and supply of the subsidiaries’ cities and industries are fully absorbed into the time-varying fixed effects.

The validity of our identification hinges on the assumption that subsidiaries’ idiosyncratic credit demand is uncorrelated with credit growth in parent companies’ cities. We also construct a Bartik-type instrument for local bank credit supply shocks similar to Greenstone et al. 2020 to mitigate concerns on this identifying assumption. We use the expansion of commercial banks at the national level, triggered by the bank deregulation, as a proxy for aggregate bank credit supply, which should not be affected by the local credit demands of individual cities. A commercial bank that expanded fast in China is considered more ambitious in providing new credits to firms. If this bank had also controlled a significant fraction of the credit market in a given city before its expansion, the city would have experienced a more substantial positive credit supply shock. The estimates using this Bartik-type instrument support our hypothesis that corporate shareholders pass along a positive credit supply shock from banks to their subsidiaries.

Another challenge is that other networks, such as input-output networks (Alfaro et al. 2019, Adelino et al. 2023), may overlap with equity ties. We control for other networks in additional robustness tests to handle this challenge. The controls include estimates of upstream supply shocks and downstream demand shocks as proxies for supply chain linkages; trade credit measures (accounts payable and receivable) as proxies for credit from trading partners; shareholder industry by subsidiary industry fixed effects, and shareholder city by subsidiary city fixed effects to control for any

geographical or industrial overlays; and a common shareholder dummy to control for the tunneling effects.

To further mitigate the concern that input-output linkages drive our results, we only include shareholder-subsidiary pairs with no link in the input-output network. Our results remain robust.

The effectiveness of tiered credit intermediation in business groups depends on two elements - subsidiary firms' financial constraints and investment opportunities. We construct various proxies for firms' financial constraints and investment opportunities following [Manova et al. \[2015\]](#), [Giroud and Mueller \[2015\]](#). Our findings indicate that subsidiary firms with more substantial long-term external financial constraints, proxied by the Rajan-Zingales measure ([Rajan and Zingales \[1998\]](#)), tend to invest more following a positive credit supply shock to their shareholders. In contrast, the short-term liquidity constraints, as indicated by the inventory ratio, the trade credit ratio, and the tangible asset ratio, 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.

We do not observe significant reverse credit intermediation from subsidiaries to parent companies nor horizontal intermediation among subsidiaries in the same business group. The finding suggests that the parent company is the only one playing the role of a financial intermediary in a business group.

Last but not least, in terms of the crucial intermediation mechanism, we show that active equity transfers between parent companies and subsidiaries are the other side of credit intermediation flows within business groups<sup>1</sup>. We establish this channel using the same identification strategy but replace 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 increase following a positive credit supply shock to these shareholders. This is the smoking gun.

This paper relates to several lines of work. The most important is the internal capital market and its interaction with external finance. Two forms of internal capital markets have been widely studied. The first is the internal capital market in a conglomerate (more prevalent in the United States) which refers to a company operating multiple divisions. In a conglomerate, investment and finance decisions are usually in the hands of headquarters ([Stein \[1997\]](#), [Rajan et al. \[2000\]](#), [Zingales \[2000\]](#), [Scharfstein and Stein \[2000\]](#), [Matvos and Seru \[2014\]](#), [Busenbark et al. \[2017\]](#), [Matvos et al. \[2018\]](#), [Min Dai \[2022\]](#)). The second is the internal capital market in a business group, which is a set of legally independent firms linked to each other through equity ties ([Khanna and Yafeh \[2007\]](#), [Almeida et al. \[2015\]](#)). Despite the many theories dis-

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<sup>1</sup>In the case of China, article 20 of “The Lending General Provision of PBOC” regulates companies not to use bank loans to engage in equity investments when applying for a bank loan. Nevertheless, money is fungible. Parent companies can still use bank loans to finance ongoing projects and then finance their subsidiaries with retained earnings or other cashflow incomes. Therefore, we do not consider the channel documented in the paper violating the PBOC requirement.

cussing the internal capital market in conglomerates, few explicitly explore the case of business groups. Empirical works on business groups usually either implicitly assume that capital allocation in business groups is the same as in conglomerates (Khanna and Yafeh [2007], Kabbach-de Castro et al. [2022]), or focus on vertical equity-holding linkages (equity pyramids) and examine the tunneling effect (Johnson et al. [2000], Almeida and Wolfenzon [2006], Aminadav and Papaioannou [2020]). They simplify the equity-holding ties as vertically-controlled equity pyramids and argue that the capital can be reallocated between firms in a business group similar to that between divisions in a conglomerate by a centralized decision maker despite their fundamental differences. For example, one key implication of the centralized decision is the reallocation between members, which is inconsistent with our tiered intermediation findings.

We make several contributions to the internal capital market literature. First, following the recent trend of using the network approach to model equity ties (Allen et al. [2019a], Vohra et al. [2020], Ederer and Pellegrino [2022]), our paper presents an equity network to formalize the discussion of credit channeling within business groups, in contrast with simplifying the business group as a centralized decision maker with a pyramid structure. We show that parent companies with looser financial constraints could intermediate banking sector credit to the more constrained subsidiaries, facilitating the channeling of credit during a credit boom. This finding also provides important implications for the role of the internal capital market during credit booms, which has yet to be extensively studied in the literature. Previous research usually focused on events of adverse financial shocks, such as external credit contractions amid financial crises (Buchuk et al. [2014], Matvos and Seru [2014], Almeida et al. [2015], Kuppuswamy and Villalonga [2016], Santioni et al. [2020]). To our knowledge, this paper is among the first ones to document the asymmetric role of internal capital markets on the real-economy impact of financial shocks.

Second, we show empirically that credit channeling is tiered. During the credit boom, it only works from parent companies to subsidiaries rather than vice versa or from subsidiaries to subsidiaries. The observed tiered intermediation is consistent with our model predictions but different from credit allocation between segments within conglomerates (Stein [1997], Matvos and Seru [2014], Busenbark et al. [2017], Matvos et al. [2018]), or credit reallocation between subsidiaries within business groups during a crisis (Almeida et al. [2015], Santioni et al. [2020]). Finally, the data we use for this paper includes a large number of private firms, which allows us to examine credit allocation within business groups beyond the scope of publicly listed firms, which was a main caveat in most previous studies (Ewens and Farre-Mensa [2022]).

The paper complements the literature studying the financing of SMEs. Small and medium-sized enterprises, often with features such as highly volatile returns, asymmetric information, and a lack of collateral, tend to have poor access to debt financing (Carpenter and Petersen [2002]). Banks do lend to SMEs sometimes, but

many require a lengthy period of relationship building (Peterson and Rajan [1994]), and it can be sensitive to bank liquidity shocks and credit cycles (Khwaja and Mian [2008], Greenstone et al. [2020]). SMEs rely more on other forms of non-bank financing, including inter-company lending (Canales and Nanda [2012]), trade credit (Carbo-Valverde et al. [2016]), and informal finance through social networks and industrial clusters (Long and Zhang [2011], Banerjee et al. [2013]). The arguments mentioned above suggest that the credit channel of monetary easing, which traditionally works through the banking sector, is challenging to reach SMEs during crises. We contribute to the literature by showing that large non-financial corporates pass bank credit to their smaller subsidiaries, thus overcoming various shortcomings of direct bank lending to SMEs.

Our paper also contributes to the recent rising discussion on shadow banking activities in China. Shadow banking involves financing activities that are not subject to regulatory oversight and has been attributed to playing a pivotal role in financing rising private sectors in China (Allen et al. [2005], Chen et al. [2018, 2020], Amstad et al. [2020]). Chen et al. [2018] document a rapid rise in shadow banking activities in terms of entrusted loan during 2009-2015 and justify that contractionary monetary policy in that period caused the rising shadow bank loans. Allen et al. [2019b] argue that most of the entrusted loans by listed companies are affiliated loans between parents and subsidiaries or suppliers and customs. Our paper contributes to this discussion in three-fold. First, the entrusted-loan activities boomed only after 2009 as a response to a series of tightening monetary policies, and the scale was tiny before 2008 (Chen et al. [2018]). There needs to be more knowledge on the financing activities among non-financial firms before the global financial crisis, which is the period studied in our paper. Second, unlike the inter-company lending channel, we document that the equity-transfer channel is vital for credit transfer among non-financial firms in our sample 2001-2008, facilitated by the equity shareholding relationship. Third, we show that inter-company financing could effectively channel bank credit to the needed enterprises.

The rest of this paper is organized as follows: In section 2, we develop a general equilibrium model to facilitate our mechanism. Section 3 describes the identification strategy and provides a detailed overview of our innovative data sets. In section 4, we present our empirical findings. Finally, section 5 concludes the paper.

## 2 Model

### 2.1 Setup

This section presents a model with heterogeneous financial constraints and investment opportunities for firms within the business group. We model the business group as an equity-holding network where firms are linked via equity-holding. Each firm has autonomous external financial access (to bank loans) and can finance its investment

projects through an equity financing contract with other firms. For simplicity, we assume in our model that there are no debt contracts between firms. This is partly due to the lack of data availability on inter-company loans and partly due to the regulatory requirement in China (the "General Rules of Loans" issued by the People's Bank of China in 1996) that prohibits the issuance of inter-company loans between non-financial corporates. The setup of this model can be linked to our empirical analysis focusing on business groups, as a business group is a particular form of equity-holding network (Khanna and Yafeh [2007]). Our model can also take into account firms out of the business group as we distinguish within-group and out-of-group firms based on the equity ties (see more details later). Using a network approach to model equity ties between legally independent firms has been burgeoning recently (Allen et al. [2019a], Vohra et al. [2020], Ederer and Pellegrino [2022]). Our model has a similar setup to the ones in Elliott et al. [2014], Vohra et al. [2020], where they examine the failure transmission in the context of equity-holding networks.

Although formal debt contracts between firms are not allowed by regulations in China, trade credit can be viewed as an informal loan between firms issued to customers by suppliers. We do not model trade credit between firms since it is primarily short-term and often used for cash or liquidity management (Petersen and Rajan [1997], Tirole [2010], D'Mello and Toscano [2020], Adelino et al. [2023]). Recently, Adelino et al. [2023] document that the supplier-customer links, through trade credit, can redistribute the benefits of the bond repurchase initiated by European Central Banks to small firms who can not directly access the bond market. To mitigate the concern that the trade credit drives our results empirically, we directly control for the change in firms' accounts payable and receivable. Besides, as a robustness check, we restrict our samples to the investor-investee pairs without supplier-customer relationships to exclude any concerns driven by trade credit. Our results are robust to various setups in coefficients and standard deviations.

The model considers an economy consisting of  $N$  firms, denoted as  $[N] = \{1, 2, \dots, N\}$ , and two periods  $t = 0, 1$ . At period 0, each firm in  $[N]$  holds two kinds of assets: equity shares of other firms and real fixed assets such as machinery and equipment. Denote  $C_{ij}$  as the equity shares of firm  $j$  held by firm  $i$ <sup>2</sup>, and  $\mathbf{C}$  as the matrix representing the equity-holding network. Let  $\hat{C}_j = 1 - \sum_i C_{ij}$  be the number of equity shares of firm  $j$  held by "outside shareholders" who are not in the network  $[N]$ , such as individuals or the state. Specifically, denote  $k_i$  as the capital stock of a firm  $i$ . At period 1, firm  $i$  can make an investment  $I_i$  with a convex adjustment cost  $\phi(I_i/k_i)$  with  $\phi(0) = 0, \phi'(0) = 0$  and  $\phi''(\cdot) > 0$  (Cochrane [1996], Cooper and Haltiwanger [2006]). The cash flow generated by the investment is  $A_i I_i$ , where  $A_i$  is to capture the heterogeneous return of the investment.

Besides the matrix representation, the network can be represented by a directed graph. In the graph, a firm can be represented as a vertice, and the edge between the corresponding vertices can represent the equity tie between two firms. A business

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<sup>2</sup>By definition,  $C_{ii} = 0$

group can be interpreted as a set of firms whose members are connected via equity ties directly or indirectly in the graph but not connected to others out of the group. We can generally partition the graph into a finite number of disjoint sub-graphs. Each sub-graph represents a business group, and an isolated vertice represents an isolated firm that has no equity ties with other firms. Thus, our network approach can well incorporate all business groups and isolated firms in the same framework.

### 2.1.1 Bank Loan

To finance its investment,  $I_i$ , one option available to firm  $i$  is to borrow from a bank. A bank loan charges an interest rate of  $r$  with an upper limit of  $\lambda_i k_i$ , where  $\lambda_i \geq 0$  captures the degree of external financial constraint for firm  $i$ . The lower the  $\lambda_i$  is, the tighter the financial constraint is. Denote  $I_i^B$  as the total amount of the bank loan of firm  $i$ . Firms can also deposit their funds into the banks with a return rate of  $r$ . For simplicity, we assume  $A_i > r$  for all firms. Thus, all firms would have a positive demand for bank credit.

### 2.1.2 Equity Finance

Alternatively, firm  $i$  also can finance its investment projects from other firms via equity. We assume it could only be done via negotiated equity transfers with other firms. We assume away the inter-firm debt contracts since inter-firm loans are prohibited in China for non-financial firms. Denote  $I_{ij}^E$  as the funding provided by firm  $j$  to firm  $i$  and  $s_{ji}V_i$  as the corresponding equity shares transferred from  $i$  to  $j$ . A one-time lump-sum cost  $f_0$  and  $f_1$  must be paid by  $i$  and  $j$ , respectively, if  $i$  and  $j$  sign an equity-financing contract. Formally, we denote the equity financing contract as a tuple  $(I_{ij}^E, s_{ji}V_i)$ . The allocation of excess profits from the investment projects can be modeled as a Nash Bargaining with a surplus split between  $i$  and  $j$ , say,  $\beta$  to  $i$  and  $1 - \beta$  to  $j$ . To simplify our analysis, we assume that the investee  $i$  obtains all the surplus and the investor  $j$  breaks even from this new financing. Thus,

$$s_{ji}V_i = f_1 + rI_{ij}^E, \text{ if } I_{ij}^E > 0 \quad (1)$$

There are two things worth mentioning. First, the zero surpluses to the investor simplify our analysis significantly, as shown later. For example, one implication of this simplification is that the equity-financing contract only exists between firms in the same business group in equilibrium. Second, we assume away the information asymmetry on the quality of the projects between the incumbent and potential investors. Suppose incumbent shareholders have a relative information advantage on the quality of the projects. In that case, our main findings will be further strengthened since the existing shareholders would be more incentivized to finance their subsidiary's project.

### 2.1.3 Firm's Value

Denote  $x_i$  as the net profits from production using physical capital  $I_i + k_i$ , where  $I_i$  is the new investment and  $k_i$  refers to existing capital stock.  $I_i^E = \sum_j I_{ij}^E$  is the total amount of funding obtained from equity financing from all other firms, and  $I_i^B$  is the funding provided by the bank loan. The production revenue  $x_i$  can be written as:

$$x_i = -k_i \phi_i \left( \frac{I_i}{k_i} \right) + A_i (k_i + I_i) - r I_i^B - \sum_{j \in [N]} [f_0 \chi(I_{ij}^E > 0) + s_{ji} V_i] + \sum_{k \in [N]} [-f_1 \chi(I_{ki}^E > 0) + s_{ik} V_k]. \quad (2)$$

Here,  $-k_i \phi(I_i/k_i)$  is the convex adjustment cost of the investment;  $A_i(k_i + I_i)$  is revenue from production,  $A_i$  is the investment return<sup>3</sup>;  $-r I_i^B$  is the interest payment associated with the bank loan;  $\chi(\cdot)$  is an indicator function that takes the value of 1 when the condition in the bracket holds and 0 otherwise;  $[f_0 \chi(I_{ij}^E > 0) + s_{ji} V_i]$  is the cost paid by  $i$  associated with an equity financing from  $j$ ;  $\sum_{j \in [N]} [f_0 \chi(I_{ij}^E > 0) + s_{ji} V_i]$  is the total payment used for obtaining equity funding from other firms;  $[-f_1 \chi(I_{ki}^E > 0) + s_{ik} V_k]$  is the payoff if  $i$  helps finance  $k$ 's investment via equity transfers, and  $\sum_k [-f_1 \chi(I_{ki}^E > 0) + s_{ik} V_k]$  is the total payoff from financing other firms' investment.

Given that the investor obtains zero surpluses in our setup, then  $s_{ji} V_i = f_1 + r I_{ij}^E$  if  $I_{ij}^E > 0$ , and  $s_{ik} V_k = f_1 + r I_{ki}^E$  if  $I_{ki}^E > 0$ . The net profits  $x_i$  can be written as

$$x_i = -k_i \phi_i \left( \frac{I_i}{k_i} \right) + A_i (k_i + I_i) - r I_i^B - \sum_{j \in [N]} [(f_0 + f_1) \chi(I_{ij}^E > 0) + r I_{ij}^E] + r \sum_{k \in [N]} I_{ki}^E, \quad (3)$$

subject to the budget constraint

$$I_i + \sum_k I_{ki}^E + \sum_j (f_0 + f_1) \chi(I_{ij}^E > 0) \leq I_i^B + I_i^E \quad (4)$$

and the external financial constraint

$$I_i^B \leq \lambda_i k_i \quad (5)$$

Here, the budget constraint (4) implies that the funding from both the bank loan and the equity financing can be fungibly used for either physical capital investment, or equity investment in other firms, or fixed costs paid in the equity financing.

Let  $V_i$  be the value of firm  $i$ . Denote  $\mathbf{V} = (V_1, V_2, \dots, V_N)'$  and  $\mathbf{x} = (x_1, x_2, \dots, x_N)'$ . Firm  $i$ 's value can be written as

$$V_i = \sum_j C_{ij} V_j + x_i \quad (6)$$

where  $\sum_j C_{ij} V_j$  is the value due to holding other firms and  $x_i$  is the net profits from  $i$ 's production.

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<sup>3</sup>Assuming different  $A_i$ 's across firms implies that there is heterogeneous returns on investments. In some literature, this is also equivalent to assuming heterogeneous productivity across firms.

ASSUMPTION 2.1 We assume that  $(\mathbf{I} - \mathbf{C})$  is invertible and denote  $\mathbf{D} = (\mathbf{I} - \mathbf{C})^{-1}$  with the  $(i, j)$ th element in the matrix as  $d_{ij}$ .

Here,  $d_{ij}$  indicates the total equity shares of  $j$  that are held by  $i$  both directly and indirectly (via other firms in the business group. [Vohra et al. \[2020\]](#) discusses in details possible conditions under which the invertability assumption holds. One possibility is that when the network is acyclic, which implies that there is no cross-holding (two firms holding each other's equity shares). In the case of China, [Allen et al. \[2019a\]](#) verify that cross-holding is very rare using the administrative database on companies' shareholder information. Therefore, we consider assumption [2.1](#) as an appropriate assumption in our case and that  $d_{ij}$  is well defined.

PROPOSITION 2.1 Under assumption [2.1](#),  $d_{ij} = \delta_{ij} + C_{ij} + \sum_k C_{ik}C_{kj} + \sum_{k,l} C_{ik}C_{kl}C_{lj} + \dots$  Besides,

$$V_i = \sum_{j \in [N]} d_{ij} x_j \quad (7)$$

with  $\delta_{ij} = 1$  if  $i = j$  and 0 otherwise.

## 2.2 Equilibrium

Denote  $\Theta = \{I_i, I_i^B, I_{ij}^E, i, j \in [N]\}$ , and  $\Theta/\theta$  as the set of variables in  $\Theta$  excluding  $\theta$ . For the simplicity of notation, we write  $V_i(\Theta)$  to indicate the dependence of  $V_i$  on  $\Theta$  and  $V_i(\theta, \Theta/\theta)$  to emphasize the dependence of  $V_i$  on  $\theta$ .

DEFINITION 2.1 An equilibrium is a profile  $\hat{\Theta} = \{\hat{I}_i, \hat{I}_i^B, \hat{I}_{ij}^E, i, j \in [N]\}$  such that,

1. Given  $\hat{\Theta}/I_{ij}^E, \hat{I}_{ij}^E$  is solved to maximize  $V_i + V_j$  subject to constraints [4](#) and [5](#) for both  $i$  and  $j$  where variables  $\Theta/I_{ij}^E$  are evaluated at the equilibrium and participation constraints for  $i$  and  $j$ , i.e.

$$V_i(\hat{I}_{ij}, \hat{\Theta}/I_{ij}) \geq V_i(0, \hat{\Theta}/I_{ij}), V_j(\hat{I}_{ij}, \hat{\Theta}/I_{ij}) \geq V_j(0, \hat{\Theta}/I_{ij})$$

2. Given  $\hat{\Theta}/\{\hat{I}_i^B, \hat{I}_i\}$ , firm  $i$  chooses  $\hat{I}_i^B, \hat{I}_i$  to maximize  $V_i$  (equivalently  $x_i$ ) subject to constraints [4](#) and [5](#).

DEFINITION 2.2 We define  $\lambda_i^*$  such that  $\phi'(\lambda_i^*) = A_i - r$  and

$$I_i^* \in \operatorname{argmax}_{I_i} -k_i \phi\left(\frac{I_i}{k_i}\right) + A_i(k_i + I_i) - rI_i, \quad (8)$$

where  $\lambda_i^* = I_i^*/k_i$  is the optimal investment rate of firm  $i$  without any financial constraints under the rate  $r$ . Obviously,  $I_i^* > 0$  since  $A_i > r$ .

ASSUMPTION 2.2 We assume  $\lambda_i^* \geq \lambda_i, \forall i \in [N]$ .

That is, we consider an economy where all firms are financially constrained.

## 2.3 Main Results and Testable Implications

This section presents our main theoretical results and associated empirical implications. All proofs and lemmas are left in the appendix.

### 2.3.1 Without Equity Finance

We first consider a case where there is no equity financing between firms. The budget constraint is simplified as  $I_i \leq I_i^B$ .

**PROPOSITION 2.2** *Suppose there is no equity finance within the business group, firm  $i$ 's investment is  $I_i^*/k_i = \min\{\lambda_i, \lambda_i^*\}$ .*

For  $\lambda_i^* > \lambda_i$ , firm  $i$  is financially constrained, the gap between the optimum and the one borrowed is  $\lambda_i^* - \lambda_i$

1. The higher a project's return  $A_i$  is, the larger the gap  $\lambda_i^* - \lambda_i$  is.
2. The lower the  $\lambda_i$  is, the larger the investment gap  $\lambda_i^* - \lambda_i$  is.

Empirically, we interpret a local positive credit supply shock to firm  $i$  as an exogenous rise in  $\lambda_i$ .

### 2.3.2 With Equity Finance

In our setup, debt financing from banks is always superior to equity financing from other firms due to the one lump-sum cost associated with equity finance. Besides, since  $\lambda_i < \lambda_i^*, \forall i \in [N]$ , all firms will borrow all they can at the interest rate  $r$ , i.e.,  $\hat{I}_i^B = \lambda_i k_i$ .

**PROPOSITION 2.3** *Under the assumption [2.3.1](#),  $\hat{I}_i^B = \lambda_i k_i$ .*

In the following, we consider a pair of firms  $(i, j)$  where firm  $i$  tends to finance its project from  $j$  through equity  $I_{ij}^E$ .

**PROPOSITION 2.4** *If  $d_{ji} = 0$ , then  $\hat{I}_{ij}^E = 0$ .*

Note that  $d_{ji} = C_{ji} + \sum_k C_{jk} C_{ki} + \sum_{k,l} C_{jk} C_{kl} C_{li} + \dots, \forall j \neq i$ ,  $C_{ji}$  is the share of  $i$  held by  $j$  directly (i.e., one step) in the existing network  $\mathbf{C}$ ,  $C_{jk} C_{ki}$  is  $i$ 's share held by  $j$  indirectly through holding  $k$  (i.e., two steps), and  $C_{jk} C_{kl} C_{li}$  is  $i$ 's share held  $j$  through  $k$  and  $l$  in three steps, etc.  $d_{ji}$  captures all of these direct and indirect holdings.  $d_{ji} = 0$  just says  $j$  does not hold  $i$ 's share directly or indirectly in the existing network  $\mathbf{C}$ .

**Testable Implications.** Following propositions [2.4](#), we can derive several important testable implications

11. If firm  $i$  and  $j$  are not connected in the equity-holding network, firm  $j$  will not provide equity finance to  $i$ . If we interpret a local credit supply shock to  $j$  as an exogenous rise in  $\lambda_j$ , firm  $i$  will not respond to such positive shock.
12. In our data, cross-holding is very rare. Thus, the equity-holding network  $\mathbf{C}$  can be viewed as acyclic ([Allen et al. 2019a](#)). Hence,
  - I2.1 If firm  $i$  is a shareholder of  $j$ , then  $d_{ji} = 0$  and  $\hat{I}_{ij}^E = 0$ . Thus, Firm  $i$ 's (investor's) investment will not respond to a positive credit supply shock to  $j$  (subsidiary) as long as  $j$  is financially constrained.
  - I2.2 If firm  $i$  and  $j$  are connected via common shareholders, firm  $i$ 's investment will still not respond to a positive credit supply shock to  $j$ .

The key assumption behind I2.1 and I2.2 is that firms receiving funding via equity finance (the investee) would obtain all the surplus from the investment project. Therefore, the only way a investor could benefit from the investment project is through shareholders' claims when it is already a pre-existing shareholder of the investee. Proposition [2.5](#) below formally states the condition under which firm  $j$  will provide equity finance to  $i$ :

**PROPOSITION 2.5** For  $d_{ji} > 0$ , then  $\hat{I}_{ij}^E > 0$  if

$$C1. d_{ji}[A_i - \phi'(I_i/k_i) - r]|_{I_{ij}^E=0} > d_{jj}[A_j - r - \phi'(I_j/k_j)]|_{I_{ij}^E=0},$$

$$C2. V(\hat{I}_{ij}^E, \hat{\Theta}/I_{ij}^E) - V(0, \hat{\Theta}/I_{ij}^E) \geq 0.$$

Furthermore, conditional on  $\hat{I}_{ij}^E > 0$ ,  $\hat{I}_{ij}^E = \min\{I_{ij}^{E,out}, I_{ij}^{E,in}\}$  where

$$d_{ji}[A_i - \phi'(I_i/k_i) - r]|_{I_{ij}^E=I_{ij}^{E,out}} = d_{jj}[A_j - r - \phi'(I_j/k_j)]|_{I_{ij}^E=I_{ij}^{E,out}} \quad (9)$$

$$d_{ii}[A_i - \phi'(I_i/k_i) - r]|_{I_{ij}^E=I_{ij}^{E,in}} = d_{ij}[A_j - r - \phi'(I_j/k_j)]|_{I_{ij}^E=I_{ij}^{E,in}} \quad (10)$$

The conditions are intuitive. Condition [C1] says that  $j$  is willing to provide a positive fund to  $i$  via equity, and [C2] means that firm  $i$  has the incentive to make an equity financing from  $j$  since the benefit associated with the equity finance is large than the fixed and variable cost. Firm  $j$ , as a fund provider, trades off the benefit and cost of financing  $i$ 's project. As  $i$ 's shareholder, firm  $j$  benefits from  $i$ 's investment at the cost of reducing its investment.  $I_{ij}^{E,out}$  is the maximum of the fund with which  $j$  is willing to supply to  $i$ .  $I_{ij}^{E,in}$  is the maximum amount of the fund that  $i$  is willing to finance from  $j$ . A bilateral contract should be  $\hat{I}_{ij}^E = \min\{I_{ij}^{E,out}, I_{ij}^{E,in}\}$ .

Recall that  $d_{ji} = C_{ji} + \sum_k C_{jk}C_{ki} + \sum_{k,l} C_{jk}C_{kl}C_{li} + \dots, \forall j \neq i$ ,  $d_{ji} > 0$  implies  $j$  holds  $i$  directly or indirectly. The larger the  $d_{ji}$  is, the larger the share of  $i$ 's stake held by  $j$  through  $C$ .

**Testable Implications** Finally, conditional on  $I_{ij}^E > 0$ , there are several additional testable implications.

13. The larger  $d_{ji}$  is, the larger  $\hat{I}_{ij}^E$  is. Thus, the controlling shareholders (with large stakes in  $i$ ) have more incentive than the smaller shareholders (with small stakes in  $i$ ) to provide equity finance. Empirically, we expect that  $i$ 's investments are more sensitive to the credit supply shock to the controlling shareholders on average.
14. The larger  $A_i$  is, the larger  $\hat{I}_{ij}^E$  is. This hypothesis implies that investees with better investment opportunities should more responsive to the credit supply shock to the investors on average.
15. The smaller  $\lambda_i$  is, the larger  $\hat{I}_{ij}^E$  is. This hypothesis implies that all else equal, investees with tighter financial constraints will finance more from the internal market when its shareholders experience a positive credit supply shock.

For the proof, please see the appendix [A](#).

### 3 Business Groups in China

This section briefly explains the definition of business groups and how they connect firms in China. A business group comprises legally independent firms connected through equity ties. In order to identify business groups, one needs to know about each company's corporate shareholders and their shares of equity holdings.

Information on corporate shareholders in China is available in the State Administration of Industry and Commerce Database (hereafter the SAIC). The SAIC provides a complete record for all enterprises registered in China on the original shareholders, including both individuals and corporates, their capital contributions, and each update of the shareholding structure<sup>4</sup>. The data spans from 1950 to 2017<sup>5</sup>. Besides the shareholder information, it also contains some basic information on enterprises, 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 rely on the SAIC to identify equity shareholding relationships between firms in the non-financial sectors and track the evolution of business groups in China over time. From 2000 to 2017, this network of business groups in China expanded rapidly and almost tripled its size. As of 2017, out of the 36 million registered enterprises in China, there are roughly 5.5 million pairs of shareholder-subsidiary linkages. A total of 2.55 million firms hold equity shares of other companies, while the total number of

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

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

subsidiary firms is 3.79 million. On average, each corporate shareholder connects to 1.5 subsidiary firms and holds 57.9% of the equity shares of each subsidiary firm. The distribution of shareholder-subsidiary linkages is highly skewed - 90% of the corporate shareholders have one or two subsidiaries, whereas around 2% of the shareholders control more than ten subsidiaries.

Despite that there is only a small fraction of firms (roughly 15.6%) that are associated with any business groups, these firms make a significant 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 Annual Survey of Chinese Industrial Enterprises (ASCIE)<sup>6</sup>. To compare their differences, we further divide firms within business groups into subsidiary firms and corporate shareholders. 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 (regarding TFP and ROA) but borrow less from the banking sector (lower leverage ratio).

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<sup>6</sup>A detailed description of the Annual Survey of Chinese Industrial Enterprises database and the construction of firm-level variables is available in section Firm-level-Data-and-

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	0.002	0	0.007	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	0.003	0	0.009	0	0	214,948	ASCIE

*Notes:* This table summarizes a partial list of variables used in the empirical exercises. 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 Firm-level-Data-and; the construction ROA and firm-year TFP is discussed in Mechanism.

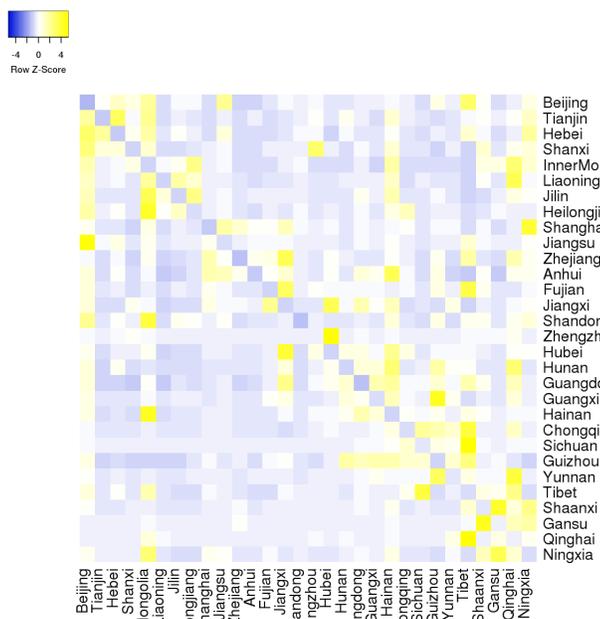
## 4 Empirical Strategy and Data

In this section, we provide an overview of our unique data set and empirical strategy for testing the implications from the model.

### 4.1 Identification Strategy

Our identification strategy exploits the geographical dispersion of business groups in China. Recall from [3](#) that a business group refers to a group of legally independent firms linked through equity ties. In other words, firms in the same group are bounded by shareholdings but not geographical proximity. Figure [1](#) below illustrates

Figure 1: The Geographical Diversification of Business Groups



the shareholder-subsidary linkages across different provinces in China<sup>7</sup>, indicating that business groups indeed span all across the country.

In our baseline analysis, we compare similar subsidiary firms from the same city with their shareholders located in different other cities and experiencing different credit supply shocks. The network of business groups is fixed at the beginning of the sample period. Assuming that the credit supply shocks to shareholders are not identical across cities, we infer the transmission of these shocks to subsidiaries located in other cities from their various responses. For example, consider two textile firms in Guangzhou that are similar in scale and exporting status but are owned by two separate corporate parents in Beijing and Chengdu. In 2009, following the four-trillion Yuan stimulus, bank lending in Chengdu grew by 62 percent. On the contrary, Beijing experienced a minor credit boom with credit growth of only 24 percent. The difference in the two textile companies' investment behaviors is then used to identify the pass-through of bank lending shocks to the two shareholders in Beijing and Chengdu.

In our baseline, we add city-year fixed effects to control for any local credit market and macroeconomic conditions. Thus, the fixed effects will absorb the time-varying local credit demand. Furthermore, we include 2-digit industry-by-year fixed effects to control for any time-varying industry factors. We also include firms not in any business groups in our control group to estimate local average trends and fixed effects.

<sup>7</sup>Provinces with higher intensities of shareholder-subsidary linkages, defined as the number of linkages divided by the total number of firms in the province, are marked as yellow; and the ones with lower intensities of the linkages are marked as purple.

We argue that the identification strategy mentioned above is valid in testing the transmission of bank credit within business groups in tow-fold. First, the Chinese financial system operates at a regional level due to institutional and regulatory constraints. Local credit growth in one city is thus unlikely to depend on the idiosyncratic credit demand of a firm in other cities. Given that city-year fixed effects already control the local credit demand of subsidiaries' cities, only firm idiosyncratic credit demand might be relevant here. We construct a Bartik-type IV for local credit supply to eliminate any potential impacts of firm idiosyncratic credit demand on bank lending growth in other cities. Second, our findings will not be fully explained by other business relationships between cities. After controlling for other possible business linkages, including the input-output linkages, industrial agglomerations, etc., we still find parent companies playing significant roles in passing credit from the banking sector to subsidiaries.

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]). The interbank 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 from conducting business 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 applied to both deposits and loans in our sample period (Huang et al. [2020]).

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 mitigate the concern further. Our Bartik-type instrument exploits the opening of new local bank branches across cities, similar to the shift-share instrument in Greenstone et al. [2020]. A commercial bank that expanded fast can be considered more ambitious in providing new credits to firms. If the bank had controlled a more significant fraction of the credit market in a city, we consider the city to have experienced a more considerable 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 matter for credit transmission after controlling for other business networks in the robustness tests. We include in estimates for upstream supply and downstream demand shocks as proxies for the supply chain linkages, trade credit measures (accounts 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 effects<sup>8</sup>. To further mitigate the concern that our results may be driven by the input-output relationship between shareholders and subsidiaries, we restrict our sample to shareholder-subsidiary pairs that do not share input-output ties.

## 4.2 Firm-level Data and Key Variables

In section 3, we discussed how to identify business groups from the business registry data - the SAIC. This section explains the construction of other firm-level variables and how we merge different firm-level data sets.

We use corporate balance sheet information from the Annual Survey of Chinese Industrial Enterprises (ASCIE) data to capture firm investment and financing activities. The ASCIE is an annual survey conducted by the Chinese National Bureau of Statistics since 1995. It covers all state-owned enterprises (SOEs) and private firms in the manufacturing, mining, and energy sectors with annual operating revenue above 5 million RMB. After 2011, the operating revenue cutoff was increased to 20 million RMB. We delete all observations after 2009<sup>9</sup> to avoid any bias due to the change in the sampling criteria. We also drop the observations before 2000 to preserve consistency in data quality. All observations in 2009 are dropped from the sample due to insufficient coverage of variables. Finally, we remove the outliers following Brandt et al. (2014), which leaves us with an unbalanced sample of 688,560 firms and 2,602,126 observations spanning nine years (2000 - 2008)<sup>10</sup>. Roughly 95% of the firms appear in the sample for at least two years<sup>11</sup>.

We merge SAIC and ASCIE using the legal name, the name of the legal representative, the domicile (location), and the year of establishment<sup>12</sup>. We can 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 two data sets, we are left with a total of 138,453 holding firms<sup>13</sup> and 151,604 subsidiaries<sup>14</sup>.

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<sup>8</sup>Specifically, we attempt to control the tunneling effect through any additional common shareholders of subsidiaries and their shareholders.

<sup>9</sup>The 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 the six-digit county level, phone, zip, 4-digit industrial code, and founding year suggested by Brandt et al. (2014).

<sup>10</sup>The total number of observations in our results is smaller because firm fixed effects absorbed firms only appeared once a time in the data set, and certain variables are missing for some firms in certain years.

<sup>11</sup>The average number of observations that one firm contributes to is 5.7, and the corresponding standard deviation is 2.8.

<sup>12</sup>According 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.

<sup>13</sup>They are roughly 20 percent of our ASCIE sample and 43 percent of the whole sample of holding firms in the SAIC database.

<sup>14</sup>These firms account for 18 percent of our ASCIE sample and 26 percent of the whole sample of subsidiary firms in the SAIC.

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 the net formation of tangible fixed assets, normalized by the one-year lagged value of the total tangible fixed asset. The real value of the total tangible fixed asset is recovered from the nominal tangible fixed asset using the program suggested by [Brandt et al. \(2014\)](#). Firms directly report R&D expenditure as an item in their operating costs. We normalize R&D expenditure also 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-term and short-term bank loans and corporate bonds; and finally, the leverage ratio is constructed as the ratio of the total book value of debt divided by the total book value of equity liabilities.

As our model suggests, we also study 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 the equity transfer channel by looking into the changes in the total fraction of equity shares (0 to 100 percent) held by all corporate shareholders of a given subsidiary company. When a subsidiary company sells its equity in exchange for capital injection, the total equity shares held by the corporate shareholders of the firm will increase with or without new equity issuance.

### 4.3 Local Credit Supply Shocks and Economic Condition

Our primary data source for local credit growth and economic conditions is the province and city yearbooks from the China Data Center, which cover 312 prefecture-level cities from 2000 to 2016.

The baseline analysis uses city-level bank lending growth as a proxy for local credit supply shock. 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 idiosyncratic investment opportunities of subsidiary firms in other cities. Thus, Bank lending growth is measured as the growth rate of the total bank loans outstanding in each city. The outstanding bank loans in nominal terms are directly available in the city yearbooks. For subsidiary firms with multiple shareholders, we compute the weighted average bank lending growth in shareholders' cities using different weights (see [5.1](#) 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 in other cities. Our variable shares a spirit similar to the one in [Greenstone et al. \(2020\)](#), which instruments changes in local credit supply using a shift-share setup. A bank that expands fast 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 obtained bank branch information from the bank branch registry database provided by

the China Banking Regulatory Commission (CBRC). The bank branch registry data includes the name, location (specific to street names), date of establishment, and cancellation for each bank branch in China. Section 5.2 discusses the construction of the Bartik-type instrumental variable in detail.

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 (%)	16.7	15.4	17.3	-21.7	60.6	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 4.2 provides a detailed discussion on the measurement of equity shareholdings. The construction of credit growth is available in 5.1. “CDC” refers to the China Data Center.

## 5 Empirical Analysis

### 5.1 Baseline Specification and Results

Our baseline specification (11) is designed to study if subsidiary firms respond to credit supply shocks to their parent companies located in other cities:

$$Y_{it} = \alpha_{ct} + \theta_i + \gamma CreditGrowth_{pt} + \kappa' X_{it} + \epsilon_{it}. \quad (11)$$

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

$$CreditGrowth_{pt} = \log\left(\sum_{j \in H_{i0}, c(j) \neq c} LoanVolume_{c(j),t}\right) - \log\left(\sum_{j \in H_{i0}, c(j) \neq c} LoanVolume_{c(j),t-1}\right) \quad (12)$$

where  $H_{i0}$  is the set of firms holding equity shares of firm  $i$  at the beginning of the sample period<sup>15</sup>, and  $c(j)$  is the city where parent company  $j$  located in<sup>16</sup>.  $c$  is the

<sup>15</sup>We use the shareholder-subsidiary linkages established at the beginning of the sample period to avoid the concern that business groups formation might endogenously respond to local credit supply shocks.

<sup>16</sup>Companies in China usually register with local registries. When a company moves to another city, it will acquire a new ID and thus be identified as a different firm in the data set. Thus

home city of subsidiary  $i$ .  $LoanVolume_{c(j),t}$  is the total value of the outstanding loans in city  $c(j)$  at the end of year  $t$ .

We include in firm fixed effect  $\theta_i$  to control for any firm-level unobserved and constant characteristics, and city-cross-year fixed effect  $\alpha_{ct}$  to capture any time-varying factors at the city level such as the local credit market and macroeconomic shocks. Any time-varying city-level variables are absorbed, and thus our results should not be driven by the correlation between local credit demand and the credit supply shock in shareholders' cities. Other controls,  $X_{it}$ , are standard controls for investment regressions (Denis and Sibilkov [2010], Gul et al. [2010], Chaney et al. [2012]), which include firm ownership and age fixed effects, a one-year lagged firm size dummy, one-year lagged debt-to-asset ratio, and two-digit industry cross year fixed effects for any industry-specific time-varying factors. For example, we do not need to be concerned that our results are driven by the uneven concentration of the business group over industries.

We use the baseline specification to study the effect of corporate shareholders' local credit supply shocks on subsidiaries in other cities. The left-hand-side variables of interest include investment, R&D expenditure, profit margin, leverage ratio, and total debt outstanding growth rate. A positive  $\gamma_1$  implies that when shareholders experience positive local credit growth, subsidiaries in other cities increase their investment or other relevant measures as a response.

Table 3 reports our baseline results. Column (1) indicates that controlling for local credit market dynamics, a 10% bank credit growth in shareholders' cities would lead subsidiaries in other cities to increase capital expenditure by an additional 0.6% of their fixed assets. This additional 0.6 percentage point accounts for 42.5% of the median investment rate (1.4%) and 4.3 % of the average investment rate (14%) of all subsidiary firms. In terms of magnitude, our result is comparable to Cingano et al. [2016], who study the direct effect of bank lending on corporate investment. They find that a 10% credit contraction would lead to a fall in investment, equivalent to 24% of the median investment rate. This finding suggests that financial intermediation within business groups is both statistically and economically significant.

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shareholders changing location will not affect the validity of our estimation.

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*** (0.014)	0.0001 (0.0001)	-0.0061* (0.003)	0.0366 (0.023)	0.872 (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

The treatment variable,  $CreditGrowth_{pt}$ , is constructed using the size of local bank lending in each shareholder city ( $LoanVolume_{c(j),t-1}$ ) as shareholder weights (equation (12)) to avoid outliers 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 the initially registered capital<sup>17</sup>), taking into account the relative importance of the shareholder in their local credit market. Columns (3) and (4) ignore the differences in local credit markets but weigh each shareholder by their relative cash-flow rights and equal weight, respectively. The estimates using alternative shareholder weights are still positive. In addition, they are significant and statistically indifferent from our baseline estimate, indicating a positive outcome in subsidiary investment following credit supply shocks to shareholders.

<sup>17</sup>We 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.

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*** (0.014)	0.0710*** (0.0167)	0.0755*** (0.021)	0.0570*** (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 firm 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 finding could be explained by a similar rationale as in Caballero and Hammour (1991): when the external condition improves<sup>18</sup>, subsidiary firms tend to slow down the destruction of outdated projects, resulting in a lower profit margin on average.

Other variables of our interests were not affected by the credit market conditions in parents' cities. R&D expenditure, on average, is not as sensitive to changes in external financing conditions as investments (Table 3, Column (3)). Compared to capital investment, R&D requires more consistent spending in human capital and is more likely to create intangible assets; thus, it tends to depend more on internal financing (Hall and Lerner (2010)). In our sample, less than 10% of the firms have actively engaged in R&D activities. Thus, it is unsurprising that credit supply shocks

<sup>18</sup>This 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 ??.

to parent companies have insignificant impacts on the R&D expenditures of subsidiary firms.

Another important finding is that subsidiary firms' external debt financing is not affected by credit supply shocks to their parent companies in other cities (Table 3, Columns (4) and (5)). This finding implies that subsidiary firms do not face a more accessible external financing environment following a positive credit supply shock to their parent companies, reassuring that credit transmission exists within business groups.

Although the geographical segmentation of local financial markets works in favor of our identification, we still face the challenge that subsidiaries and shareholders may not locate randomly across cities. For example, two cities with more synergies may have more firms investing in each other. 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. In general, any correlations between the local credit demand in parents' and subsidiaries' cities will be absorbed by city-year fixed effects. Our only concern is that subsidiary firms' idiosyncratic credit demand may correlate with credit growth in shareholders' cities, which is unlikely. For robustness, we construct a Bartik-type instrument and estimate the effect using an instrumental variables approach. Section 5.2 discusses the instrument for local credit supply shocks and the estimation results. Another concern is that other types of networks, such as the input-output network, could also overlap with the business-group network. It is more of a challenge to the interpretation of the results in Table 3, rather than to the identification itself. To address this concern, we add other types of networks in our baseline specification and discuss the estimation in Other-Robustness-Tests. For the rest of the empirical analysis, we focus only on the investment of subsidiary firms.

## 5.2 Instrument for Local Credit Supply

This section uses an instrumental variables approach to address possible endogeneity concerns. As discussed in Identification-Strategy, our baseline specification is valid as long as local bank lending growth does not depend on subsidiaries' idiosyncratic 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 the CBRC:

$$Z_{pt} = \sum_{j \in H_{i0}, c(j) \neq c} \frac{\sum_b B_{b,c(j),t-3}}{\sum_{c(j) \neq c} \sum_b B_{b,c(j),t-3}} gBranch_{c(j),t},$$

where  $B_{b,c,t}$  is the total number of branches of bank  $b$  in city  $c$  at time  $t$ .  $gBranch_{c(j),t}$  is the projected growth rate of the total number of bank branches in city  $c(j)$  at time  $t$  (defined below). Finally,  $\frac{\sum_b B_{b,c(j),t-3}}{\sum_{c(j)} \sum_b B_{b,c(j),t-3}}$  is the weight of city  $c(j)$  among all parent companies' cities, constructed as the ratio of the number of bank branches in city

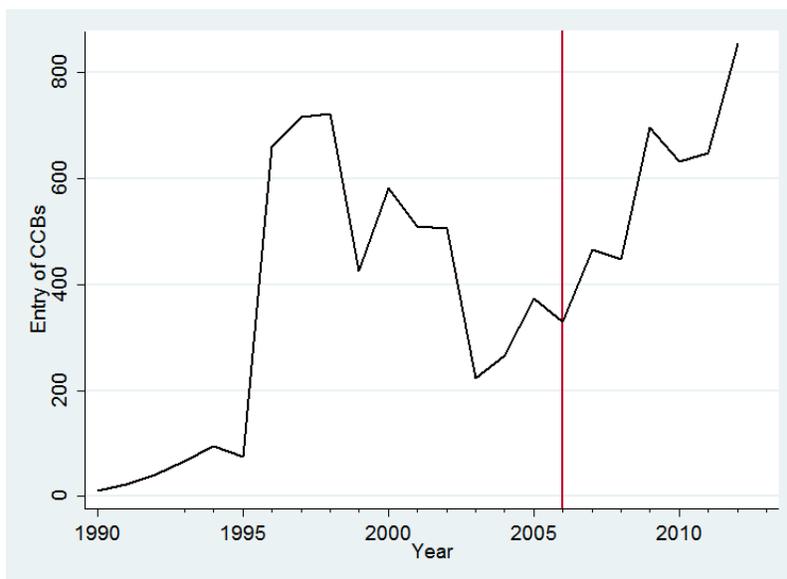
$c(j)$  over the total number of branches in all parent companies' cities.  $gBranch_{c(j),t}$  is defined as:

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

We use time  $t - 3$  to compute the share of bank branches to mitigate the concern of endogenous branch allocation. Branches of policy banks and trusts are excluded to ensure the economic 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.

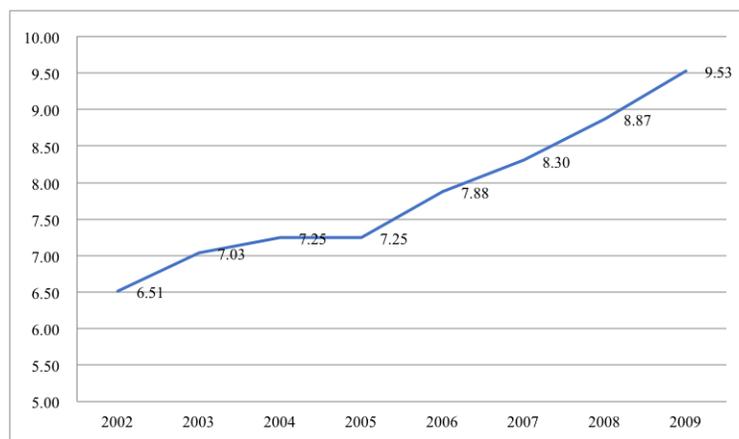
The significance of the shift-share instrument could be partly explained by the heterogeneous expansion of city commercial banks (CCBs) and other banks following the 2006 deregulation [Amstad et al. \[2020\]](#). Before 2006, the CCBs were only allowed to conduct business within the city of their headquarters. Then with the real estate markets commercialized across the country, the CBRC lifted the constraint on CCBs setting up inter-city branches. At the end of 2005, the new regulation “Notice of the China Banking Regulatory Commission on Issuing the Measures for the Administration of Non-Home-City Branches of City Commercial Banks” authorized qualified CCBs to open new branches in other cities. Following the branching deregulation, there was a large wave of inter-city branch openings in China. For example, as of 2014, the Bank of Beijing, a city commercial bank established in 1996 in Beijing, has 116 of its 136 branches established after 2006 in 9 other provinces. [Figure 2](#) presents the total number of newly established cross-city CCB branches each year since 1990. The deregulation of CCB branching accelerated the expansion of these city commercial banks at the national level. Moreover, CCBs increased their footprint in the banking sector faster than the state-owned banks following the deregulation ([Figure 3](#)).

Figure 2: New Bank Branches Established by CCBs



Note: The figure shows the total number of new branches established by city commercial banks in China from 1990 to 2013.

Figure 3: CCBs' Share of Total Banking Sector Assets



Note: The figure presents the ratio of CCBs' total asset value relative to the value of total assets held by the "Big Five" state-owned banks, the 12 big national commercial banks, all CCBs, and all foreign banks. The ratio is only shown from 2002 to 2009 due to data availability.

The first-stage and second-stage results are summarized in Table 5.

Table 5: The Instrumental Variables Approach

cc				
	(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 Holding 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

### 5.3 Other Robustness Tests

Another challenge we need to address is interpreting the findings as credit transmission within business groups. 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 subsidiaries' investments, it might have been driven by 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  $\gamma$  in eq (11) 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 the supply chain linkages also matter is because firms sometimes rely on trade credit for external financing. If the shareholders and subsidiaries are 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 et al. \(2016\)](#) and based on the 2002 China Input-Output Table (3-digit industry level). For the trade credit channel, we add firm accounts payable and receivables (normalized by the one-year lagged total asset value) to control 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 insufficient to explain our baseline findings.

Someone may argue that including upstream supply, downstream demand, or the industry-by-industry fixed effect is not enough to control the overlap between the input-output and equity-holding links. We take the following to handle the concern further. First, we construct an input-output network at the three-digit industry level. We divide subsidiaries into two groups: the "with input-output ties" group, where there is an input-output link between the subsidiary and shareholder in the input-output network, and the "without input-output ties" group, where there is no input-output relationship between the subsidiary and shareholder. Second, we take a difference-in-difference regression. We find that the investment of subsidiaries, linked to the shareholders in input-output, is much less responsive to the credit supply shocks to shareholders than those without input-output ties with shareholders. Thus, our findings should not be driven by input-output ties between the subsidiary and its shareholders.

**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 and shareholder-city cross subsidiary-city fixed effects, to take into account any possible industry-to-industry or city-to-city spillover effects.

Columns (3) and (4) in [Table 6](#) summarize the results of the robustness test for the geographical network channel. The geographical overlay of industries does partially contribute to the impact, but our main finding still holds.

Table 6: Robustness Tests

	(1)	(2)	(3)	(4)	(5)	(6)
	Investment					
Avg. Credit Growth in Holding Firms' Cities	0.0571***	0.0624***	0.0413***	0.0480***	0.0625***	
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)				
Avg. Credit Growth in Hold. Firms						
× with input-output ties						0.0134
						(0.0295)
× without input-output ties						0.0551**
						(0.0216)
Number of Observations	1,306,201	1,299,605	1,233,051	1,306,169	1,306,201	1,306,201
Shareholder Ind. × Subsidiary Ind. FE	NO	NO	YES	NO	NO	NO
Shareholder city × Subsidiary city FE	NO	NO	NO	YES	NO	NO
Common Shareholder Dummy	NO	NO	NO	NO	YES	NO
City × Year FE	YES	YES	YES	YES	YES	YES
2-digit Industry × Year FE	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Firm-level Controls	YES	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

**The Tunneling effect** Last but not least, we try to rule out the tunneling effect documented in the literature on equity-holding relationships. A large corporate fi-

nance literature (La Porta et al. [1999], Claessens et al. [2000], Gopalan et al. [2007], Jiang et al. [2010], Gul et al. [2010]) argue that in an equity-holding network, there are potential 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 to benefit more, which distorts 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 an 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 include it in the specification (11). 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.

## 5.4 The Equity Transfer Channel

We argue that an important channel for reallocating capital from shareholders to subsidiaries following a positive credit supply shock to the shareholders is through equity transfers. For example, a holding firm can purchase additional equity stakes of its subsidiaries as a way to pass along cash to subsidiaries (Almeida et al. [2015]). As shown in our model, compared to commercial banks, holding firms are typically more inclined to finance subsidiaries due to additional shareholder benefits. When facing good investment opportunities or positive credit market shocks, holding firms might increase external borrowing and finance subsidiaries through the internal capital markets.

To show that holding firms reallocate capital to subsidiaries through equity transfers, we repeat the baseline and IV analyses but replace 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 be positive and significant, indicating that the total equity shares held by corporate shareholders increase 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 of 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

## 5.5 The Effectiveness of Financing within Business Groups

Finally, we look into the conditions under which parent companies can be an effective intermediary between banks and subsidiaries. An effective intermediation should see subsidiaries respond significantly to credit supply shocks to their shareholders.

A direct implication based on our model is that we expect a larger effect when a shareholder claims a larger fraction of subsidiaries' returns. To test for such an implication, we compare controlling majority versus minority shareholders. Table 9 implies that a positive credit shock to controlling shareholders who own more than 50% of the subsidiaries' equity shares would significantly increase the investment of subsidiary firms. In contrast, the same shock to minority shareholders generates a positive yet insignificant effect. We also compare SOE versus POE (privately owned enterprises) shareholders. Interestingly, although the SOEs are generally considered as financially unconstrained compared to POEs, we do not find that subsidiaries benefited from SOE shareholders passing bank credit to subsidiaries (Table 8). This finding is intuitive, given that by definition, the SOEs could have other incentives instead of the corporate shareholders' best interests in mind. Ljungqvist et al. (2015), Megginson et al. (2017) document a similar result that the state groups are less efficient

in capital allocation compared to private groups, based on a smaller sample of stock market listed firms.

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 Minority 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*** (0.0248)	0.0800*** (0.0246)	0.0791*** (0.0227)	0.0923*** (0.0248)
Avg. Credit Growth in Minority Holding Firms' Cities	0.0329 (0.0414)	0.0855 (0.0557)	-0.0635 (0.0585)	0.0331 (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 and investment opportunities, as shown in section 2.

To understand the importance of subsidiaries' financial constraints, we construct four measures of industry-level financial vulnerability following Manova et al. (2015): the external financial 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. External financial dependence is measured as the share of capital expenditure not financed by the cash flows in operations, which matters more to long-term investment activities. The other three remaining variables imply the short-term financial constraints of corporates. The inventory ratio, calculated as the ratio of inventory value over total sales, signals the need for working capital due to variable costs in the production process. The tangible asset ratio indicates the collateral value of the industry, which is defined as the ratio of fixed asset value<sup>19</sup> to the book value of total assets. Finally, the trade credit ratio,

<sup>19</sup>Fixed asset value refers to the value of plant, property, and equipment on the balance sheet.

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 modify the baseline specification (11) to study the impacts of subsidiaries' financial vulnerability on the pass-through of credit supply shocks from shareholders to subsidiaries:

$$Y_{it} = \alpha_{ct} + \theta_i + \gamma_0 \text{CreditGrowth}_{pt} + \gamma_1 \text{CreditGrowth}_{pt} \times \text{FinVul}_{is} + \kappa' X_{it} + \epsilon_{it}, \quad (13)$$

where  $\text{FinVul}_{is}$  equals to 1 if the financial vulnerability measure of industry  $s$  ( $i \in s$ ) is above median, and 0 otherwise. We construct 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 private subsidiaries given that SOEs face atypical constraints on the credit market. Column (1) in the table implies that following an average 10% annual growth of total credit in shareholders' cities, subsidiaries in industries with an above-median external finance dependence invest 1.1% 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 (4) in Table 10). The ability to collateralize has limited impact as well (Column (3)), which again complements our baseline finding (Table 3, Column (4)) that the subsidiary firms' bank financing condition is not affected by shocks to their parent companies in other cities.

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 Mueller [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 et al. [2008], Giroud and Mueller [2015]) and estimate first the linear production function at the 2-digit industry level:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_m m_{it} + \beta_k k_{it} + \mu_{it}, \quad (14)$$

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 (14). For robustness, we have also imposed an  $AR(1)$  process on productivity  $\mu_{it}$  and the same results hold.

Next we extend again the baseline specification (11) to study the impacts of firm investment opportunities on the pass-through of credit supply shocks from shareholders to subsidiaries:

$$Y_{it} = \alpha_{ct} + \theta_i + \gamma_0 \text{CreditGrowth}_{pt} + \gamma_1 \text{CreditGrowth}_{pt} \times \text{InvOpp}_{i,t-1} + \kappa' X_{it} + \epsilon_{it}, \quad (15)$$

where  $\text{InvOpp}_{i,t-1}$  equals to 1 if the investment opportunity measure of firm  $i$  at time  $t - 1$  is above median, and 0 otherwise, the term  $\text{InvOpp}_{i,t-1}$  is included in the controlling variables for difference-in-difference setup.

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.

To further understand the differential responses of subsidiary firms, we divide the subsidiaries into three groups: 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 to 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.

Finally, we examine whether subsidiaries can also play the role of a financial intermediary. Column (1) of Table 13 examines whether subsidiaries' investment responds to the bank lending shocks to other subsidiaries located in other cities under the umbrella of the same corporate shareholder. We find that the coefficient is insignificant and much smaller compared to subsidiaries responding to the credit supply shocks to their parent companies. There could be several explanations. First, subsidiaries tend to be smaller and face tighter financial constraint, so they may gain a limited extra external financial support during a bank lending boom. Second, moving capital from one subsidiary to another might be more costly given that the subsidiaries do not hold each others' equity shares. Even a small fixed transaction cost of equity exchanges could discourage capital transfer from one subsidiary to the shareholder, then to another subsidiary. Beyond that, as in our model, compared to the corporate shareholders, the subsidiary has less incentive to make equity finance in other subsidiaries. In Column (2), we examine whether the corporate shareholder's investment responds to the bank lending shocks exposed to subsidiaries located in other cities. The result shows that the response is small, negative, and insignificant both economically and statistically.

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

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.

\*\*\* Significant at the 1 percent level

\*\* Significant at the 5 percent level

\* Significant at the 10 percent level

Table 13: Subsidiaries are not Effective Intermediaries

	(1)	(2)
Dependent Variable:	Subsidiary Firms Investment	Shareholders Investment
Avg. Credit Growth in Cities of Other Subsidiaries under Common Ownership	0.00733 (0.0237)	
Avg. Credit Growth in Subsidiaries' Cities		-0.0157 (0.0236)
Number of Observations	121,485	200,717
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 the effect of subsidiaries as potential financial intermediaries in business groups. Other subsidiaries' cities credit growth is computed as the weighted average of the growth rate of total bank loans. 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

## 6 Conclusion

Using business registry data from China, we show that internal capital markets in business groups can play the role of financial intermediary and propagate corporate shareholders' credit supply shocks to their subsidiaries. An average of 10% local bank credit growth where corporate shareholders are located would increase subsidiaries' investment by 0.6% of their tangible fixed asset value, which accounts for 42.5% (4.3%) 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 provides evidence to support the channel. This financial intermediation is tiered in that it only works from shareholders to subsidiaries, not vice versa, nor from subsidiaries to subsidiaries. This tiered intermediation becomes pronounced when the shareholders are controlling shareholders or non-SOEs or when the subsidiaries are financially constrained or have good investment opportunities. Finally, we model the business group as a network with heterogeneous financial constraints and investment opportunities to facilitate the channel and match the empirical evidence.

## A Appendix: Omitted Proofs

We first present a lemma about  $\partial V_i/\partial I_{ij}^E$  and  $\partial V_j/\partial I_{ij}^E$ .

LEMMA A.1 Consider a firm pair  $(i, j)$  with an equity finance contract  $I_{ij}^E$ , then

- For firm  $j$ , the marginal payoff with respect to  $I_{ij}^E$  is

$$\frac{\partial V_j}{\partial I_{ij}^E} = d_{ji}[A_i - \phi'(I_i/k_i) - r] - d_{jj}[A_j - r - \phi'(I_j/k_j)] \quad (16)$$

- for firm  $i$ , the marginal payoff with respect to  $I_{ij}^E$  is

$$\frac{\partial V_i}{\partial I_{ij}^E} = d_{ii}[A_i - \phi'(I_i/k_i) - r] - d_{ij}[A_j - r - \phi'(I_j/k_j)]. \quad (17)$$

Besides, it pays the fixed cost  $f_0 + f_1$ .

- For the second order derivations, we have

$$\frac{\partial^2 V_j}{\partial I_{ij}^{E2}} = -d_{ji}\phi''(I_i/k_i)/k_i - d_{jj}\phi'(I_j/k_j)/k_j < 0$$

$$\frac{\partial^2 V_i}{\partial I_{ij}^{E2}} = -d_{ii}\phi''(I_i/k_i)/k_i - d_{ij}\phi''(I_j/k_j)/k_j < 0$$

The statements in the lemma is intuitive For firm  $j$ , the first term on the right hand side of equation [16](#) is the marginal payoff it obtains if  $j$  is the shareholder of  $i$  while the second term is the marginal cost due to a reduction in its own investment. For firm  $i$ , the first term on the right hand side is the marginal payoff from  $i$ 's investment while the second term is the cost if  $i$  holds the equity of  $j$ . For both the investee and investor,  $\frac{\partial V_j}{\partial I_{ij}^E}$  and  $\frac{\partial V_i}{\partial I_{ij}^E}$  are marginally decline with respect to  $I_{ij}^E$  due to an decline in marginal return from investment and an increase in marginal opportunity cost.

### Proof of Lemma [A.1](#)

**Proof.** From the equation [7](#), we can write

$$\frac{\partial V_j}{\partial I_{ij}^E} = \sum_{k \in [N]} d_{jk} \frac{\partial x_k}{\partial I_{ij}^E} = d_{jj} \frac{\partial x_j}{\partial I_{ij}^E} + d_{ji} \frac{\partial x_i}{\partial I_{ij}^E}$$

Using equations [3,4](#) and [5](#), we have

$$\frac{\partial x_j}{\partial I_{ij}^E} = r - \max\{r, A_j - \phi'(I_j/k_j)\}$$

If firm  $j$  is financially unconstrained, then  $A_j - \phi'(I_j/k_j) = r$ . Otherwise,  $A_j - \phi'(I_j/k_j) > r$ . Thus, we have

$$\frac{\partial x_j}{\partial I_{ij}^E} = r + \phi'(I_j/k_j) - A_j \leq 0$$

. For the term  $\frac{\partial x_i}{\partial I_{ij}^E}$ , using equations [3](#), [4](#) and [5](#), we have

$$\frac{\partial x_i}{\partial I_{ij}^E} = A_i - \phi'(I_i/k_i) - r > 0$$

since we always consider the case where  $i$  is financially constrained.

Similarly, for firm  $i$ , we have  $\frac{\partial V_i}{\partial I_{ij}^E} = d_{ii}[A_i - \phi'(I_i/k_i) - r] - d_{ij}[A_j - r - \phi'(I_j/k_j)]$ .

Note that

$$\frac{\partial^2 V_j}{\partial I_{ij}^{E2}} = -d_{ji}\phi''(I_i/k_i)/k_i - d_{jj}\phi''(I_j/k_j)/k_j < 0$$

and

$$\frac{\partial^2 V_i}{\partial I_{ij}^{E2}} = -d_{ii}\phi''(I_i/k_i)/k_i - d_{ij}\phi''(I_j/k_j)/k_j < 0$$

Thus, the marginal payoff of the equity finance  $I_{ij}^E$  for both  $i$  and  $j$  declines. Thus, providing that firm  $i$  and  $j$  is willing to reach the contract, then  $I_{ij}^{In,E}, I_{ij}^{Out,E}$  is uniquely determined.

### Proof of Proposition [2.4](#)

**Proof.** The proof is quite intuitive. We first note that firm  $j$  has no incentive to obtain equity finance from other firms like  $k \neq i$  to finance firm  $i$ . If firm  $j$  do this, it will pay the fixed cost  $f_0 + f_1$  and additional cost  $rI_{jk}^E$ , but it only obtains  $rI_{jk}^E$  from financing  $i$ . Besides, since firm  $j$  is financially constrained, i.e.,  $\partial V_j / \partial I_{ij}^E = d_{ji}[A_i - \phi'(I_i/k_i) - r] < 0$ . Thus, we have  $\hat{I}_{ij}^E = 0$ .

### Proof of I4 and I5 [2.3.2](#)

**Proof.** We provide a proof of  $\frac{\partial I_{ij}^E}{\partial A_i}, \frac{\partial I_{ij}^E}{\partial \lambda_j}$  in the context of a partial equilibrium in the sense that we hold the investment of all other firms unchanged except  $i, j$ .

Denote  $\pi_i = A_i - r - \phi'(I_i/k_i), i \in [N]$ . From equation [9](#), we take derivative with respect to  $A_i$

$$d_{ji}[1 - \phi''(I_i/k_i)/k_i \times \frac{\partial I_{ij}^{E,out}}{\partial A_i}] = d_{jj}\phi''(I_j/k_j)/k_j \times \frac{\partial I_{ij}^{E,out}}{\partial A_i}$$

Thus

$$\frac{\partial I_{ij}^{E,out}}{\partial A_i} = \frac{d_{ji}}{d_{ji}\phi''(I_i/k_i)/k_i + d_{jj}\phi''(I_j/k_j)/k_j} > 0$$

Similarly, we can easily check  $\frac{\partial I_{ij}^{E,in}}{\partial A_i} > 0$ . Thus

$$\frac{\partial I_{ij}^E}{\partial A_i} > 0.$$

since

$$I_{ij}^E = \min\{I_{ij}^{E,in}, I_{ij}^{E,out}\}$$

Using the budget constraint [4](#) and  $I_i^B = \lambda_i k_i$ , from [9](#), suppose  $i$  is financially constrained, we have

$$d_{ji}[\phi''(I_i/k_i) + \phi''(I_i/k_i)/k_i \times \frac{\partial I_{ij}^{E,in}}{\partial \lambda_i}] = 0 \implies \frac{\partial I_{ij}^{E,in}}{\partial \lambda_i} = -k_i < 0.$$

Besides,  $\frac{\partial I_{ij}^{E,out}}{\partial \lambda_i} = 0$ , thus, we have

$$\frac{\partial I_{ij}^E}{\partial \lambda_i} < 0$$

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